

# AQUAFOCUS

Vol. 1 / Issue 1 / March 2023 / ENGLISH QUARTERLY / CHENNAI

**POSTBIOTICS AQUACULTURE**

**AQUACULTURE FOR  
SUSTAINABLE DEVELOPMENT**

**CRESCO ALGAE FORT**

**NANOVACCINE FOR  
TILAPIA**

**AQUACULTURE EVENTS**

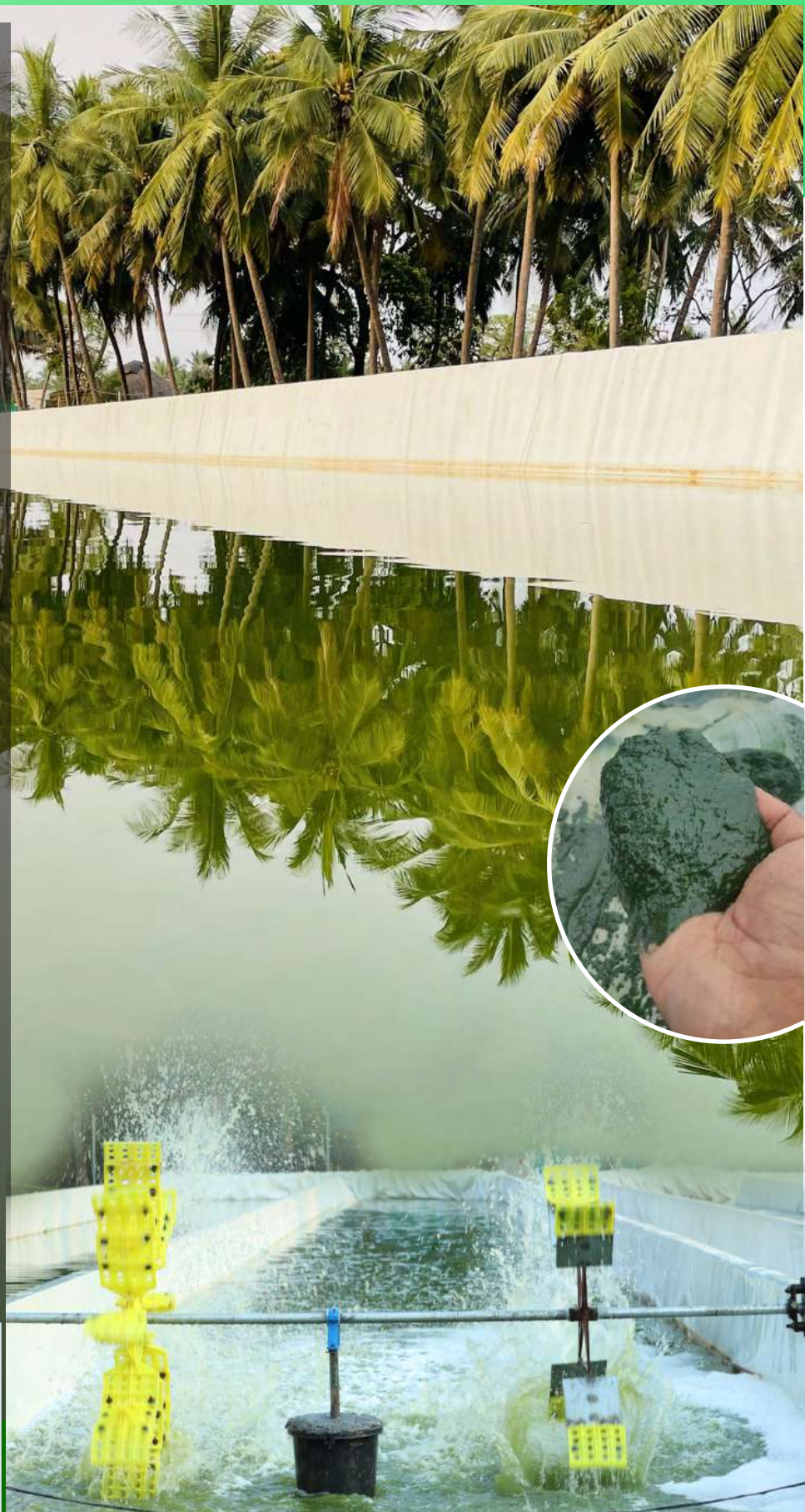
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# AQUAFOCUS

Dedicated to

## Aquaculture Research & Development

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# EDITORIAL



Greetings !

