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Aquaculture Spectrum™

The Indian Aquaculture Magazine

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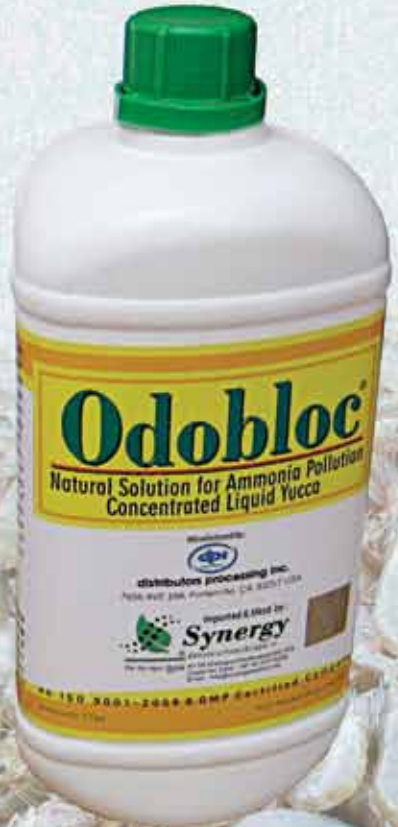

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Aquaculture Spectrum™
The Indian Aquaculture Magazine

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Cover page:

Photograph of Asian Seabass (*Lates calcarifer*) fingerlings

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- విబ్రియో ద్వారా సంక్రమించే **white faeces** ని అరికడుతుంది.
- **RMS** నుంచి రక్షణ కల్పిస్తుంది
- బయోఫేజ్ V వాడకం వలన ప్రోబయోటిక్ కి ఎటువంటి హాని జరగదు. మరియు **probiotic** పనితనం పెరుగుతుంది.
- బయోఫేజ్ V వాడకం వలన **biofloc** పెరుగును. దానివలన గ్రోత్ పెరిగి F.C.R. తగ్గును.

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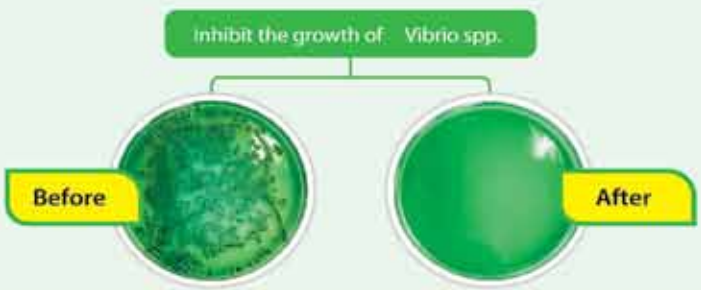

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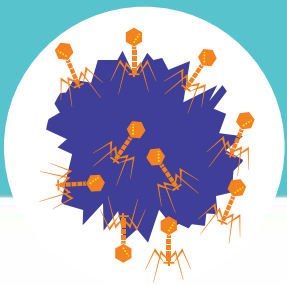

Lysis of pathogen and release of new phages for repetitive action

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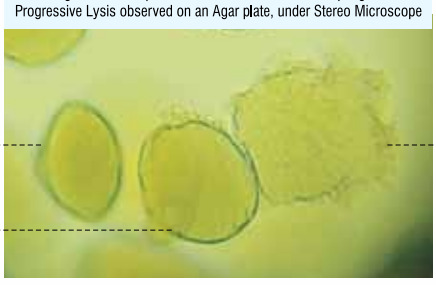
Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope



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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EDITORIAL

As the shrimp farming sector in India continues to deal with nagging disease issues, unpredictable weather conditions, rising production costs, and fluctuating prices, with the situation getting progressively worse each year, stakeholders ponder on the strategy to be followed to come out of this crisis. Stocking seed throughout the year across major farming areas in the country without specific crop patterns, is ensuring that several diseases that were earlier prevalent only during specific seasons, are now widespread all through the year, severely affecting production and more importantly profits. Ideas such as having a crop holiday have been mooted by farmer associations, while embracing advanced genetics and nutrition are being considered as the life saver by the academe. Stakeholders have also been voicing the need to aggressively promote domestic consumption of shrimp in India and develop domestic markets at the same time. While individual voices and efforts are underway with regard to all these, the sector is yet to have a common direction and plan of action for sustainable production in the coming years.

In addition to a collective effort on the above, big players as well as the thinktanks of the sector need to come together, not only to provide a clear direction to the sector but also to lead from the front by adopting technologies and practices to set an example for smaller players and farmers. While nursery systems and multistage farming practices have been initiated by a few progressive farmers, adoption of advanced farming technologies being practiced in the western world as well as in countries like Vietnam and Indonesia that ensures disease free farm production, also need to be tried out in India. Zonation of farming areas and recommending cropping seasons for these zones could also be considered as a tool to curb disease outbreaks.

Jaideep Kumar

Last month witnessed the Norway based global giant in aqua feed and nutrition - Skretting, firmly planting its feet in India by inaugurating its state-of-the-art production facility for shrimp and fish feed at Mangrol, Surat in Gujarat. Known as the most innovative company in animal nutrition, Skretting has played a key role in the transformation of shrimp culture in Ecuador. With its repertoire of products, technical services and innovations, it could certainly play a similar role in supporting the Indian aquaculture sector to take it to greater heights.

This issue of Aquaculture Spectrum features articles on "Unlocking the critical factors responsible for the 'Economic Returns Imbalances' in the Shrimp Aquaculture Sector of India" by S. Felix & M. Menaga, "Sustainable Development Goals and Fisheries Sector: Progressing towards a Sustainable Future" by Mohammed Meharoof et.al., "Cluster farming in aquaculture to uplift small and marginal farmers" by Maibam Malemngamba Meitei et.al., and "Nutritionally optimal feeds for Asian Seabass - Lates calcarifer" by Raghavendrudu. Our regular column on "Shrimp Aquaculture – Industry Review" by Dr. P. E. Cheran along with SPF shrimp broodstock imports and news from across the Indian and global aquaculture sector brings up the rest of the issue..

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SUSTAINABLE DEVELOPMENT GOALS AND FISHERIES SECTOR
PROGRESSING TOWARDS A SUSTAINABLE FUTURE

Mohammed Meharoof[1] *, Albin Albert C.[2], Ratheesh Kumar R.[3]

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[3]Scientist, ICAR-Central Marine Fisheries Research Institute, Cochin

Introduction

With the present population trends, the global food demand is expected to rise 50% by 2030 and it becomes imperative to manage the resources thus to sustain this demand. The United Nations Sustainable Development Goals (SDGs) are a global call for action to achieve sustainable development by 2030 through a combined effort from all the countries. This Agenda 2030 for Sustainable Development is intended to foster growth while safeguarding the environment and bringing out a safer, healthier, and more prosperous world by 2030. SDGs are centered on five P's viz. people (wellbeing of all people), planet (protection of the earth's ecosystems), prosperity (continued economic & technological growth), peace (securing peace) and partnership (improving international cooperation). These five factors are interlinked and necessitate

The Millennium Development Goals (MDGs)	
Goal 1	Eradicate extreme poverty and hunger
Goal 2	Achieve universal primary education
Goal 3	Promote gender equality and empower women
Goal 4	Reduce child mortality
Goal 5	Improve maternal health
Goal 6	Combating HIV/AIDs, malaria, and other diseases
Goal 7	Ensure environmental sustainability
Goal 8	Develop a global partnership for development

Table 1. Millennium Development Goals (MDGs)

integrated thinking and ways to achieve the objectives. There are 169 targets which are divided into 17 SDGs measured by 232 unique indicators which were developed aiming at economic growth, social inclusion, and environmental protection.

The fisheries and aquaculture sector plays a key role for the adoption and success of the SDGs because of its high contribution towards food and nutritional security especially in the rural areas. The sector also encompasses numerous opportunities for employment and income enhancement. And managing fisheries resources in a sustainable manner is central in achieving SDGs of the United Nations, a universal call to end poverty and hunger. Sustainable development in fisheries is a global challenge that will require countries and organizations to work together in a clear, cohesive, and meaningful manner. Sustainable development is described as development that meets current needs without jeopardizing future generations' ability to meet their own. In particular, the goals of poverty reduction (SDG 1), zero hunger (SDG 2), community wellbeing (SDG 3), gender equality (SDG 5), clean water and sanitation (SDG 6), economic growth (SDG8), responsible consumption and production (SDG 12), climate change (SDG 13) and life below water (SDG 14) are especially impactful and relevant to the fisheries sector. This article highlights the importance of achieving sustainable development goals in fisheries and sheds light to the status of fisheries and SDG in Indian context.

Transition: MDG to SDG

The United Nations Millennium Development Goals (MDGs) were initiated in September 2000 when representatives from 189 Countries met at the

Sustainable Development Goals (SDGs)	
Goal 1	No Poverty: End poverty in all its forms everywhere
Goal 2	Zero Hunger: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
Goal 3	Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages
Goal 4	Quality Education: Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
Goal 5	Gender Equality: Achieve gender equality and empower all women and girls
Goal 6	Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all
Goal 7	Affordable and Clean Energy: Ensure access to affordable, reliable, sustainable, and modern energy for all
Goal 8	Decent Work and Economic Growth: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
Goal 9	Industry, Innovation, and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
Goal 10	Reduced Inequality: Reduce inequality within and among countries
Goal 11	Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Responsible Consumption and Production: Ensure sustainable consumption and production patterns
Goal 13	Climate Action: Take urgent action to combat climate change and its impacts
Goal 14	Life Below Water: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
Goal 15	Life on Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss
Goal 16	Peace and Justice Strong Institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels
Goal 17	Partnerships to achieve the Goal: Strengthen the means of implementation and revitalize the global partnership for sustainable development

Table 2. Sustainable Development Goals (SDGs)

Millennium Summit in New York. The countries committed to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women by 2015 forming 8 goals, 18 targets, and 48 indicators (table. 1). With global, regional, national, and local efforts, the MDGs has shown commendable progress in achieving the targets proposed and it was one of the most successful anti-poverty movements in history as the number of people living in extreme poverty has declined by more than half. Thus, Millennium Development Goals (MDGs) have been replaced by the Sustainable Development Goals (SDGs) with a collection of 17 interconnected and indivisible goals that draw on the MDGs' accomplishments while being much wider, deeper, and more ambitious in scope. The United Nations Conference on Sustainable Development at Rio de Janeiro in 2012 gave birth to the SDGs with a vision to framework a set of common goals that addresses the world's urgent environmental, political, and economic challenges. The United Nations General Assembly adopted the SDGs in 2015, with the aim of achieving them by 2030 and enshrined in UN resolution known as the 2030 Agenda, or Agenda 2030. The United Nations General Assembly adopted the 2030 Development Agenda on 25 September, 2015 that entitled "Transforming our world: the 2030 Agenda for Sustainable Development," by 193 countries which includes 17 SDGs, 169 objectives and 232 indicators (table. 2). Thus, the SDG Agenda 2030 aims to create a world that is just, rights-based, equal, and inclusive, that provides a vision of a fairer, more prosperous, peaceful, and sustainable world in which no one is left behind.

SDGs in fisheries and its importance:

The fisheries sector has shown tremendous growth over the years when compared to other food-producing sectors with a production of 178.5 million metric

tonnes (FAO, 2020). This increase in production is highly correlated with the livelihood of millions of people who depend on the sector for food, nutrition, and income. But the increase in population coupled with the increase in demand for fish and fish products has driven out the overexploitation of resources. With the fast expansion of the fishing industry that has increased the fishing pressure, leading to overfishing followed by juvenile fishing, and bycatch discards. According to the FAO, the percentage of marine fish stocks that are biologically sustainable has decreased from 90% in 1974 to 65.8% in 2017, while stocks fished at biologically unsustainable levels has increased, indicating the degree of exploitation. Overexploitation of fisheries resources, indiscriminate fishing due to open access and free rider mechanism, weak regulations, inadequate infrastructure, and habitat destruction are the major constraints and challenges of achieving SDGs in fisheries.

The SDGs proposed are highly interlinked when it comes to the fisheries sector and hence a coordinated effort is necessary to achieve sustainable development in fisheries which in turn have a significant synergic effect on achieving the SDGs.

Going through the SDGs 1, 2, 3 and 12, the targets can be fulfilled through fisheries as the development in the sector paves the way towards getting nutritional food resulting in achieving food security, health improvement and a better source of employment and income. Because fish is the cheapest, tastiest, and the most digestible form of animal protein, with higher proportions of unsaturated fatty acids. The fisheries sector offers key solutions for sustainable development, and is central for hunger and poverty eradication as fish is a good and cheap source of protein and it is rightly said "Give a man a fish, and you will feed him for a day. Teach a man to fish, and you have fed him for a lifetime ". Fish production has increased manifold since the 1940s and currently an estimated 59.51 million people are engaged (on a full-time, part-time, or occasional basis) in the primary sector of aquaculture (20.5 million people) which shows that the fisheries sector is vital as a source of employment and income generation. An estimated 820 million people are hungry globally which itself is a serious concern and achieving blue revolution in the sector is the need of the hour to combat this and ensure nutritious food for all. Fish, especially small fish, is rich in micronutrients such as vitamin A, iron, calcium, and zinc, as well as essential fatty acids, and provides nutrients and micronutrients that are important for cognitive and physical development, particularly in infants and children. Eating fish also increases the amount of iron and zinc absorbed from other foods in a meal.

When it comes to SDG 5, social sustainability, non-discrimination, gender equality, and mutual development are all important factors to consider. Women contribute almost half of the population, and perform nearly 2/3rd of its work hours but receive 1/10th of the world's income and own less than 1/100th of the world's property. About 66% of the women in rural areas are underutilized, but in agriculture and animal care the women contribute 90% of the total workforce. In fisheries, women play a vital role in the development of the sector and they are dependent on food, work, income and identity. Policy formulations and management in the field of fisheries will provide equal importance to women which will further lift women in the field of fish culture, vending, processing, value addition etc. thus achieving the goal. When it comes to climate change (SDG 13), 2020 has become the warmest year and sea level is rising due to thermal expansion and the impacts will be severe on fish and fisheries affecting the aquatic ecosystem and altering the fish distribution and productivity. In marine ecosystems, the rise in sea surface temperature (SST) is a direct effect whereas indirect effects like ocean acidification, sea level rise, coral bleaching and changes in wind speed and direction will affect the marine flora and fauna thus creating instability in fish stock and production. Also, the fishing pressure will increase due to the increase in temperature, change in rainfall, wind and fish abundance also with extreme weather events like cyclones and all as fishing is mainly dependent on the weather, climate and season.

In aquaculture, extreme climatic events like flood, droughts and the change in temperature affects the dissolved oxygen level and other water quality parameters which significantly influence the flora and fauna thus affecting the production and output. The increase in production cost will have severe repercussions in the supply chain of the aquaculture products and this will affect the dependent communities and stakeholders. So, it is imperative to mitigate the climate change impacts for the development of the fisheries sector through research, adopting new farming techniques, setting carbon footprints, conducting restoration programs, and by efficient monitoring, management and action plans for achieving SDGs. The SDG 17 calls for strengthening the global partnership and in fisheries sector the linkages between governmental and nongovernmental organizations like Food and Agriculture Organization (FAO), Regional Fisheries Management Organizations (RFMOS), Indian Ocean Tuna Commission (IOTC), Marine Stewardship Council (MSC), WorldFish, Global Aquaculture Alliance (GAA) and all is very crucial. Out of 17 SDGs, the goal 14 is giving special reference to the fish and fisheries of the world that emphasize on life below water to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. This goal has 10 targets (table.3) which broadly emphasizes on reducing pollution, protecting the ecosystem, managing resources by controlling over exploitation and enforcing management laws. The preference given in the SDG agenda for fisheries itself demonstrates the importance of the sector and managing the sector would substantially contribute to accomplishing other SDGs.

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Goal 14: Life Below Water	
Target 1	Reduce marine pollution: By 2025, prevent and significantly reduce marine pollution of all kinds, from land-based activities, including marine debris and nutrient pollution
Target 2	Protect and restore ecosystems: By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and act for their restoration in order to achieve healthy and productive oceans
Target 3	Reduce ocean acidification: Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels
Target 4	Sustainable fishing: By 2020, effectively regulate harvesting and end overfishing, illegal, unreported, and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics
Target 5	Conserve coastal and marine areas: By 2020, conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information
Target 6	End subsidies contributing to overfishing: By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported, and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation
Target 7	Increase the economic benefits from sustainable use of marine resources: By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture, and tourism
Target 8	Increase scientific knowledge, research, and technology for ocean health: Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
Target 9	Support small scale fishers: Provide access for small-scale artisanal fishers to marine resources and markets
Target 10	Implement and enforce international sea law: Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "The future we want"

Table 3. Targets of SDG 14 (Life Below Water)

While capture fisheries will continue to be important, aquaculture production is on the rise and plays an important role in ensuring global food security, accounting for 46% of total production and 52% of fish for human consumption with an annual production of 82.1 million tonnes (FAO, 2020). Although fishes are not calorie-dense, fish and fish products are appreciated as some of the healthiest foods on the planet and important for their high-quality proteins and essential amino acids, PUFAs and micronutrients, such as vitamins and minerals. Higher consumption of fish, with its diverse and valuable nutritional attributes, can directly reduce the prevalence of malnutrition and correct imbalanced high-calorie and low-micronutrient diets. The scientific studies suggest that the capture fisheries sector is in a struggling phase and aquaculture has a great role to play in food security and human welfare. The sector also has much to contribute towards achieving all of the SDGs by offering a cheap and nutritious protein source, but challenges such as disease outbreaks, competition for production factors, environmental and economic instability remain serious concerns that necessitate new innovative strategies to harness inclusive and sustainable growth. Moreover, from 7.8 million in 1995 to around 20.5 million in 2016 people are engaged in aquaculture and dependent on it as an income and employment source and of that 19 percent are women. It is

critical that aquaculture production be enhanced for improved efficiency of resources through research and development in the field of disease control, genetics, nutrition, biotechnology, and artificial intelligence in order to reach sustainability in the sector. Apart from this, structural transformation and innovation is required to change the phase of the sector. The expansion and development of the aquaculture sector in this direction has the scope and potential to drive the sector towards achieving the SDG objectives and targets.

SDG in Fisheries: Indian Scenario

When compared to other food-producing sectors in India, the fisheries sector plays a significant part in the country's economic growth and continues to grow at a remarkable rate. India is the 2nd largest producer of fish in the world contributing about 6.3% of the global fish production and 16th largest maritime country. The sector has shown impressive growth with an average annual growth rate of 10.88% and provides employment to millions of people directly and many more indirectly. Despite the increase in fisheries and aquaculture production in India, sustainable development of the sector is a major concern as the country ranked 117 with a score (percentage) of 61.92 out of 193 countries in SDG index 2020. The marine fisheries sector of the country is facing serious challenges in attaining SDG targets which includes over exploitation, Illegal, Unreported and Unregulated (IUU) fishing, pollution, bycatch discards, juvenile fishing, climate change, destruction of marine ecosystem, socio-economic conflicts and low catch per unit effort majorly. While the inland sector faces underutilization of resources, lack of infrastructure, destruction and fragmentation of aquatic ecosystems, aquatic pollution, impoundment and channelization of water bodies, soil erosion, and modification of river, lake, and floodplain hydrological features, poor policies and management strategies. The culture sector is troubled with disease outbreaks, climate change, natural calamities, and increased competition on resources and factors of production. As underlined in the 17th SDG, it is vital for India to accomplish SDGs in fisheries through a collaborative cooperation between international organizations, fisheries departments, research institutes, and other stakeholders bringing out the Blue Revolution through sustainable and responsible development. The launch of Pradhan Mantri Matsya Sampada Yojana (PMMSY), a flagship scheme for the development of the fisheries sector as part of the Aatma Nirbhar Bharat Package, with an estimated investment of Rs. 20,050 crores for implementation over a 5-year period from financial year 2020-25 in all States/Union Territories will have the potential to catalyze the blue revolution and SDGs in fisheries. Because 42 percent of the PMMSY's total estimated investment is intended for the establishment and upgrade of fisheries infrastructure facilities, which is the need of the hour, the programme is expected to deliver sustainable development to the fisheries sector through comprehensive infrastructure development.

Achieving Sustainable Development Goals in Indian Fisheries:

The comprehensive action points to achieve SDGs in Indian fisheries is mentioned in Figure 2. There are several key strategies that can be implemented to achieve SDGs which includes:

Culture fisheries

- Implementing sustainable aquaculture practices using environmentally friendly techniques such as recirculatory systems, integrated multi-trophic aquaculture, and organic and biodynamic aquaculture
- Diversifying the species of fish and shellfish grown in aquaculture operations to reduce the risk of disease and improve overall productivity
- Encouraging the use of renewable energy sources, such as solar or wind power, in aquaculture operations
- Developing mariculture to increase the efficiency and sustainability of aquaculture operations
- Ensuring responsible fish farming using responsible feeding practices, minimizing the use of antibiotics and chemicals, and ensuring the health of farmed fish
- Promoting transparency and traceability by implementing traceability systems to ensure that farmed fish can be traced back to the farm of origin, and providing transparent information about the origins and sustainability of farmed fish to consumers
- Developing sustainable feed sources using sustainable feed ingredients, such as plant-based proteins, and minimizing the use of fishmeal and fish oil in feed

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Fig. 1 & 2. SDG indicators & action points for Indian Fisheries

● Collaboration and partnerships by working with governments, NGOs, and the private sector to develop and implement sustainable aquaculture policies and practices

● Investing in research and development for new sustainable aquaculture technologies and practices and to improve our understanding of the environmental impacts of aquaculture

Capture fisheries:

- Implementing sustainable fishing practices using selective fishing gear, reducing bycatch, and implementing catch quotas and area closures to protect vulnerable fish populations

- Promoting responsible fish sourcing by ensuring that fish caught by the industry is sustainably sourced and certified by relevant certification schemes

- Enhancing transparency and traceability to ensure that caught fish can be traced back to the point of catch and providing transparent information about the origins and sustainability of caught fish to consumers

- Supporting small-scale fisheries by providing technical assistance, capacity building and access to markets to small-scale fishing communities

- Collaboration and partnerships with governments, NGOs, and the private sector to develop and implement sustainable fishing policies and practices

- Investing in research and development to improve our understanding of fish stocks and the environmental impacts of fishing, and to develop new sustainable fishing technologies and practices.

- Addressing the illegal, unreported, and unregulated (IUU) fishing by implementing stricter regulations, monitoring and enforcement to combat IUU fishing which is a major threat to the sustainability of fish stocks.

Way Forward:

From the Millennium Development Goals, it is evident that it has accelerated global development, and that

fulfilling SDGs is significant for a prosperous and sustainable world. The achievement of Sustainable Development Goals (SDGs) in fisheries is crucial for global progress towards a sustainable and prosperous world. Fisheries and aquaculture are a vital component of global food security and have much to contribute to the success of the SDGs. Sustainable management of fisheries is crucial as they are not only confined to SDG 14, but can also significantly contribute to achieving reducing poverty (SDG 1), food security (SDG 2), promoting community well-being (SDG 3), achieving gender equality (SDG 5), ensuring clean water and sanitation (SDG 6), fostering economic growth (SDG 8), and promoting responsible consumption and production (SDG 12) among other goals. However, the term "sustainability" has become a marketing phrase, and regulations and policies alone are not enough to achieve the targets. Instead, a holistic approach to implementation and monitoring is necessary to ensure true sustainability. Global partnerships and agreements with all stakeholders in the sector, such as innovation and transformation, funding, international trade flows, and strengthening data collection and analysis, are essential to achieving the SDG targets in fisheries. Additionally, new methods and approaches that support the successful implementation of policy and management requirements for sustainable fisheries and ecosystems are needed to ensure global fisheries sustainability. It's also worth noting that AI is being increasingly used in combination with other advanced technologies such as big data, IoT, and remote sensing can play a significant role in helping to meet the sustainable development goals (SDGs) related to fisheries.

References are available upon request from the corresponding author

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CLUSTER FARMING IN AQUACULTURE TO UPLIFT SMALL AND MARGINAL FARMERS

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Introduction

The world fish production is approximately 179 million tonnes with a total first sale value of USD 401 billion to which aquaculture contributes 82 million tonnes, worth USD 250 billion. Fish production is projected to reach 187 million tonnes by 2030. Aquaculture has become the world's fastest-growing food industry that provides the cheapest protein source and around 20.5 million people are engaged in this sector. 90% of aquaculture production is centered in Asia and is dominated by emerging small and medium-scale commercial enterprises. Around 87% of Indian farms and more than 90% of shrimp farmers belong to the small-scale or marginal category with operational holdings of less than 2 hectares per individual. The majority of the farmer's production systems are independent and unsynchronized with that of their neighbors, and they generally adopt conventional farming practices with little access to modern breakthroughs or scientific applications. Small and medium-scale farmers have a low rate of adoption of technology, standards, and practices for reducing negative impacts and preserving landscape values. In order to fill this gap various state governments and development agencies have been advocating and supporting the creation of agricultural clusters, which place a strong emphasis on building networks and partnerships between farmers and other supply chain actors to facilitate small-scale producers' adoption and adaptation of technologies and practices that also help enhance their production, productivity and profits.

Cluster farming

Clusters can be defined as a geographically proximate group of interconnected companies and associated institutions in a particular field. In aquaculture, a cluster refers to a group of interdependent aquaculture ponds/farms often situated in a specified geographical locality and in close proximity to each other with the following characteristics:

a) sharing resources or infrastructure (e.g. water sources or effluent discharge systems)

b) having the same production system

c) involving the same candidate species

Fish production is projected to reach 187 million tonnes by the year 2030

It is a joint aquaculture/agricultural production where subsistent farmers who lack sufficient investment for modern production technologies individually can use large mechanization and other farm inputs in geographically grouped farming. In some cases, the term "cluster" is synonymous with Farmer organizations (FOs) or Farmer society (i.e. a cluster or group of farmers); however, in other cases (such as in Andhra Pradesh, India), a cluster refers to a cluster or grouping of FOs in the same locality. In the latter case, a cluster is an example of an informal multilevel organizational structure.

Cluster Farming (Fig. 1) is created by merging several smallholder farms (**Satellites**) attached to a nucleus farm (**Hub farm**), into a solid entrepreneurial group (**Cluster**), which is capable to share both the benefits and the burden.

For instance, in a cluster farming of catfish operations, fingerlings are produced at the Hub farm and the satellite farms will then grow these fingerlings to table size (1 kg). In addition, the hub farm will process the table-size catfish and execute the sales and distribution of these consumer products for the satellite farms, so that the satellite farms can focus on the quality of the produce. The hub farm accompanies the satellite farmers in all facets necessary to run their farm successfully to promote their independence.