*"Give a man a fish and you feed him for a day.  
Teach him how to fish and you feed him for a lifetime!"*

- An Old Wisdom Proverb

**Dr. Jesu Arockiaraj, Highly Acclaimed Eminent Scientist with Stanford University World Ranking in Top 2%.  
Received Young Scientist Award by Government of India and Government of Tamilnadu.**

In consonance with and to uphold this scintillating old adage and brilliant Chinese Proverb, a New Species was recently born in the vast ocean of aquaculture operations – "FAITT".

Having 6 scintillating jewels in its Crown, FAITT aims to proactively foster Innovative Research and development and impart professional training to artisans and all interested stakeholders in the aquaculture industry. In juxtaposition with this, it will help spread awareness and enrich cognizance on the various facets of aquaculture through workshops, seminars, publications, Special Events, etc.

In this nascent issue, FAITT brings you well-curated, discerning and insightful articles in the Aquaculture trade and operations, by eminent academics and research scientists.

India has a well established Aquaculture industry over many decades and a robust seafood export market. Aquaculture Produce is one of the scintillating stars in Indian food exports! The Aquaculture industry is progressing well in India despite the pandemic situation. As per reports, Tamil nadu seafood exports fared pretty well, earning \$758 million in exports between April 2021 and November 2021, nearly 80% of the \$973 million export target set for 2021-22 by the Centre.

A lot of Investments are also pouring into this vibrant sector! US Aquaculture firm, The Fishin' Company is slated to invest about Rs. 1,000 crores in Telangana.

Tamil Nadu is also on the upswing. Tamil Nadu alone contributes to 15% of total national seafood with Shrimps being the main export item. Seafood exports have been identified as one of the 'champion' sectors for boosting exports and helping the state achieve its \$1 trillion economy target by 2030. This is aided by active encouragement of the current Tamilnadu Chief Minister and his proactive Government officials. In October 2021, the Chief Minister inaugurated "Institute of Paraprofessional Aquaculture Technology" at Muttukadu near ECR, Chennai. This will help to train skilled artisans for the aquaculture industry with 3 Year degree and diploma programs. He also inaugurated a project on freshwater ornamental fish breeding in Trichy.



# EDITORIAL

Also, as per reports and Industry experts, seafood exports from Tamil Nadu can touch Rs.15,000 crores and more in the next five years, thus offering a huge potential to scale up the aquaculture industry .

Sustainable aquaculture is a cardinal aspect to promotion of aquaculture industry in India. We need to set up innovative mechanisms and creative processes for breeding of fishes, shrimps, Algae – Spirulina, etc. Sustainable aquaculture processes help improve both quality and quantity of the farm produce along with positive environmental impacts, social community development and boosts economic growth, thus ensuring long-term benefits to all stakeholders.

In juxtaposition with this, disease management is a key aspect and of cardinal importance in Aquaculture Also one needs to be on guard against certain indigenous challenges , especially natural and man-made bottlenecks. For instance, African catfish, a banned species, introduced into some Indian states from Bangladesh for aquaculture purposes in the early 1990s is spreading rapidly in Tamilnadu and some other states. During heavy rains induced floods, these fishes escape into the ponds and get into the rivers and lakes and marshlands and breed very quickly. Being a predatory and an invasive species, they pose a potential threat to other aquaculture farmers.

Also, a recent virus outbreak, including white spot syndrome virus in thousands of hectares of aquaculture farms in many parts of the world, is of major concern to the shrimp farming sector.