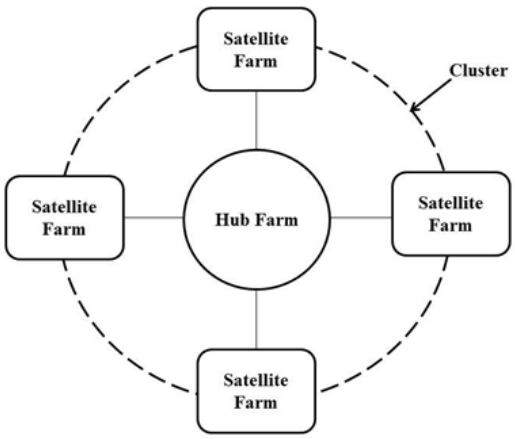

Fig 1. Schematic illustration of cluster farming

Formation of cluster farming

1. Lead farmer

A Lead Farmer (or Chairman) is the guiding individual of the cluster. They are either approached by an agricultural/environmental professional to establish a cluster or decided to explore the idea for themselves having heard about it. Some characters of a lead farmer include:

- Socially or professionally well-connected in their area.
- Conversant regarding environmental issues.
- Commit a significant amount of time to the farmer cluster.
- Competent in communication.

2. Invite farmers

The lead farmer contacts potential farmer cluster participants. Informal meetings are conducted in a household or local meeting place.

3. Decide aims

Meetings are scheduled if the prospective farmer members decide to establish a cluster. By then, a draft of the group's geographical scope and the farmer community will have begun to take shape. There may be debates on the following questions to establish a framework of objectives:

- What concerns do they have that are simpler to resolve as a group?
- Which local species are distinct or in decline?
- Which of their existing habitats would they prefer to improve or expand?
- Can they reduce flooding and/or enhance the local watercourse's quality?
- Do any strategies exist that they might use to approach business/marketing as a group?
- How can they connect with the local communities?

4. Select a facilitator

A facilitator is necessary for a cluster to:

Potential farmers are invited by the lead farmer to join a cluster

- Take charge of the farmer cluster project
- Seek funding
- Conduct training and programs
- Monitor and coordinate environmental work.

It is imperative that the farmers themselves select this individual/group/institution. Generally, facilitators are agricultural or environmental professionals or government institutions which must have the necessary skills and connections, preferably achieving or aspiring to meet an industry standard. e.g. in India, NaCSA (National Centre for Sustainable Aquaculture) acts as the facilitator for shrimp farmers and provides training to follow the cluster approach in shrimp farming. NaCSA also helps its Society members to obtain licenses from the Coastal Aquaculture Authority (CAA) and enroll society farmers in MPEDA Farm enrolment by providing necessary documentation.

4. Contact details of NaCSA

The National Centre for Sustainable Aquaculture (NACSA) (MPEDA, Ministry of Commerce & Industry, Govt. of India), Door No. 70-1A-6/1, Boat Club Road, Ramanayyapeta, Kakinada-533003, East Godavari Dt., Andhra Pradesh, India.

Toll Free No. : 1800-4252374
Phone : 0884-2350655
Fax : 0884-2350649
Email : nacsa@mpeda.gov.in
nacsa.hq@gmail.com

NaCSA has facilitated the creation of over 900 farmer societies across India

5. Getting funds

The facilitator formulates a project to avail funds for the cluster. Some funding agents in India are NFDB (National Fisheries Development Board), NABARD (National Bank for Agriculture and Rural), MPEDA (Marine Product Export Development Authority), etc.

Needs of cluster farming

- All the actors in the agricultural value chain are often more innovative and successful when they interact with supporting institutions and other actors in the supply chain.
- It promotes the diffusion of innovation, as well as the use and generation of important local externalities
- It also enhances access to markets and information

Advantages of cluster farming

- Product quality improvement by using mechanized farming.
- Sourcing better quality inputs including seed at better prices.
- Productivity improvement due to the use of mechanized farming like tractors and combine harvesters, improved agricultural inputs like varieties, fertilizer, agrochemicals, agronomic management, and continuous field follow-up.
- Strong market linkage with agro-processors, exporters, and supermarkets.
- More adoption of improved agricultural technologies by a member of the cluster and also neighboring farmers due to awareness creation, skill development, and more confidence in market linkage.
- Economies of scale for both input and output marketing.

Challenges in cluster farming

- Environmental-related risks like heavy rainfall and other stress can damage all farms in the village and have a negative impact on producer farmers who have no alternative farm or means of income.
- The emergency of newly introduced diseases and pests may lead to crop failure on the whole farm.
- Unexpected price failure on selected crops may lead to automatic rejection of the producers from their business.
- Cluster farming on a specific crop for commercial purposes may lead to nutrition insecurity compared to mixed farming where farmers use domestic consumption from different nutritious crops on their farm.
- Quality controlling problems like seeds had a great impact on product supply to aqua processers.

Case studies

Mohapatra and Barik experimented on 61 and 15 beneficiaries of Jemamantadeipur and Kantabada Villages, respectively of Begunia Block, Khordha District, Odisha adopted by ICAR-CIFA project funded by DBT, GoI. The study includes various components like carp hatchery, seed rearing, grow-out farms, and integrated farms as part of the component of cluster farm. The species cultured included catla, mrigal, rohu, and grass carp. The study observed an enhanced fish production from the pre-adoption level of 450 kg/ha/yr to a range of 3,096-3,610 kg/ha/yr, with a profit share per beneficiary family of Jemamantadeipur Village estimated to be approximately Rs. 3,200 per year.

Ha et al., in 2013 conducted a case study on the intensive shrimp farming cluster in Nhi Nguyet hamlet, located in Tran Phan commune, Dam Doi district, Ca Mau province in Vietnam. The cluster started in 2005 with 9 intensive shrimp farmers with the goal of sharing experiences and new techniques, as well as to benefit from the support offered by the government for installing a three-phase electricity system and by 2011 the cluster expanded with 100 members with a total area of 120 ha made up of 96 ha of white leg shrimp and 24 ha of black tiger shrimp. The cluster improved vertical coordination with hatcheries and feed mills, a 1.5% reduction in costs for individual farmers, and a three-phase electricity system are calculated at 1.7% of total production costs which was more than 14% of total production costs through petroleum and diesel generator in the non-clustered intensive farm. Besides, through clusters, members are getting cheaper and higher quality post larvae since they can share the costs for screening common diseases such as the white spot virus.

In India too the National Centre for Sustainable Aquaculture (NaCSA), a society under the Marine Products Export Development Authority (MPEDA) has facilitated the creation of several farmer societies (over 900) comprising of over 18000 farmers with a total area of over 16000 Ha and making them eco-friendly, sustainable and socially responsible societies.

Conclusion

Most of the farms are small farmer based as 87% of the farming area is owned by farmers with less than 2 ha area, creating an opportunity for organizing them into clusters of Farmer Producer Organisations (FPOs) to realize the economy of scale and adopting the good management practices. National Centre for Sustainable Aquaculture (NaCSA) started grouping these farmers into societies and educating them on better management practices (BMPs) for safe and sustainable shrimp farming. NaCSA also trained these farmer societies to follow cluster approach in shrimp farming. Clustering allows farmers to share resources for production and collective marketing of their produce. This improves farmer responsiveness to changes in the marketplace. It lends support for collective bargaining which increases the premiums and incomes of farmers operating in clusters. These activities ensure that farmers become more consistent in their planning and production activities which are favorable for attracting micro-financial institutions. However, the lack of awareness of cluster farming makes the cluster approach not so popular.

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Asian Seabass – Lates calcarifer

Asian seabass (*Lates calcarifer*) is an important finfish species for aquaculture in several countries across the world. Popularly known as Pandugappa in Andhra Pradesh and Betki in West Bengal, Seabass is an important candidate finfish species for farming in India as well. This is a euryhaline fish, growing rapidly up to 3 - 5 kg within a growing period of 2 - 3 years both in freshwater as well as brackish water environments. For maturation and spawning it migrates to the sea while the post larvae and juveniles migrate to lagoons and backwaters for growing. It is a voracious carnivorous fish.

Seabass attains sexual maturity at the age of 3 - 4 years and at a length and weight range of 60 to 70 cm and 2.5 to 4.0 kg respectively. Males are generally smaller and in the size range of 2.0 - 3.0 kg and seabass being a protandrous hermaphrodite, males change sex and become females as they reach a size above 5.0 kg. The fecundity is between 2.1 to 17.0 million depending upon the size of the fish.

Availability of seed and appropriate feed are the two important prerequisites for development and propagation of aquaculture of any fish species. In general, most marine carnivorous fish, including seabass require high dietary protein compared to omnivorous and herbivorous species. Therefore, fishmeal is being used as a major protein source in commercial formulations due to its balanced nutrients, essential amino acids and fatty acids, higher palatability and digestibility.

The nutritional requirements of fish vary with different growth stages and depend upon the feeding habits that change according to the morphology of digesting system. Considerable effort has been made in Australia, Thailand, Philippines and more recently in Israel in defining the nutritional requirements of this species in order to enhance production. Understanding the nutritional requirements of the candidate species is the first and essential prerequisite for development of cost effective, efficient and eco-friendly feeds. Diet preparation mainly focusses on energy nutrient requirement and micronutrient requirement such as vitamins as well as trace minerals.

Seabass fingerlings reared in a nursery

Nutritional requirement in Initial stages (Hatchery or Nursery)

The nutritional requirements of larvae that have a body mass less than few milligrams are not very much understood. Based on the composition of the yolk, live prey and larvae themselves, it is assumed that the nutritional requirements of larvae were higher than those of the juveniles. The nutritional requirement is not similar for larvae and juveniles.

Protein: Protein sources were selected based on their amino acid profile and incorporated in micro diet. Fish meal has been used as the main protein source in diet. The profiles of essential amino acids of fish body tissue are generally considered as a good indicator of their amino acid requirements.

Lipids: Lipids included in microparticulate diets come partly from fish meal or other meals incorporated as protein source and are generally derived from marine sources. Cod liver oil, roe oil, sardine oil or menhaden oil are added as triglycerides in larval diets.

Nutritional factors affecting larval metamorphogemesis

Protein hydrolysate enhances larval morphogenesis. The molecular form of the dietary protein supply, native proteins or hydrolysed into oligopeptides (around 20 amino acids), has probably an indirect effect on morphogenesis. Dietary lipids play an essential role in larval growth and survival. Growth and normal morphogenesis increased as the dietary inclusion of phospholipids and vitamins, particularly vitamin A.

Nutritional requirements for growers

Protein and amino acids constitute the key group of essential nutrients required by seabass for synthesis of protein and subsequently growth.

Protein: Most of the studies undertaken to examine the requirements for protein in barramundi diets suggest a relatively high protein requirement due to the carnivorous/ piscivorous nature of the fish. Seabass being highly carnivorous showed a dietary requirement of 45 – 55% protein. The diet energy density and the size of fish used, appear to be the key factors influencing the specific amount of protein required for seabass.

Amino acids: Most of the finfish including seabass show the requirement of the same ten amino acids (arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine tryptophan, tyrosine or valine) as essential.

Lipid: Lipids comprise an important dietary energy source for seabass and are also a source of essential fatty acids. Much work has been devoted to exploring the inclusion of lipids in barramundi diets to increase

S. No	Nutrient	Requirement in Feed
1	Protein	50-55 %
2	Fat	10-18%
3	HUFA	1.72%
4	Carbohydrate	10-20%
5	Protein energy ratio	128mg protein/KCal

Nutrient requirement of Seabass

Seabass harvested from a farm in Andhra Pradesh

their energy density. Best growth rate has been observed in barramundi from diets having 45% to 50% protein and 15% to 18% lipid content.

Vitamins: It requires vitamin A, B, Riboflavin, Nicotinic acid, Cobalamin, Biotin, Inositol, Vit D, E, K and Vit C

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Prof. S. Felix & M. Menaga*

President, Aquaculture Technology & Research Foundation India (AQUAFIN)
**Asst. Professor, Dept of Aquaculture, TNJFU, Corresponding author: felixfisheries@gmail.com*

Shrimp sector in India

India's farmed shrimp producers are largely focused on high-volume production of low-cost, minimally processed shrimp almost exclusively for the export market. This focus allows producers to export their products quickly without the cost of additional processing and investment. However, value-added processing is far more profitable at global market.

India is by far the largest global shrimp exporter, and shrimp is the country's largest agricultural export. Until recently, less than 5% of total production was for domestic consumption. In recent years, domestic consumption has increased close to around 20% of total production, primarily fresh shrimp. Approximately 90% of processed shrimp, mostly frozen, is exported. Around 40% of shrimp is exported to the US, followed by approximately 30% to Vietnam and nearly 15% to the EU. The growth rate of India's exports has slowed recently. In 2019, exports grew 31%, but in 2022 the growth reduced to 21%.

Penaeus vannamei – the species most farmed in India

Farmed shrimp species of India

There are two farmed-shrimp species in India: *Penaeus vannamei*, also known as whiteleg shrimp, and Penaeus monodon, or *P. monodon* (black tiger shrimp). *P. vannamei* accounts for over 80% of shrimp production, growing at an 18% CAGR over the past five years. The maximum production of *P. vannamei* takes place in Andhra Pradesh, followed by states such as Odisha, West Bengal and Gujarat. Black Tiger Shrimp, *P. monodon* has declined in importance following the introduction of vannamei, growing at a 5% CAGR over the past five years. Most *P. monodon* is produced in West Bengal followed by Andhra Pradesh and Gujarat. The focus of this report is mainly on *P. vannamei* since it is the primary driver of market growth.

A weak link and its survival logic

For the following reasons, India's farmed-shrimp industry has been thriving in recent years:

- Strong Demand - While many competitors struggle with disease outbreaks
- Competitive Advantage - Due to lower production costs
- Abundant Land - That enabled quick expanding of production
- Focus on High-Volume Exports - With only basic processing

Shrimp aquaculture value chain

The value chain of India's farmed-shrimp industry comprises several interrelated steps: feed mills, hatcheries, farmers, middlemen and commission agents, processors, exporters and retailers.

Future of India's shrimp aquaculture

Three imperatives inform the future of India's farmed-shrimp industry:

i) Pursue immediate change to alter current practices on an individual level, increasing efficiency and productivity while improving profit margins.

ii) Collaborate to achieve product traceability.

iii) Gradually shift to indoor shrimp farming by investing in closed containment indoor facilities that reduce contamination, increase output, minimize environmental footprint, and improve accountability.

Scope for swiftly saving the sector

The shift to traceability, transparency, and indoor farming offers the highest potential for successfully defending the currently strong competitive position of India's shrimp industry, but this will require considerable capital investment, extensive expertise, and time. Meanwhile, there are several immediate changes that acts along the value chain, particularly feed mills and farmers, can implement to significantly improve financial performance and resource efficiency and create environmental benefits.

The Shrimp Aquaculture Economics of Short-Term Improvements

In order to achieve the short- term improvements in the shrimp aquaculture sector one needs to understand the economics of this sector.

1. Feed Mills

a) Market Dynamics: The shrimp feed industry in India is expected to grow at about 11% per year. Most feed players are located in Andhra Pradesh, where they have easy access to farmers and lower transportation costs. Approximately 90% of the feed reaches the farmer through a well-established dealer network. Dealers often provide smaller farmers with credit. Direct sales are common only to large corporate farmers.

b) Business Case: The average economics of today's average feed mill is close to 8% (EBIT- Earnings before Income and Taxes). Here we looked at business case with two types of functional feeds: growth enhancement and health enhancement.

i) Growth Enhancement Functional Feed: The use of growth enhancement functional feed enables higher efficiency in shrimp farming: demand falls when farmers use functional feed, and revenues could decline by as much as 16% owing to lower feed mill sales. However, there is the possibility of increasing today's Earnings before Interest and Taxes (EBIT) margins by 130%, and, as farmers will not use functional feed continuously, the impact on feed mill revenues is expected to be marginal. The following are the

A shrimp feed mill

assumptions on which we based the business case calculations for growth enhancement functional feed for feed mills:

• Revenues per kilogram of feed sold increase because feed mills can charge a price premium of up to 20%.

• Production and input costs increase about 6% per kilogram of feed produced.

• The potential FCR improvement at the farm level is 30% for half of the growth cycle, leading to an overall FCR of 1.11, reducing demand.

ii) Health Enhancement Functional Feed: Feed mills can charge a premium price of up to 50%. The premiums result in a profit margin increase of 260% compared with today's average EBIT margin. The following are the assumptions on which we based the business case calculations for health enhancement functional feed for feed mills:

• Revenues per kilogram of feed sold increase because feed mills can charge a price premium of up to 50%.

• Production and input costs increase about 15% per kilogram of feed produced.

• The disease survival rate increases from a range of 20% to 30% to a range of 70% to 75%. (This is particularly relevant for farmers who deal with high risk disease viz. WSSV, EHP, etc.)

c) Environmental Impact: The overall impact on the environment is limited, but feed mills enable positive change at the farm level: The use of health enhancement functional feed for feed mills improves efficiency and reduces farm waste. With lower mortality rates, for example, less feed is wasted.

• Through reduced feed use in general and the inclusion of ingredients that replace fish meal and oil, the use of land, water, and antibiotics and the need for wild-caught fish are reduced.

• It's important to further consider ingredients used in functional feed as substitutes for fish meal in terms of their effect on the environment. Greater dependence on soy, for example, has negative implications for the environment, because soybean production is causing widespread deforestation.

2. Shrimp Hatcheries

a) Market Dynamics: The PL market in India has been growing at around 26% in recent years and India has more than 300 operational *P. vannamei* shrimp hatcheries. Almost all hatcheries are located on the East Coast of India, primarily in Andhra Pradesh, while only around 15 hatcheries are located on the West Coast. The market is very fragmented with very few big players. *P. vannamei* broodstock is sourced primarily from the US. High-quality PL is essential for preventing disease, and therefore the relationships between hatcheries and farmers are crucial. In addition, the hatchery sector is regulated to prevent nationwide outbreaks of diseases and ensure a stable supply of PL.

b) Business Case: The average economics of today's shrimp hatcheries are very high that is close to 50% (EBIT) and they are the major single beneficiaries of the sector. Even with no quantitative business case assessment, it's clear that high-quality PL contributes to better results for the industry overall.

c) Environmental Impact: The hatcheries have only

limited impact, and water treatment and anti-pollution measures could further reduce their impact. Better PL quality leads to better survival for shrimp, reducing the impact of failed production on farms. This is a key driver for future value.

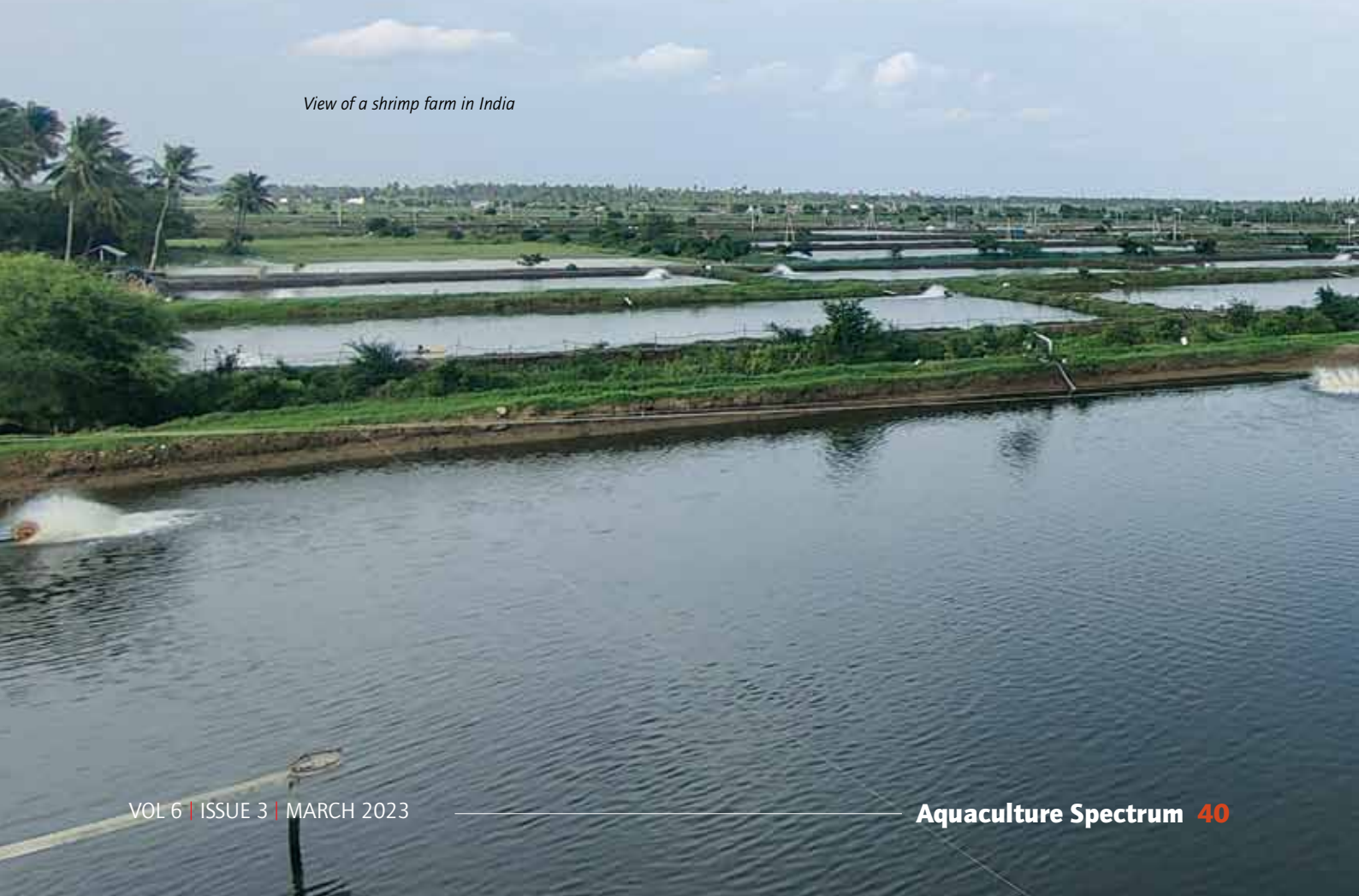
3. Shrimp Farmers

a) Market Dynamics: The farming market in India is very fragmented. Large corporate players, control only 10% of the farms and 10% of the area under culture. Approximately 90% of the farms are managed by small or midsize players, and most are family-run operations. While there are more than 100,000 *P. vannamei* farms in India, only around 1% of farms are officially registered with the Coastal Aquaculture Authority (41140 Nos. Registered; 13773 Nos Active). MPEDA in turn has a registration record and it has 70000 Nos. The majority of *P. vannamei* farms are located in Andhra Pradesh, which is responsible for some 70% of *P. vannamei* production. P. monodon farms are mainly in West Bengal.

Approximately 80% of Indian farms are semi-intensively farmed, with stocking densities of about 30 PL per square meter, and survival rates have been relatively low (around 55%). Many of these farms are clustered together. Only some 15% of farms operate intensively with high stocking densities.

Middlemen, or commission agents, in India still play a significant role in the lives of individual farmers: 40% of farmed shrimp is distributed to processors through commission agents. Approximately 40% of farmers have direct agreements with processors who sell feed to farmers and buy back their harvested shrimp in return. Less than 20% of shrimp is sold at the farm gate directly for local markets without further processing.

b) Business Case: The average economics of today's farms is 22% (EBIT). The economics is impacted by a number of factors related to farming system/practice as well as environmental impact, both individually and in combination: Use of functional feed, biofloc, RAS, and solar energy etc. Growth Enhancement Functional Feed has an EBIT Margin Increase of upto 32%.



View of a shrimp farm in India

Functional Feed: The use of growth enhancement functional feed can lead to EBIT margins of up to 30% at the farm level, representing an increase of up to 32% in EBIT margins over today's average. The assumptions for the business case calculations for growth enhancement functional feed are the following:

- Shrimp that grows faster or to a larger size within the same timeframe can achieve price premiums of up to 6%.

- Growth enhancement functional feed lowers FCR by 30% in general, but because it is used during only half of the growth cycle, the FCR would be lowered by 15%, compensating for the 20% increase in feed prices.

- There is no need for a larger investment, but it is assumed that farmers can pay higher feed costs up front.

Health enhancement Functional Feeds: The use of health enhancement functional feed if used continuously is not economically viable for farmers: it would result in a steep decrease in EBIT and possibly negative EBIT margins caused by sharp increases as much as 50% in feed costs. However, if disease outbreaks are anticipated, it would be possible to achieve an EBIT margin as high as 23%, compared with 11%, when disease hits while basic feed is being used. This assumes that 20% of crops are affected by disease and treated with health enhancement feed. Health enhancement feed serves as a risk management tool for farmers. Although it offers a clear financial incentive, its benefits can be achieved only with long-term planning, management, and foresight. The business case calculations for health enhancement functional feed for farms are based on the following:

- Feed is sold at a premium of up to 50% above the price of conventional feed.

- There is no change in FCR, but survival rates rise from a range of 20% to 30% to a range of 70% to 75%.

- Scenario 1. Using basic feed for the entire production, about 80% of the crops are successful with a 55% survival rate, and 20% of crops hit by disease have a survival rate of only 20%.

• Scenario 2. Using basic feed two-thirds of the time, successful crops have a 55% survival rate, and using health enhancement functional feed one-third of the time to avoid disease achieves a survival rate as high as 74%.

c) Environmental Impact: If farmers increase their efficiency, less feed will pollute the water, and the use of growth enhancement feed can indirectly reduce the impact of overfishing and lead to a positive environmental impact.

Biofloc and RAS:

a) The business case: The business for using biofloc depends on a farm's technical management, which influences prices, costs, and production parameters such as FCR and growth cycles. In the best-case scenario, farmers achieve EBIT margins as high as 29%, increasing margins as much as 30%. Even in the worst- case scenario, margins increase slightly, leading to overall EBIT margins of 26%. If farmers are knowledgeable and consistently monitor the system, they can expect to achieve the best- case scenario.

Indoor shrimp farming systems

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Biofloc can increase EBIT Margins by as much as 30%, while RAS can increase them by as much as 22%. The assumptions for business case calculations for biofloc for farms include the following:

- Energy costs increase 20% to 40% owing to the extended need for aerators.
- The costs for skilled labour increase 5% to 10% owing to the need for higher controls and constant supervision.
- FCR decreases by 25% because biofloc can be used partly as a feed source.
- The costs for chemicals decrease by 3% to 7% owing to water quality improvement through biofloc use.
- The additional cost for cornmeal as a carbohydrate source ranges from $0.23 to $0.36 per kilogram. (For a kilogram of shrimp, approximately 0.6 kilograms of cornmeal is a required biofloc ingredient.)
- The survival rate is similar to that of a system without biofloc.
- Due to the protein content in biofloc, the growth rate increases by as much as 27%, allowing farmers to benefit from a 2% to 4% higher sales price for larger shrimp.