On the other front, a lot of farms are being converted gradually to aquaculture in small towns and villages, This being a good sign and versatile strategy for aquaculture industry growth, it also pays to consider the UN – FAO EAA strategy of ‘Ecosystem Approach in Aquaculture’, wherein the farms are first assessed for their overall operational capacities and if the aquaculture process can be carried without any kind adverse influence on surrounding Ecosystem and Biodiversity aspects.

Finally, it is great time to look forward to a host of opportunities and advancements in this scintillating year 2022 – a UN designated “International Year of Artisanal Fisheries and Aquaculture”! The use of technological initiatives like Internet of Things (IoT) platforms and digital data analytics in aquaculture ponds will leapfrog the industry to greater heights in the years ahead!

Time to begin to change the future of Aquaculture now!

Regards,

**Jesu Arockia Raj A**

Editor-in-Chief,  
AQUAFOCUS



### CRESCO Objectives

CRESCO aims to cultivate and produce huge quantitative of Algae for Aquaculture Industry for use as Feed and Nutrition agent. It aims for Mass production of Spirulina and value added products with an initial Target of 1 Ton per month. Gradually it aims to develop large scale Algae ponds and be one of the largest producer of Spirulina – both for domestic consumption and also for International exports.

### CRESCO and MICROALGAE Production

Cresco aims to produce large quantities of Algae and Microalgae. This would encompass production of economically important algal species like *Spirulina sp.*, *Chlorella sp.*, *Dunaliella sp.*, *Hematococcus sp.*, *Nanochloropsis sp.*, *Diatoms*, etc. These are highly useful in the Aquaculture industry as Fish Nutrition.



### CRESCO ALGAE FORT

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# NANOVACCINE FOR TILV IN TILAPIA NEW HOPE TO BOON THE TILAPIA AQUACULTURE

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Aquaculture continues to be the fastest growing food production sector in the world. Fishery related activities are gaining profound significance in providing food, nutrition and socio-economic development for many countries. Asia has a production of 89% of the global total production of fish in volume terms in last 20 years (FAO 2020). Aquaculture is being promoted with various aims like empowering women and young people towards their employment, notably by facilitating women's decision-making on the consumption and provision of nutritious food (FAO, 2017).

However, intensification of aquaculture activities creates issues with environmental sustainability, drainage of wild fish stocks and increased risk of disease outbreaks. Improving fish health management with advanced diagnostic tools and introducing appropriate strategies for sustainable, long-term food production and economic growth is important for fish farming, tilapia farming in India and the global aquaculture.

Tilapia (*Oreochromis* sp.) (Fig 1) provides essential revenue for many low-income families, and is a major trade commodity for many low to middle-income countries (LMIC). Even though tilapia are less prone to infectious diseases compared to other farmed fish species and exhibit good tolerance to the stressful growth conditions, intensification of tilapia aquaculture (Fig 2) has led to the emergence of infectious disease outbreaks. These are proving a major constraint for the sustainable productive expansion of tilapia aquaculture industry.

The disease outbreaks are characterized by significant mortality and morbidity, resulting in massive losses to tilapia industry and a global threat to food security and global economy. We have seen fruitful years of using antibiotics and management practices to combat the onset of diseases. To treat the diseases Vaccination is a proven method for controlling bacterial and viral diseases in aquaculture, with most vaccines delivered by intraperitoneal (IP) injection. Many tilapia farmers will not prefer to vaccinate by injection once the fish have been moved onto the farm and prefer to vaccinate fish in the hatchery. Owing to the technical difficulties in handling fishes during the injection of vaccines, alternative vaccine delivery methods, such as oral or immersion delivery, are therefore needed. Also, injection mode of vaccination will be a difficult task for the common farmers. Tilapia provides essential revenue for many low-income families in Kerala. Pathogenic infections in tilapia aquaculture is responsible for the disease outbreaks seen in tilapia farms, which have significant impacts on the livelihoods of fish farmers and food security in India. Intensification of tilapia farming has promoted severe disease outbreaks, resulting in high mortalities and economic hardship for tilapia farmers. Protecting the industry from emerging infectious threats is of considerable economic and social importance by supporting fish farmers to help control disease spread and to allow sustainable expansion of tilapia aquaculture industry in India.



Tilapia Lake Virus (TiLV), a highly virulent and contagious novel orthomyxo-like virus has recently been associated with disease outbreaks in tilapia aquaculture, resulting in massive mortalities in both wild and cultured tilapines. First reported in Israel in late 2009, TiLV-related disease outbreaks have now been reported across Asia, Africa, and North and South America. In Indian tilapia aquaculture, the virus is associated with mortality levels around 80–90%. The disease has now been identified across 16 countries globally (Surachetpong, 2020). Since TiLV disease is highly pervasive and hence reflects the possibility of being extremely transboundary, we can expect more reports from other geographical regions other than enlisted. This may be largely due to the lack of specific diagnostic tests or less attention towards the mortality occurring in Tilapia industry.

The fast spread of TiLV causing high mortalities demands the urgent requirement of vaccine. There has been some studies which have come up with different mode of vaccination strategies but nothing has been commercialized yet.

Nowadays, nanoparticles are in being used for more efficient way of controlling diseases and TiLV is ahead with nanovaccine to protect. As global aquaculture is enmeshed with the spread of TiLV the findings should not be constricted in the laboratories but to reach the layman for their safety of living is more important. Hence, a cost effective and easily administered vaccine should be available for preventing the disease spread, and to maintain a healthy Tilapia aquaculture.



FIG. 1 TILAPIA  
(ORECHROMIS SP)



FIG. 2 (TYPICAL; TILAPIA FARM IN KERALA)



# AQUACULTURE FOR SUSTAINABLE DEVELOPMENT

BASED ON UN SDG (SUSTAINABLE DEVELOPMENT GOALS) 2030

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## UN SDGs - Sustainable Development Goals

Aquaculture, globally is a dynamic and high growth industry with well established traditional practices. Its genesis dates back to almost 8,000 years in China, and involves water based cultivation – breeding, raising, and harvesting fish, shrimps, etc., including certain specific nutrient-rich marine aquatic plants, seaweeds and specialized algae like spirulina.

Traditional knowledge and systems rely on well-established belief patterns and knowledge. Aquaculture Industry traditionally relies on pond based breeding of fish & other aquatic species for human benefits.

But, in the 21st Century, full of innovations, a whole gamut of amelioration and improvements call for asking questions like ‘What if?’ and ‘Why not?’ and “How to do it better ?” etc. Also, the operations must be aligned progressively to the excellent

UN SDGs – Sustainable Development Goals, which are a call for action by all countries in various spheres, to promote prosperity and human welfare and simultaneously protecting the planet.

In order to align and achieve the SDGs, it is imperative to continually improve the operations, processes, yield and benefits and cognize

the cardinal aspects affected by aquaculture operations and the effects thereof.

## SUSTAINABLE ECONOMIC EFFECTS

Aquaculture industry employs arrange of artisanal workers across the value chain – locally, nationally and internationally, from breeding, processing, storage and shipment or exports or retail, etc. It thus provides both macro-economic and micro-economic benefits to a wide spectrum of staff involved in the aquaculture process and thus increases the number of possible jobs in the market. It provides both new versatile food products for a market and creates ample job opportunities as labor is required to maintain the ponds, production, processing, etc.

Sustainable aquaculture would require sustainable economic practices. This would entail the use of human and material resources to create long-term sustainable values by optimal use, reduce wastage and adopt measures for re-use and recycling of resources.

It would also entail ameliorations in the innovative uses of storage, packaging, transportation, etc. to reduce the overall carbon footprint and safeguard against climate change. As a paradigm, energy efficient electric vehicles with zero carbon footprint can be used for local transportation needs and warehousing of produce etc. Another paradigm is the use of reusable plastic packaging.