Farms that use RAS can see EBIT margins rise by up to 22% per kilogram at the farm gate, achieving EBIT margins as high as 27%. Additionally, overall revenues are boosted owing to higher stocking densities and, consequently, yields. Assumptions for business case calculations for RAS include the following:

- Stocking densities could increase fourfold, owing to better water quality and improved monitoring of water conditions.
- Investment costs of $150,000 per hectare, depreciated over ten years, could lead to an expected yearly yield of 30,000 kilograms per hectare (based on increased stocking densities).
- The risk of disease is lower due to superior water quality and higher biosecurity, leading to improved survival rates.
- Variable costs decrease by 15%, reflecting increased energy and maintenance costs, reduced labour costs due to higher automation and stocking densities, lower chemical requirements, and less disease risk.
- Higher stocking densities lead to a 50% decrease in fixed costs.
- The increase in stocking densities is maximized in indoor systems. Therefore, an investment in RAS is recommended only as part of a shift to indoor systems. With indoor farming, the water quality and shrimp conditions can be fully controlled to minimize contamination, allowing for even higher stocking densities and higher survival rates.

b) Environmental Impact: The environmental impact of biofloc and RAS is positive. With biofloc, better water quality leads to less pollution, eutrophication, and ground water contamination, permitting water recycling and reducing water intake. Lower FCR has an indirect impact on feed production and the potential to reduce the number of wild fish used in feed. RAS reduce the use of new intake water (except to make up for seepage and evaporation), but because energy consumption is higher, there is the risk of higher air pollution if diesel generators are used. Still, the use of RAS has the potential to reduce land use, because the increase in stocking densities allows for higher output per hectare.

Solar Energy: The use of solar energy can be beneficial for farms in remote areas with an unstable grid connection. Currently, these farms use diesel generators to ensure a constant energy supply. Diesel generators are expensive and a source of pollution. For a remote farm with an unreliable grid connection, renewable solar energy represents a reliable, economic, and clean alternative.

Although on the basis of the cost per mega-watt hour, solar energy is more expensive than grid energy, it is significantly less costly than diesel. Replacing diesel generators with solar energy can yield an increase of up to 12% in EBIT margins. This said, the initial investment for PV systems requires significant investment upto $15,000 to $25,000 per hectare, depending on the system and if battery storage is required, which small farms in remote areas may not be able to afford. But as the costs of batteries and solar power continue to decrease, this option could eventually become more affordable for remote farms as well as grid users.

The total EBIT margin can be as high as 25% when solar energy is combined with grid energy, representing an increase of up to 12% EBIT margin compared with today's average. The use of solar energy generates a 12% increase in EBIT margins. Assumptions for business case calculations for solar energy for farms include the following:

- A levelized cost of energy for solar options, including batteries, is estimated to be higher than for grid energy but significantly lower than for diesel generator use.

- The shift to solar energy is relevant and applicable only for farms in remote areas with high diesel generator use.

- The assumptions are comparable to standalone solutions, as the three methods affect different variables.

Doubled stocking density is possible due to better water quality and improved monitoring of water conditions. FCR is reduced by 15% owing to the use of functional feed during half of the production cycle. A 6% increase in the shrimp sales price is due to larger shrimp size based on the use of functional feed. For half the growth cycle, there is a 20% increase in the feed sales price, and additional feed mill costs are incurred. A 15% decrease in overall variable costs is the result of the combination of a cost increase that is due to the use of functional feed and a decrease in the cost per kilogram that is due to the use of RAS and solar energy. There is a 50% decrease in fixed costs due to RAS.

Investment costs of $150,000 per hectare are depreciated over ten years with an expected yearly yield of 30,000 kilograms per hectare.

Combined Options: The combination of growth enhancement functional feed, biofloc, and solar energy provides a better business case than today's average economics. Nevertheless, it is difficult to compare it with the standalone feed or biofloc business case, as both improvement levers, growth enhancement functional feed and biofloc affect the same production parameters (for example, FCR), and their combined impact has not been studied yet. Assumptions for business case calculations for the combination of growth enhancement functional feed and biofloc for farms include the following:

- FCR improves up to 32%, as the functional feed and biofloc can reduce FCR. Compare this with a 15% reduction through the use of growth enhancement functional feed and a 25% reduction through biofloc. (The effect on the FCR is not the sum of both standalone options; the combined impact has not yet been studied in depth.)

- The sales price increases up to 10% because a higher price can be achieved for larger shrimp. Accelerated growth through the combined use of functional feed and the high protein content of biofloc lead to even higher prices achievable in the market if global shrimp prices are correspondingly high.

- Additional cost assumptions for biofloc (averaged best and worst cases) include for skilled labour, increase of 8%; for energy, increase of 30%; for chemicals, decrease of 5%; and for cornmeal as a carbohydrate source, about $0.30 per kilogram (about 0.65 kilograms of cornmeal per kilogram of shrimp produced is needed for biofloc development). However, as indicated earlier, the combination of the two options still needs in-depth assessment, and these assumptions must be validated through further research. A combined solution can increase EBIT margins by about 61% - A higher potential benefit than a standalone solution

4. Middlemen

a) Market Dynamics: Middlemen handle business interactions between the fragmented farmers and processors. There are great differences in the role and activity of middlemen across the country, but generally such commission agents provide the link between farmers and processors. Their operating model also differs by region and state, but many operate on a commission basis and achieve EBIT margins of around 10%. Farmers choose middlemen for various reasons: to ensure transportation of shrimp to processors, to outsource sales risks, and to provide financing.

The network of middlemen that collect and aggregate shrimp from multiple farms and then deliver the regrouped batches of shrimp to processors is a major point of non-transparency along the value chain. During this process, the origin of single shrimp products becomes untraceable. Owing to their practices and the sector's informality, middlemen present major challenges to progressing toward traceable supply chains.

A shrimp processing plant

b) Business Case: No quantitative business case was assessed, but middlemen can play a key role in moving the industry toward traceability. Currently, it is difficult to trace and track shrimp in India because, in many cases, middlemen mix and sort shrimp from multiple farms.

c) Environmental Impact: Middlemen can decrease their environmental footprint by ensuring that no drugs or other illegal substances are injected into shrimp, that shrimp is not farmed in mangrove areas, and by providing guidance to farmers on best practices.

5. Processors and Exporters

a) Market Dynamics: Shrimp processors in India are highly fragmented, with more than 400 processors. Larger and integrated players have the largest processing capacities. The Indian shrimp and seafood processing industry, which is regionally very fragmented, is located mainly in port cities. There are various types of processing, such as shrimp with or without heads and shrimp with or without tails. The type of processing depends on the preferences of export countries. With limited value-added processing facilities in India, 60% of Indian shrimp is block frozen after basic processing (for example, headless shrimp without shells), and 40% receives more value-added processing (for example, ready-to-eat cooked shrimp). Basic frozen shrimp achieve EBIT margins of around 8%, whereas value-added processing achieves EBIT margins of some 20%.

b) Business Case: the average economics of today's processors:

Because processors are at the intersection of buyers and retailers, they are directly affected if retailers refuse, owing to environmental concerns, to buy Indian shrimp or if retailers want better traceability and sustainable supply chains and are willing to pay a premium.

This opportunity for premium pricing currently exists only for niche markets: the main-stream market is

Frozen Shrimp	Prepared Shrimp
Subjected to block freezing and blast freezing	Subjected to value added processing
Volume share-60%	Volume share-40%
EBIT margins-8%	EBIT margins -20%
Typical products: headless, shell on; peeled, deveined, and tail on, peeled, deveined and head on; shell on	**Typical products:** cooked, breaded and sushi

competing on price. If processors drive positive change in the upstream supply chain, they will yield high benefits, including sustained access to larger quantities of high-quality shrimp, market access, and good relationships with buyer markets.

c) Environmental Impact: Processors' support for traceability would reduce land use, as well as water and energy consumption. Processors also have an obligation to improve social norms and concerns, including labour conditions.

The basic data of cultivable area of the country is essential for any planning to be undertaken. But it is not available accurately with the agencies concerned; In order to counter the viral diseases faced by the sector, it is of paramount importance to screen the seeds scrupulously through PCR protocols for which the Labs are not monitored by any relevant agencies the residual effect of antibiotics and other drugs in shrimp leading to repeated rejections (200 plus in the last 7 years!) of shrimp consignments at export market could be due to the indiscriminate use of uncontrolled farm inputs and to cap it all the traceability is the master factor that all stakeholders need to understand and to comply its regulations to stay high and safe in the marketing. Shrimp seed and feed suppliers and processors in the country (a few firms controlling more than 60 to 70% of the sector) have to volunteer to stabilise the prices so as to share the margin with the farmers, the main players of the sector to avoid an imminent collapse.

Note: This paper is based on the analysis conducted by the Boston Consulting Group (BCG, 2022), Frankfurt, USA and it was well deliberated and discussed in the technical workshop (comprising reps of all stakeholders, PFFI and aquaculture media) handled by AQUAFIN on 29th January, 2023 at Vijayawada.

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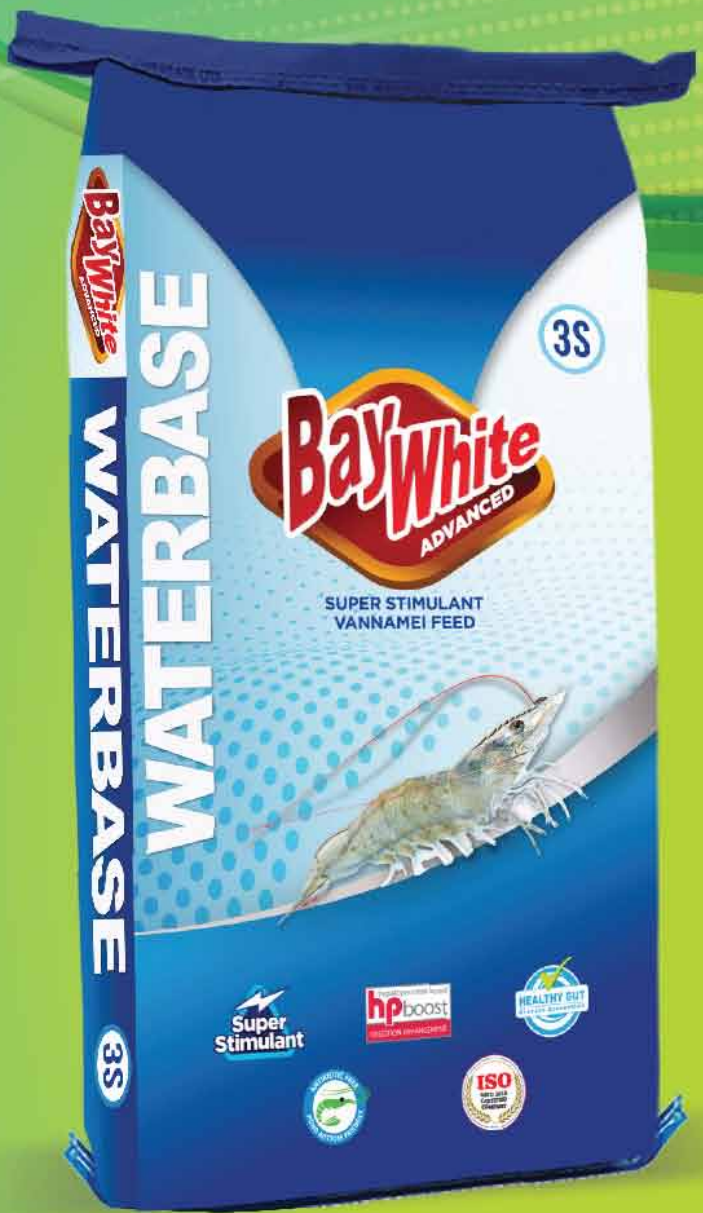

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SKRETTING INDIA LAUNCHES STATE-OF-THE-ART SHRIMP AND FISH FEED FACILITY IN SURAT

Skretting, the Norway-based global leader in aqua feed and nutrition, inaugurated its state-of-the-art production facility for shrimp and fish feed in Mangrol, Surat, 13th February 2023. The 50,000 MTPA facility has been built with an investment of EUR 18.5 million and the high-end facility allows Skretting to further enhance support for its customers and the Indian aquaculture sector as well as export markets.

The facility was inaugurated by Dr. Sanjeev Balyan, Hon'ble Minister of State of Fisheries, Animal Husbandry and Dairying, and Mr. Michiel van Erkel, Agriculture Counsellor for India and Sri Lanka, Embassy of the Kingdom of the Netherlands. Dr. Sanjeev Balyan congratulated the team for their achievement and welcomed the multinational as they bring the global expertise and research for Indian aquaculture

Dignitaries lighting the inaugural lamp

Ribbon cutting ceremony by dignitaries

development. He also sent the message to the Indian aquaculture industry about the requirement of technology usage for improving productivity and efficiency and promoting domestic consumption to continue our leading position globally.

Mr. Erkel mentioned that just last year they had celebrated 75 years of warm diplomatic relations and that business from the Netherlands finds its way to India. When Nutreco was nominated last year as the most innovative company in animal nutrition by World Finance, they had stated that they want to help farmer's produce more, strengthen animal' health and resilience while also looking at sustainable practices. He congratulated Skretting India for the support to Make in India initiative.