Aquaculture would thus be a robust and viable business proposition for small and marginal farmers even in the rural segments, with good long term prospects via efficient aquaculture health management and disease control and improving the net yield and profits, thus ensuring sustainable aquaculture economics in the long term.

Thus, these sustainable practices in aquaculture operations contribute to UN Sustainability goals – UN SDG 2 (Sustainable Development Goal 2 – Zero Hunger), and UN SDG 8 (Sustainable Development Goal 8– Promote Sustained, Inclusive and Sustainable Economic growth), as part of the UN 2030 Agenda for Global Sustainable Development!

Apart from the main Economic benefits of the Sustainable Aquaculture operations, one must also focus on its

- ★ Sustainable Environmental Effects
- ★ Sustainable Social Effects
- ★ Sustainable Health and Safety effects.

### **SUSTAINABLE ENVIRONMENTAL EFFECTS**

Aquaculture by itself helps in positive Environmental Sustainability results, in that it causes humans to depend less on the Oceans for food and thus save the Oceans and rivers from destruction on a long-term.

Aquaculture operations indubitably leave a large environmental footprint. As a Paradigm, a large volume of water from a captive source is cardinal aspect for breeding Fish and other Aquatic species. And high density of Fish produce lot of bio-waste, and such waste can contaminate the water . They can even potentially deplete the Oxygen content in water and produce algal blooms in the ponds.

Additionally, Aquaculture Farmers use a range of antibiotics to control this, which further causes exacerbation in effluent build-up and thus contributes to Environmental hazard around ponds and surrounding land, during Rains, floods and surface run-offs.

Sustainable Environmental practices in Aquaculture would entail risk mitigation of environmental hazard and disruptions to the ecosystem,. It would also entail preservation of biodiversity and avoidance of significant level of pollution impact.

As a simple paradigm, we can use Modern Technology for this purpose. Android Apps developed to plan, manage & control their Aquaculture Operations. These can also be specially designed and used to provide Weather and Market information on a variety of specific parameters. Bio-Sensors based on IoT (Internet of Things ) and AI (Artificial Intelligence ) are now available , which can be used very effectively in ponds for Data capture , analyses and monitoring .The Data Analytics from such devices on Hand held digital Devices, Laptops and Mobile Apps , would help in implementing Just-in-time remedial measures and adjustments to monitor and improve any adverse Pond situations like Water

Alkalinity/ Acidity ,Temperature, bio-oxygen levels, etc, to maintain a Positive Environment and Healthy and Safe eco- system in the Fish Pond.

Another innovative paradigm, one innovative way to solve water pollution in ponds , is to breed SHELLFISH, alongside other Finfishes . This is known as POLYCULTURE, or Integrated Multi-Trophic Aquaculture (IMTA). The shellfishes are known to easily survive by sponging off on uneaten fish feed, excess nutrients in water and even fish waste . Thus effluent buildup in water is minimized resulting in Environmental sustainability.

Another innovation is that Fish ponds can be built on robust concrete stilts to safeguard against Pond ecological disturbances during Heavy rains, floods , etc

Additionally, there can be innovative mechanisms like Reduce , Recycle and reuse of waste water, using optimum water flow and good ambient water quality maintenance by e-sensors, establishing mini-water treatment plants near the ponds,, managing the effluents and controlling water quality also contribute to sustainable practice

Thus, these Sustainable practices in Aquaculture operations contribute to UN Sustainability goals – UN SDG 6 (Ensure availability and sustainable management of water for all), UN SDG 7 (Affordable and Clean Energy), UN SDG 13 (Affirmative Climate Action), and UN SDG 14 (Life below Water), as part of the UN 2030 Agenda for Global Sustainable Development !