Spread over an area of 20,000 sq mt, the facility will produce feeds for different species of shrimp such as pacific white and black tiger as well as fish, which include Indian major carps, and high-value fish like snakehead, seabass, etc. It will produce both extruded/floating and pelleted/sinking feed as per the requirement of the species and customers. There is also adequate land and infrastructure available to increase production capacity in the future.

Dr. Saurabh Shekhar, General Manager, Nutreco South Asia spoke; "We are thrilled to launch our state-of-the-art production facility at Mangrol in Surat. We have been meeting the needs of shrimp hatcheries, nurseries and farmers since 2018 in India, and supporting customers across feed-farm-health with our high-quality feed and services. The new facility will enable us to contribute to the prestigious Atmanirbhar Bharat – Make in India initiative, while simultaneously improving efficiencies for a closer connect with our customers. We will cater to the domestic market and also to customers in Bangladesh, Sri Lanka and The Middle East."

Skretting, a division of The Netherlands-based Nutreco, the leader in animal and aqua nutrition, which is a subsidiary of SHV Holdings N.V., a family-owned Dutch multinational, has manufacturing footprints in 18 countries and produces 3 million MT of feed annually for more than 60 species from hatching to harvest, with global leading position in salmon and shrimp. Skretting has held a leading position in Ecuador and has played a key role in the transformation of shrimp culture in the country. With a combination of products, technical services and digitally enabled solutions like AquaSim and Skretting 360+, Skretting has supported

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Plaque unveiling ceremony

in improving efficiencies and production of the shrimp farmers. With this facility and stronger footprints, Skretting India aims to deploy the same technologies and capabilities for South Asia.

The facility is equipped to support both sustainability and feed-to-food safety measures, in line with Skretting's Sustainability RoadMap 2025 and Nutrace. As part of sustainability measures under RoadMap 2025, the premises has systems like rainwater harvesting and effluent treatment plant, amongst others. The factory follows the global feed-to-food safety and quality program Nutrace for end-to-end tracking and traceability with certified supplier assessments and checks at each critical point.

"The factory is key to achieving our purpose of Feeding the Future in growth territories of Asia and India. We already have plants in Vietnam, Japan, China, and Indonesia. This state-of-the-art production facility reinforces our commitment to South Asia and the Indian markets. Construction of the factory started in September 2020, and the work was completed in just over two years despite the various challenges posed by the Covid pandemic. The facility has generated local employment opportunities with 120 employees. This is just the beginning in our journey and to bring knowledge and technology as a differentiator and enabler," said Mr. Jurriën Zandbergen, Managing Director, Nutreco, Asia.

Nutreco has both organic and inorganic growth plans to expand its footprints in South Asia and is actively looking for companies that can support its purpose of Feeding the Future via its investment arm NuFrontiers. Through NuFrontiers, Nutreco has invested strategically in startups globally, including the Internet of Things (IoT) enterprises, Eruvaka – for innovations in aquaculture and Stellapps – for improving efficiencies in the dairy value chain.

About Nutreco: Nutreco is the global leader in animal and aqua nutrition with headquarters in Amersfoort, The Netherlands. It has two divisions - Trouw Nutrition which is in animal nutrition and Skretting, the global aqua feed and nutrition leaders. With over 125 years of experience, Nutreco's more than 11,000 dedicated employees in more than 33 countries across the globe relentlessly pursue its purpose of Feeding the Future in a way that ensures sustainability, is front and centre in all it does. It has over 4,000 employees in growth geographies of Asia, Africa and Latin America.

Skretting's dealers and key farmers attended the event

Nutreco's solutions go beyond nutrition - it provides best-in-class advice and technology to help customers produce more food in a sustainable way to feed the rising population. It produces 9.2 million tonnes of animal products annually through more than 98 production plants in 33 countries. Its NuFrontiers team works to identify, develop and invest in next-generation breakthrough innovations. In 2021, Nutreco had net revenues of € 9.0 billion. It is a subsidiary of SHV Holdings N.V., a family-owned multinational with net sales of € 20 billion in 2021.

About Skretting: Skretting is a global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry working closely with shrimp and fish farmers. Skretting has 30 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. It is headquartered in Stavanger; Norway and it employs 4,000 employees. Its team of more than 140 employees is dedicated to Innovation that works on the core competencies of nutrition, feed production and health for aquaculture. Skretting India is a subsidiary of Skretting and is headquartered in Hyderabad. It started in India in 2018, recognizing the Indian sub-continent and Asia's critical role in fulfilling the purpose of Feeding the Future. India is among the top 2 producing countries with shrimp exports and the industry is expected to grow at 8 - 9% per annum. Skretting India's team works closely with farmers to support their feed, farm, and health requirements. Skretting India goes beyond nutrition and feed with its Aqua specialty range that supports pond, water, and soil management.

For more information, please visit us at:
www.skretting.in

IMPORT OF SPF *L.VANNAMEI* TO INDIA DURING JANUARY 2023 TO MARCH 2023

S. NO	NAME OF THE HATCHERY	SUPPLIER	DATE OF RECEIPT	QUANTITY RECEIVED
JANUARY 2023				
01	Sun Shine Marine, Tamil Nadu	SIS; Florida	08.01.23	300
02	Ravi Hatcheries, Andhra Pradesh	SIS; Florida	11.01.23	600
03	Rajvarma Hatcheries, Andhra Pradesh	SIS; Florida	13.01.23	600
04	Sree Kamadhenu Aquatech Pvt. Ltd - Prakasam, Andhra Pradesh	SIS; Florida	13.01.23	600
05	Golden Marine Harvest - Unit IV, Tamil Nadu	Blue Genetics; Mexico	16.01.23	800
06	Fedora Sea Foods Pvt. Ltd, Andhra Pradesh	Syaqua Americas Inc; Florida	16.01.23	400
07	Vaisakhi Bio Marine Pvt. Ltd - Unit III, Andhra Pradesh	Syaqua Americas Inc; Florida	16.01.23	1000
08	Sapthagiri Hatcheries - Unit II, Andhra Pradesh	SIS; Florida	18.01.23	800
09	Sapthagiri Hatcherie, Andhra Pradesh	SIS; Florida	18.01.23	800
10	Golden Prawns Pvt. Ltd, Andhra Pradesh	Blue Genetics; Mexico	19.01.23	600
11	Anjaneya Marine Hatcheries, Andhra Pradesh	SIS; Florida	19.01.23	380
12	Sandhya Aqua Exports Pvt. Ltd, Andhra Pradesh	SIS; Florida	19.01.23	450
13	Varun Hatcheries, Andhra Pradesh	SIS; Florida	19.01.23	400
14	Prince Aqua Pvt. Ltd, Andhra Pradesh	SIS; Florida	20.01.23	1200
15	Pavani Hatcheries, Tamil Nadu	SIS; Florida	20.01.23	600
16	Golden Marine Harvest - Unit IV, Tamil Nadu	Blue Genetics; Mexico	21.01.23	400
17	Gaayathri Bio Marine, Andhra Pradesh	SIS; Florida	21.01.23	560
18	Gayathri Hatcheries, Andhra Pradesh	SIS; Florida	21.01.23	600
19	Vandayar Hatchery, Tamil Nadu	SIS; Florida	21.01.23	400
20	Regal Bio Marine Hatchery, Tamil Nadu	SIS; Florida	22.01.23	500
21	Star Aqua Hatchery, Tamil Nadu	SIS; Florida	25.01.23	300
22	Srinivasa Hatcheries, Andhra Pradesh	Syaqua Americas Inc; Florida	27.01.23	400
23	Sri Srinivasa Hatcheries, Andhra Pradesh	Syaqua Americas Inc; Florida	27.01.23	600
24	Vaisakhi Bio Marine Pvt. Ltd - Unit III, Andhra Pradesh	American Penaeid; Florida	28.01.23	520
25	Sapthagiri Hatcheries - Unit II, Andhra Pradesh	Syaqua Americas Inc; Florida	30.01.23	400
26	Sri Manjunadha Hatcheries, Andhra Pradesh	Syaqua Americas Inc; Florida	30.01.23	600
FEBRUARY 2023				
27	Sri Mahalakshi Hatcheries - Vizag, Andhra Pradesh	SIS; Florida	02.02.23	600
28	Neeva Aero Solutions, Andhra Pradesh	SIS; Florida	03.02.23	800
29	Amaze Shrimp Hatchery, Tamil Nadu	SIS; Florida	03.02.23	600
30	BMR Exports - Kancheepuram, Tamil Nadu	Syaqua Americas Inc; Florida	04.02.23	800
31	Sri Manjunadha Hatcheries, Andhra Pradesh	SIS; Florida	04.02.23	400
32	Vaisakhi Bio-Marine Pvt. Ltd - Unit IV, Tamil Nadu	SIS; Florida	08.02.23	580
33	Balaji Aqua & Agro Products Pvt. Ltd, Andhra Pradesh	Kona Bay; Hawaii	10.02.23	1320
34	Sri Sai Hatchery & Prawn Culture Pvt. Ltd, Andhra Pradesh	SIS; Florida	10.02.23	600
35	Royal Hatcheries, Tamil Nadu	SIS; Florida	10.02.23	600
36	KPR Hatchery, Andhra Pradesh	SIS; Florida	11.02.23	550
37	Sarada Hatcheries - Unit I, Andhra Pradesh	SIS; Florida	11.02.23	550
38	Golden Marine Harvest - Unit III, Tamil Nadu	Syaqua Americas Inc; Florida	11.02.23	800
39	BMR Marine Products Pvt. Ltd - Unit II, Andhra Pradesh	SIS; Florida	15.02.23	600
40	CP Aquaculture (India) Pvt. Ltd - Nellore, Andhra Pradesh	American Penaeid; Florida	16.02.23	600
41	Anjaneya Marine Hatcheries, Andhra Pradesh	Syaqua Americas Inc; Florida	16.02.23	500
42	Ananda Foods, Andhra Pradesh	SIS; Florida	16.02.23	570
43	Samudra Hatcheries Pvt. Ltd, Andhra Pradesh	SIS; Florida	17.02.23	250
44	Sai Marine Exports Pvt. Ltd - Unit II, Andhra Pradesh	SIS; Florida	18.02.23	600
45	Ananda Foods, Andhra Pradesh	Syaqua Americas Inc; Florida	18.02.23	400
46	Aqua Star Shrimp Hatchery, Tamil Nadu	SIS; Florida	18.02.23	400
47	Snehitha Hatcheries - Unit II, Andhra Pradesh	SIS; Florida	18.02.23	600
48	Sai Lalitha Hatchery, Andhra Pradesh	Syaqua Americas Inc; Florida	18.02.23	500
49	Sri Manjunadha Hatcheries - Phase II, Andhra Pradesh	Blue Genetics; Mexico	19.02.23	440
50	CPF (I) Pvt. Ltd, Tamil Nadu	American Penaeid; Florida	23.02.23	600
51	CP Aquaculture (India) Pvt. Ltd - Mukkam, Andhra Pradesh	American Penaeid; Florida	23.02.23	600
52	Srinidhi Biotechnologies, Andhra Pradesh	SIS; Florida	24.02.23	1200

53	Vaisakhi Bio-Resources Pvt. Ltd, Andhra Pradesh	SIS; Hawaii	26.02.23	600
54	BKMN Aqua (379), Andhra Pradesh	SIS; Hawaii	26.02.23	550
55	Meenakshi Hatcheries Pvt. Ltd, Andhra Pradesh	SIS; Hawaii	26.02.23	550
56	The Water Base Ltd, Andhra Pradesh	SIS; Hawaii	26.02.23	300
57	Sandhya Aqua Exports Pvt. Ltd, Andhra Pradesh	Benchmark Genetics; Florida	26.02.23	500
MARCH 2023				
58	Sri Sampat Vinayak Aqua Products Pvt. Ltd, Andhra Pradesh	Blue Genetics; Mexico	01.03.23	800
59	Sri Venkateswara Shrimp Hatcheries Pvt. Ltd, Andhra Pradesh	SIS; Florida	03.03.23	600
60	Bay Fry Pvt. Ltd, Andhra Pradesh	SIS; Florida	03.03.23	600
61	Seven Staar Aquatech, Tamil Nadu	SIS; Florida	04.03.23	400
62	TMR Bio Marine, Andhra Pradesh	SIS; Florida	04.03.23	600
63	NSR Aqua Farms Pvt. Ltd, Andhra Pradesh	SIS; Florida	04.03.23	600
64	Vaisakhi Bio Marine Pvt. Ltd - Unit III, Andhra Pradesh	SIS; Florida	08.03.23	1200
65	Sheng Long Bio-Tech (India) Pvt. Ltd, Tamil Nadu	SIS; Florida	09.03.23	700
66	Rama Shrimp Hatchery, Andhra Pradesh	SIS; Florida	09.03.23	600
67	Sapathagiri Hatcheries - Unit II, Andhra Pradesh	Kona Bay; Hawaii	10.03.23	440
68	Sapathagiri Hatcheries - Anakapalli, Andhra Pradesh	Kona Bay; Hawaii	10.03.23	1232
69	SVR Hatcheries, Andhra Pradesh	Kona Bay; Hawaii	10.03.23	660
70	Ravi Hatcheries LLP, Andhra Pradesh	Kona Bay; Hawaii	10.03.23	660
71	NSR Hatcheries, Andhra Pradesh	SIS; Florida	11.03.23	400
72	NSR Hatcheries - Prakasam, Andhra Pradesh	SIS; Florida	11.03.23	400
73	Shilpa Hatcheries LLP, Andhra Pradesh	SIS; Florida	12.03.23	1140
74	Jay Jay Gold, Tamil Nadu	SIS; Florida	15.03.23	580

Source: CAA Website, AQF-RGCA, MPEDA

IMPORT DETAILS OF SPF *P. MONODON* CONSIGNMENTS QUARANTINED AT AQF (JANUARY 2023 TO MARCH 2023)

S. NO	NAME OF THE HATCHERY	SUPPLIER	DATE OF RECEIPT	QUANTITY RECEIVED
JANUARY 2023				
NIL				
FEBRUARY 2023				
1	Unibio (India) Hatcheries Pvt. Ltd, Tamil Nadu	Aquaculture De La Mahajambal; Madagascar	05.02.23	126
MARCH 2023				
2	Unibio (India) Hatcheries Pvt. Ltd, Tamil Nadu	Aquaculture De La Mahajambal; Madagascar	13.03.23	302
3	Gaayathri Bio Marine - Unit II, Andhra Pradesh	Aquaculture De La Mahajambal; Madagascar	13.03.23	202
4	Golden Marine Harvest - Unit VI, Tamil Nadu	Aquaculture De La Mahajambal; Madagascar	13.03.23	706

Source: CAA Website, AQF-RGCA, MPEDA

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- Ecomask encourages PL survival in the early stages at grow out ponds.
- Promotes reduced FCR
- Reduces size variations
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Farmers' feedback on Ecomask

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- Improved survival rate
- Reduced size variation
- Increase in ABW
- Good feed intake
- Reduced FCR

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Shrimp Aquaculture

- Industry Review

Indian Shrimp aquaculture industry continued to move at a sluggish pace in March 2023 as well. Stocking has been extremely slow as fluctuating prices and unabating disease outbreaks continued to create anxious moments for the farmers.