### **SUSTAINABLE SOCIAL EFFECTS**

Aquaculture is considered as one of the best ways to help feed billions of people in the future society. Hence, Aquaculture operations must be socially responsible and contribute to the overall well-being of society and growth and enhancement of the happiness of Local community

Seafood cultivation and production aspects make significant social and economic contributions in coastal and rural communities, where economic opportunities can be limited, and helps provide means of sustenance and contributes to poverty alleviation.

As a paradigm, aquaculture operations must be aimed to produce high protein food. The production of spirulina algae is an excellent way to increase long-term sustainability, as it has immense benefits and potential for both animal nutrition and human nutrition.



This results in an affirmative and positive impact on the nutrition and health development aspects of local populations, especially in the developing nations worldwide.

Also Training of Local unemployed and Rural youth can be initiated to bring them to artisanal level of competence . For this purpose , many modern technical aids can be employed.

As a paradigm, Digital Courseware including Mobile Courseware can be developed to Train and educate and ameliorate the cognizance of Frontline workers and technicians and Supervisors in the Farms and Ponds . Interesting and interactive content related to Aquaculture Best Practices and Safe practices in Fish Health & Nutrition, etc can be produced . Assessment by the Trainers can be undertaken via simple Quizzes that can be incorporated to help keep track of the learning curve and motivate the Learners , along with suitable rewards.

Interactive web applications based on Videos with an easy-to-navigate interface will help low-literate Aquaculture farmers and local artisans and workers on any device.

Also effective community involvement via Information dissemination, periodic Publications, news alerts ,in juxtaposition with ensuring the artisanal workers safety aspects , ensuring fair labor practices along with practices of equitable compensation, would ensure good Social Sustainability.

Also, social involvement of various stakeholders via Aquaculture Groups, clubs and Community hubs can be initiated, systematically organized and evolved over time. in juxtaposition with developing and expanding international cooperation and capacity-building support programs.

All these aforesaid aspects can greatly help in creating jobs, training artisans, youth, entrepreneurs, etc for the job requirements and also re- skilling and up-skilling them in modern Aquaculture sustainable processes.

Thus, these Sustainable practices in Aquaculture operations contribute to UN 2030 Sustainability goals - UN SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment),

UN SDG 11 (Sustainable Communities), UN SDG 12 (Responsible Consumption and Production), and UN SDG 17 (Partnerships for the Goals), as part of the UN 2030 Agenda for Global Sustainable Development !

### **SUSTAINABLE HEALTH AND SAFETY EFFECTS**

Aquaculture operations produce products which have a great deal of trade value as food commodities in markets – both Nationally and globally. Hence the Quality, Health and Safety aspects of the Food produce is of cardinal importance. Equally important is the sustainability of the Fishes in the pond ecosystem, Thus, Fish Survivability, Feed efficiency, and Product yield is a major aspect which requires adoption of sustainable breeding and management practices.

As a paradigm, Prebiotics and Postbiotics are innovation in improving Fish health, disease prevention measures and enhancement of fish immunity to diseases. This will also greatly help in Aquaculture Health Management and disease control and thereby improving the Net yield and Profits, thus ensuring Safe and Healthy and Sustainable Aquaculture in the long term.

Technology aids like Bio-sensors can monitor ambient temperature of water, pH levels etc to protect Fish Health and Safety aspects.

Thus, these Sustainable practices in Aquaculture operations contribute to UN 2030 Sustainability goals - UN SDG 9 (Industry, Innovation and Infrastructure), UN SDG 11 (Sustainable Communities), UN SDG 14 (Caring for Life Below Water),and UN SDG 17 (Partnerships for the Goals), as part of the UN 2030 Agenda for Global Sustainable Development !

In this way Sustainable Aquaculture practices, based on the aforesaid paradigms, in juxtaposition with scientific and innovative applications to Aquaculture Farming processes, will ensure great Prosperity, Environmentally Friendly, Safe and Healthy Ponds , along with its heightened and vastly ameliorated , attendant Social and Economic Benefits – in consonance with UN Sustainability Goals!