Farm Front

WSSV outbreaks continued in the major farming areas of the East and West Godavari districts in **Andhra Pradesh**, irrespective of the source hatchery/genetic breed or general quality of seeds. Additionally, running mortality syndrome and white muscle disease also increased as the temperatures increased with the onset of summer. Farmers, on the whole complained of poor quality of seeds being supplied by the vannamei hatcheries. It is reported that in the Kaikaluru and Eluru areas, several big farmers have reverted to farming fish or resorted to polyculture of fish with shrimp. **Madhu Talluri, Technical Director of SGS Aqua Solutions**, Kakinada informs that stocking is generally progressing at a very slow pace as severe white spot disease outbreaks are seen in several areas. Most farmers are still drying their ponds as the situation is highly unfavourable.

Stocking of vannamei was slow during March 2023

Considering the difficulties in vannamei farming, several farmers have turned their interest in SPF monodon farming, with farmers leasing out sites suitable for monodon farming. Farmers who have already stocked SPF monodon seeds during January-February have achieved 14 - 15 gm in 60 days in their farms. Monodon farmers expect a decent price for this species this year as they feel that exporters have been able to obtain orders for monodon. In Nellore and Gudur areas, farming is underway in less than 30 percent of the farms and most of the ponds are vacant, while several hatcheries in this area are also under temporary shutdown. The multiplier hatcheries supplying CIFA GI Scampi seeds have been widely promoting Scampi culture in low saline areas. Some farmers also inform that GI scampi is giving better growth and survival.

Hardly 25 - 30 percent of the farms have been stocked in **West Bengal** until the end of March 2023. The growth in the ponds that have already been stocked is reported to be slow with animals reaching a size of 2 - 3 grams only at 30 DOC. Several farms have been affected by the new virulent variant of WSSV which is locally termed as the "Red Virus" by the farmers. While WSSV was earlier dominant during winter and monsoon seasons, it is presently affecting during warmer periods as well. Several farms have also been affected with White Faeces disease as well as EHP, probably because of the very high stocking densities at which farming is done in the state this year. Inspite of the tough conditions being faced by farmers, lease amount for shrimp farms continues to be high at Rs. 1-1.25 lakhs/ acre. Similar conditions prevail in the state of **Odisha** as well, but stocking densities are comparatively lesser than in West Bengal, with farmers aiming to achieve production of bigger sized shrimp.

In **Tamil Nadu**, most of the farms are under preparation for stocking, while others have commenced filling water into the ponds. Though it is expected that maximum stocking would happen during the month of April, hardly 30 - 35 percent of the farms are preparing for stocking. Most of the farmers across the state prefer to watch the trends in the shrimp market closely, before taking a decision on stocking. Unseasonal rains have also disturbed pond preparation, delaying stocking in some areas. Overall, farmers in the state are not very keen to stock as many of them suffered losses in the previous crop inspite of achieving fairly decent production.

White faeces disease was very common as water temperatures rose

Several farmers are seriously considering shifting to monodon farming this year

Vannamei seed sales were very slow during the month

Saji Chacko, CEO of Onaway Group, Gujarat informed that stocking is progressing only at a very slow pace in the state as WSSV outbreaks are being reported from several farming areas. Like last year, a large chunk of farmers would continue to stock monodon inspite of facing severe market issues last year.

Hatchery Front

March 2023 was a tough month for hatcheries as vannamei seed sales were very slow and prices were low as well according to **Madhusudhan Reddy, Director, Saranya group**, Andhra Pradesh. Only West Bengal, Odisha and Andhra Pradesh witnessed moderate stocking of ponds during the month. Madhu felt that farmers were low on confidence after repeated setbacks one after the other both due to disease as well as price challenges. The Aquatic Quarantine Facility for *L. vannamei* which is most often fully booked for space during the first quarter, is fairly free this year when compared to the previous years. Broodstock imports have come down as hatchery operators fear that seed market would be less this year. Production drop in one of the SPF monodon hatcheries during March resulted in a much lower stocking of this species. A maximum number of farms in Andhra Pradesh generally prefer to stock monodon during march when temperatures are fairly good at above 27 - 28°C.

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Dosage: 20 Ml / per Kg of feed once in a meal per day
Or as directed by Aqua Consultant.

Storage: Store in cool, well-ventilated area & away from direct sun light.

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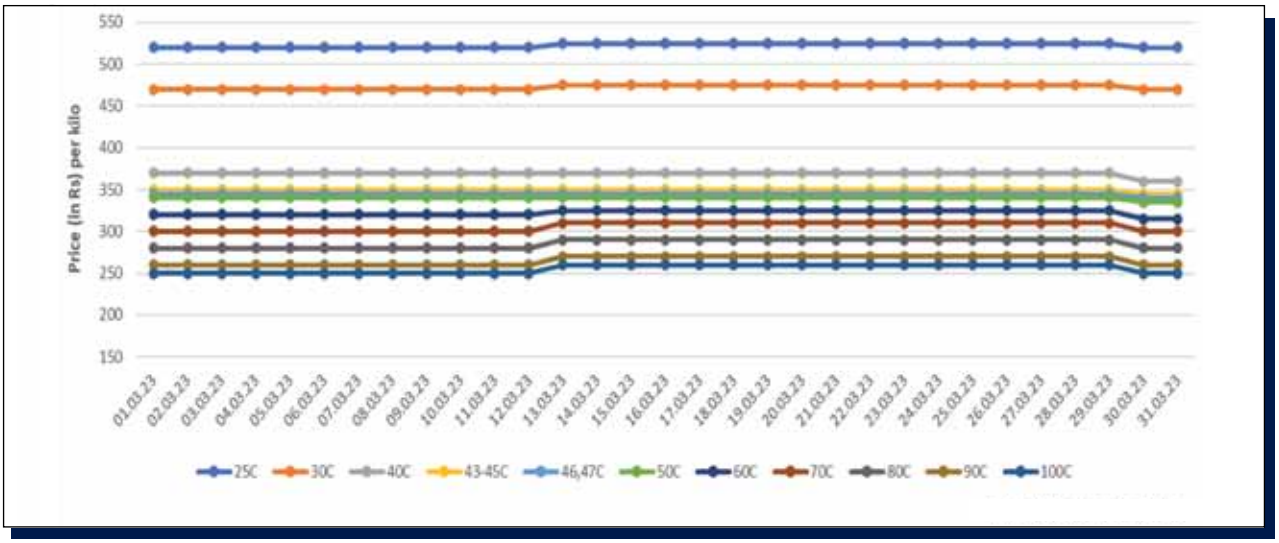
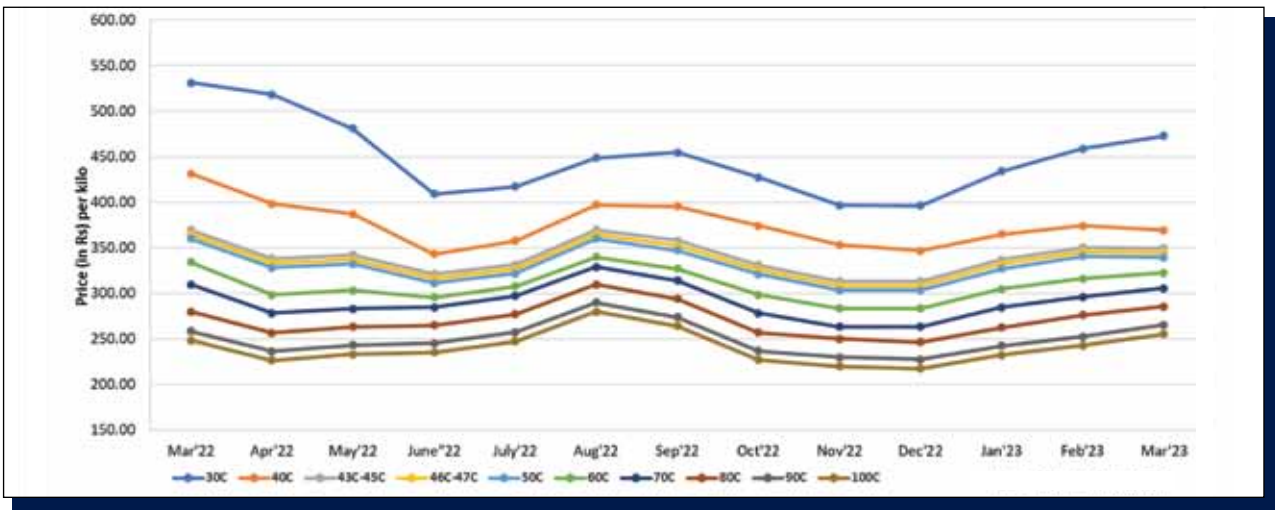
AQUA BRAHMA SHRIMP PRICES

Daily trend in *P. vannamei* prices (March 2023) in Andhra Pradesh



● **Where C denotes count/ kilo**

Fluctuation in price (monthly mean values) of *P. vannamei* for a period of 1 year (March 2022 to March 2023)



● **Where C denotes count/ kilo**

● Vannamei prices registered a marginal increase in the month of March 2023 as well following similar increment in January and February as well. Material availability was low in the market mainly because seed stocking was very slow in the preceding months. Premature harvests because of WSSV, EHP and RMS also caused reduction in harvest volumes.

● During March 2023, the monthly mean prices of all counts registered an increase over February 2023 prices by Rs. 15/Kg for 100 and 90 counts and by Rs. 10/Kg for 80, 70, 60 and 30C shrimp. While the monthly mean price of 50C shrimp in March was the same as that in February, it declined by Rs. 5/Kg for 40C vannamei. Within March 2023, the prices remained the same for 100 - 70C shrimp and declined marginally (by Rs. 5/Kg) for the rest of the counts. However, when compared to March 2022 prices, the prices this year were lower by a margin of Rs. 60/Kg for 30 and 40C, and by Rs. 20, Rs. 10 and Rs. 5 for 50, 60 and 70C respectively. For 80 to 100C shrimp, the prices in 2023 were higher than March 2022 prices by Rs. 5/Kg .

● Seed stocking was marginally higher in March 2023, but much lower when compared to stocking during March in the previous years. Continued WSSV outbreaks, disease situation, increased production costs and financial limitations continued to be the main reasons for slow stocking.

SAP ORGANIZES "FISH INDIA 2023" AT VIJAYAWADA

The inaugural edition of "Fish India", a biennial conference exclusively for finfish aquaculture - "Fish India 2023", with the theme "Scaling new heights in fish farming" was organized by the Society of Aquaculture Professionals (SAP) at the Taj Vivanta, Vijayawada on the 25th February 2023. Madhusudan Reddy, Vice President (Events), SAP welcomed the gathering while Arul Victor Suresh, President SAP gave a brief introduction on the Fish India programme, how it was visualized and its objectives. The programme had four technical sessions followed by panel discussions.

The session on **Carps** was moderated by B. Rambabu, General Manager - Sales & Marketing (South India), Growel Feeds and had eminent speakers - Dr. Haribabu Punati, Head - Technical, Nexgen Feeds and Dr. Pramoda K. Sahoo, Director, Central Institute of Freshwater Aquaculture speaking on various aspects of Carp farming in India. V. Ramachandra Raju, President, DFWA & SIFA moderated the session on **Pangasius**, where S. Chandrasekar, Head Aquaculture Utilization South Asia, USSEC and Pinaki Biswas, Technical Lead (Aqua), Godrej Agrovet Ltd. provided detailed accounts of Pangasius production systems abroad and in India.

Dr. D. Vijay Anand, Treasurer, SAP moderated the next session on **Tilapia** which had Naga Murali, Managing Director, Mansvi Fisheries Pvt. Ltd and Dr Dominique Bureau, Professor, University of Guelph as speakers. Dr. S. Kandan, Director, Rajiv Gandhi Center for Aquaculture, Dr. R. Jayakumar, Principal Scientist, Central Institute of Brackishwater Aquaculture and Anil Ghanekar, Ecosecure Systems, Consultant, Zash Farms, Goa made presentations in the session on **Asian Seabass** moderated by Jaideep Kumar, Editor, Aquaculture Outlook.

Panel discussions on "**Other Species**" was moderated by S. Santhanakrishnan, Founder President, SAP and panelists included Narasimha Rao (Naveen) Tatavarthy, Managing Director, Uno Feeds, Jaideep Kumar, Editor, Aquaculture Outlook, Sandip Ahirrao, Vice President of Sales, Growel Feeds and Dr. R. Jayakumar, Principal Scientist, Central Institute of Brackishwater Aquaculture.

Panel discussions on "**Markets**" was moderated by Dr. G. Ramesh, General Secretary, SAP and the panelists included P.S. Narendra, Executive Director, Growel Feeds, Dr. Edward Danish, Chief R&D Officer, Fresh to Home, Murali Anand Varma Uddaraju, Director, Ananda Enterprise (India) Pvt. Ltd. and Manoj Sonkar, Managing Director, Arnav International.

Ornamental fish - Discus

KERALA'S ORNAMENTAL FISH SECTOR REVIVES AFTER COVID-19 LOSSES

Over 500 start-up units in the ornamental fish sector in Kerala are on a course of revival after they suffered a heavy loss during the COVID-19 pandemic, thanks to efforts of the Kerala Aqua Ventures International Limited (KAVIL), a government of Kerala undertaking. Through a slew of initiatives such as buyer-seller meets, start-up training and effective marketing strategies, the body under the Department of Fisheries supported hundreds of families to sustain their livelihood and improve their income. The buyer-seller meet, in particular, played a major role in streamlining the market avenues and connecting wholesale traders in the sector from across the country to the ornamental fish farmers in the state.

Business worth Rs. 72 lakhs from Buyer-Seller Meet

The meets, being conducted every Monday in a week, yielded good results with potential buyers in the field turning up to buy the fish from the farmers associated with the KAVIL. "Within the past two years, the event has generated a business worth around Rs. 72 lakhs", said M. S. Saju, Managing Director of KAVIL and Joint Director of the Department of Fisheries. Each session of the event in a week from 9 am to 12 pm witnesses a business of up to Rs. 2 lakhs, turning the ornamental fisheries into a lucrative source of income for farmers, he said.

Aims Rs. 5 crores annually by 2025

"The buyer-seller meet has become a game-changer in the sector as the platform is becoming increasingly popular among farmers and traders, witnessing increased dealings in recent months. We are taking measures to attract wholesale giants in the industry into KAVIL, aiming to do a business of Rs. five crores annually by 2025 through this platform and make the state a hub of ornamental fisheries in the country", Saju said. Additionally, it launched a newly-designed website (www.kavil.in) with an e-commerce facility to further boost the sales of ornamental fishes.

A government nodal agency to improve ornamental fisheries in the state, KAVIL provided intensive training that paved the way for an increased number of start-up units in the sector. These units now produce quality ornamental varieties and reach targeted consumers with the body playing the role of a facilitator, ensuring a reasonable price to the farmers by avoiding middlemen.

A view of the buyer-seller meet that connects wholesale traders in the sector from across the country to the ornamental fish farmers in the state

Ornamentals from Kerala are known for good quality and health and varieties such as koi carp, oscar, angelfish, cichlid, tetra and morphs in varied colours are the most demanding fishes produced by the farmers.

Large-scale production

Dr. Mini Sekharan, the Marketing Consultant of KAVIL and Associate Professor in School of Industrial Fisheries, Cochin University of Science and Technology (CUSAT) said: "The lack of large-scale production for consistent supply to domestic and international markets and proper marketing strategies hindered the growth of a highly prospective industry in Kerala in the past. India is a country with huge domestic market potential which can be explored well with enhanced production and marketing".

A series of start-up training and advanced training would help the farmers enhance technical skills for large-scale production to respond to the demands, she added. KAVIL will organise an advanced training on the technology of large-scale breeding of market-demanded ornamental fishes on 24 and 25 March. Global experts in the field, Kapila Tissera from Sri Lanka and Sriram Hatwalne from Mumbai will lead the training sessions. (For more details on trainings, contact 8304906412, 9745442656).

About KAVIL

KAVIL, Kerala Aqua Ventures International Limited is a Government of Kerala Undertaking. KAVIL offer a common platform for domestic marketing, export and import of fish. The fish for marketing is sourced from mass farming of good quality ornamental fishes from fish culture units all over Kerala. KAVIL contributes to the income and employment of the ornamental fish farmers and thereby the development of the ornamental fisheries by way of production, distribution and trade of aquarium fishes, aquarium tanks, aquatic plants, fish feed and other accessories.

For further details, contact:
M. S. Saju, Joint Director of Fisheries - 944726145
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SHRIMP EXPORTS TO THE US IN 2022

Inspite of Ecuador breathing hot on its heels, India once again led the world in shrimp exports to the U.S. in 2022 retaining its crown since nine years, but its lead over upstart Ecuador narrowed. India shipped 303,574 metric tons (MT) of shrimp to the U.S. in 2022, down from 2021, when it exported 340,892 MT to the U.S. Following India was Ecuador, which sent 199,813 MT, of shrimp to the U.S. in 2022. Its total was up from the 183,833 MT it sent in 2021. Indonesia sent 166,954 MT or 368 million pounds of shrimp to the U.S. in 2022, up from 160,174 MT it sent in 2021.

Rounding out the top 10 were: Vietnam in fourth place, Thailand in the fifth, Mexico in sixth, Argentina in seventh, China in eighth, Peru in ninth and Canada in the tenth,

Source: Sea Food Source

RESEARCHERS USE MACHINE LEARNING TO PREDICT SHRIMP PRICES

To predict the export price trends for Vietnamese shrimp, researchers from Can Tho University (Vietnam) and Hokkaido University (Japan) have used machine learning, based on information from the world's top shrimp exporting countries. The researchers used the databases of the US Department of Agriculture (USDA), the Food and Agriculture Organization of the United Nations (FAO), and the World Trade Organization (WTO), in the period from May 1995 to May 2019. The seven leading exporters of frozen shrimp products for the US market – China, Thailand, India, Indonesia, Ecuador, Chile and Vietnam – were included in the database.

A technique known as "super learner", which combines 10 simple algorithms, was used to make the predictions in selected base periods (3, 6, 9, and 12 months). The prediction was interpreted by using the SHapley Additive exPlanations (SHAP) method to determine how each predictor influences the export price and then suggest solutions to develop the Vietnamese shrimp industry. The researchers found that the super learner returned results across all base periods that were more approximate and stable than any other candidate algorithm. According to the study, Vietnam is likely to get better prices for its shrimp products if it fully implements shrimp export safety certificates, which can give it a competitive advantage over other producing countries in the international market.

Source: Fish site

US TAKES OFF IN COMMERCIAL SHRIMP FARMING

The shrimp farming in the United States is making strides commercially with new shrimp farming projects of all shapes and sizes cropping up across the country after a long fallow period. Small as well as large recirculating aquaculture systems (RAS) have emerged in California and Florida, while traditional pond aquaculture is seen in Texas. Urban shrimp farming in shrimpbox developed in 2022 by Atarrayai, a start-up tech company based in Mexico City, Mexico is also emerging.

Shrimpbox that is making waves is essentially a shipping container converted into a small commercial shrimp farm. It requires minimal water exchange and contains an automated feeding system and biofloc waste-removal system, minimizing the work involved in farming shrimp in the unit while eliminating the need for using antibiotics and chemicals. It also relies on artificial intelligence that can remotely monitor water quality and regulate water temperature and oxygenation. Homegrown Shrimp of Charoen Pokphand Foods (CP Foods) operates a hatchery and farm capable of producing up to 720 metric tons of the species annually. A 1,880-acre shrimp farm located in Rio Hondo, Texas, shuttered for more than a decade is going to be rehabilitated and reactivated from its current set-up as a shrimp genetics research facility into a commercially- productive farm.

Source: Seafood Source

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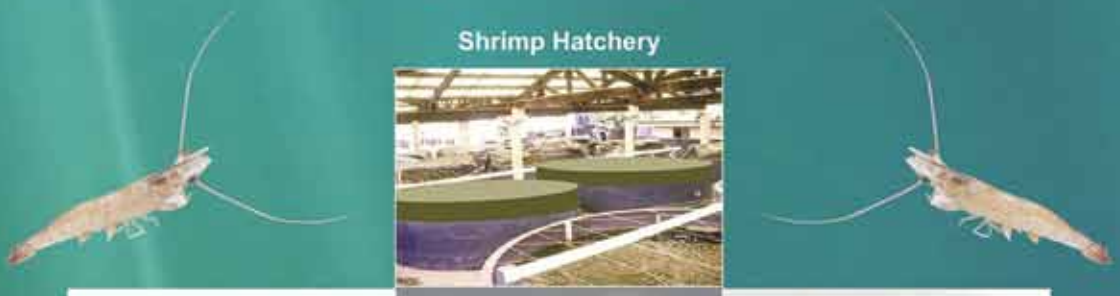

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GLOBAL SHRIMP FORUM 2023 TO BE HELD IN UTRECHT FROM 5TH TO 7TH SEPTEMBER 2023

After a hugely successful debut, the Global Shrimp Forum is back and this year it is even bigger and better. Once again it will take place in Utrecht, the Netherlands, from 5th to 7th September 2023. The event is already proving enormously popular, with 80% of tickets already sold. A limited number of places are still available.

More than 100 speakers and panelists have been confirmed and this year, to set the scene, the Forum will open with a leadership panel, including President of Cargill Aqua Nutrition, Helene Ziv-Douki, General Manager of Omarsa, Sandro Coglitore and Chairman of Devi Fisheries, Rajagopal Choudary Chitturi.

There is a star line-up for the breakout sessions featuring industry leaders such as, General Manager of Skretting Ecuador, Carlos Miranda, CEO of Marinasol, Roberto Ferron, Shrimp Buyers Maruha Nichiro and Hidetami Haruta, and Managing Director of MU Seafood, Shyamal Das.

The subjects for this year's sessions will be:

- Trade Statistics: The Latest Import and Export Trends
- Feed Manufacturing and Feed Ingredients
- Production: Strategies to Sustain Shrimp Production in Challenging Times
- Finance and Investment: CEO Visions and Investor Reflections
- Animal Welfare and Decarbonization
- Technology and Innovation
- Retail and Consumption

This year the conference organizers, the Global Shrimp Forum Foundation (GSFF), are also funding a study to inspire discussion about how to promote global shrimp consumption. The preliminary results of the research will be presented and debated as part of the meeting. During an invite only lunch, the world's top producers will also discuss the status of establishing a global shrimp council.

Established by the Aquaculture Stewardship Council, Shrimp Insights and Contango, the Global Shrimp Forum Foundation is an independent, non-profit and mission-oriented organization based in Utrecht, the Netherlands. The Global Shrimp Forum (GSF) is the place where industry leaders come together to discuss the most pressing issues their businesses face and to develop a vision on the long-term strategy towards a resilient and sustainable industry. The GSF aims to facilitate dialogue and encourage collaboration. The inaugural GSF in 2022 attracted more than 430 people, representing over 225 companies and 33 countries, to hear keynote speeches and take part in breakout sessions.

As a non-profit foundation the GSF uses any financial surplus generated from the annual meeting of the Global Shrimp Forum, to contribute financially to projects aligned with the GSFF's mission. These projects will initially focus on mangrove conservation, aquaculture improvement and pre-competitive research.

This year, the GSFF board is using the financial surplus, to support a mangrove conservation project in Indonesia and a study to define how global shrimp consumption can be promoted effectively. The results of this study will be presented during the second annual Global Shrimp Forum in Utrecht, the Netherlands, from 5-7 September 2023.

FORM IV

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I, Jaideep Kumar, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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UPCOMING AQUACULTURE EVENTS

153rd Annual Meeting of the American Fisheries Society
Date: 20 Aug - 24 Aug 2023
Location: DeVos Place Convention Center, Grand Rapids, MI

Aqua Nor
Date: 22 Aug - 25 Aug 2023
Location: Trondheim Spektrum, Trondheim, Norway

Global Shrimp Forum 2023
Date: 05 Sep - 07 Sep 2023
Location: Van der Valk Hotel Utrecht, Utrech, Netherlands

Cold Harvest 2023
Date: 05 Sep - 07 Sep 2023
Location: St. John's, Newfoundland and Labrador, Canada

21st International Conference on Diseases of Fish and Shellfish
Date: 11 Sep - 14 Sep 2023
Location: Aberdeen, UK

"Balanced Diversity In Aquaculture Development"
Date: 18 - 21 September 2023
Location: Vienna, Austria.

Responsible Seafood Summit
Date: 02 - 05 Oct 2023
Location: Saint John, New Brunswick, Canada

1st International Symposium on Sustainable Aquatic Research
Date: 24 - 27 Oct 2023
Location: Izmir - TURKIYE

Aquaculture Africa 2023
Date: 13 – 16 November 2023
Location: Lusaka, Zambia.

Acres USA's 2023 Eco-Ag Conference & Trade Show
Date: 4 – 7December 2023
Location: 1 W Rivercenter Blvd, Covington, KY 41011

Aquaculture America 2024
Date: 18 – 21 February 2024
Location: San Antonio, Texas

116th Annual Meeting. National Shellfisheries Association
Date: 17 – 21 March 2024
Location: Charlotte, North Carolina

Aquaculture UK
Date: 14 – 15 May 2024
Location: Aviemore, Scotland

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