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# SCOPE FOR MARINE ORNAMENTAL AQUACULTURE IN INDIA

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Ornamental fish breeding and management and keeping aquariums is a hobby in many industrialized countries now due to its high affordability. It has also become a standard consumer product.

This commercial activity generates very high revenue even though the trading volumes are low. This sector earns good income for the rural communities in the developing countries. The organisms associated with coral reefs play a dynamic role in nourishing the ecological balance of the marine ecosystem, besides increasing the value of aquarium trade and providing livelihood to the coastal and island communities. Marine ornamental aquaculture and aquarium keeping is a flourishing industry in both developed and developing countries. The organisms include fishes and invertebrates (Fig 1 to 6), which are collected from the coral reef habitats throughout the Indo-Pacific, as well as the Redsea and Caribbean regions. Fishes, corals including invertebrates and live-rock contribute to the bulk of the trade in terms of quantity and value. The demand for marine invertebrates such as soft corals, sea anemones, shrimps, crabs and sea lilies are increasing, as a result of the growing interest in keeping home aquaria and technological developments.

The marine ornamentals trade is worth of US\$ 693 million (including import and export) and its value is globally increasing with an average growth rate of 14% per year comprising wholesale and retail business. The tropical coral reef ecosystem spurs the aquarium trade by contributing 46,000,000 organisms representing 25,000 species with an annual trade value of US\$ 300,000,000.

However, very accurate ornamental fish industry data is difficult to obtain, as statistics vary between countries in terms of data collected, format and reliability. To justify this, the Food and Agriculture Organization (FAO) of the United Nations data indicate that, exports were worth approximately USD 330 million in 2011 with approximately 1.5 billion fish per annum, although according to INFOFISH, the figure was USD364.9 million in 2011. FAO data also reveals, the volume of live fish export increased in value from USD 21.5 million in 1976 to USD 315 million in 2007, so it is evident that, the sector is growing.

More than two million people in the world are involved in the ornamental trade as collectors to hobbyists including government agencies, airlines, other associations etc. In general, the trade is dominated by freshwater species; however, the increasing popularity of reef aquaria has become a leading trend, since the late 1980s. Current global trade of the marine ornamental organisms from wild collections reveals ecologically unsustainable practices that require immediate policy interventions. It is estimated that, around 90% of the freshwater fishes are captive raised and remaining 10% are wild caught. However, in marine ornamentals, about 95% are harvested from natural waters, while only 5% are hatchery produced and most belongs to Pomacentridae family. The mortality of tropical organisms prior to reaching the aquarium market (25-80%) are associated to a range of factors, including poor or even destructive collection and husbandry practices, stress and poor shipping add to loss to marine ecosystems. It is difficult to estimate the long-term effects of this wild exploitation from the vulnerable and fragile reef ecosystem, which already faces the serious challenge of climate change, ocean acidification and coral bleaching.

## ICAR – NBFGR INITIATIVES ON CONSERVATION AND LIVELIHOOD PROMOTION

As a measure towards marine biodiversity conservation and promoting livelihood to the coastal and island community of the country, ICAR – National Bureau of Fish Genetic Resources (NBFGR), Lucknow has been taken initiatives and designed concepts to validate a replicable working model for harmonizing biodiversity conservation and promotion of livelihood in Lakshadweep islands. Since, the marine ornamental aquaculture is an impetus to generate employment, livelihood and earning of high foreign exchange; this will be an option to them. Culture of marine ornamental fishes, dissemination of the relevant technologies through trainings, demonstrations and hands on learning will encourage the island community to enter this venture. Running a successful ornamental business unit calls for relatively easier skills, which can be learned within few weeks time. When there is a major shift in technology and associated process or policy matters, periodic hands-on learning will improve their professional competency. A well managed rearing unit can produce quality fishes and shrimps, which fetch higher market prices and India can cater to the burgeoning global demand for marine ornamental fishes.

ICAR-NBFGR has established a Germplasm resource center for marine ornamental invertebrates is established in Agatti Island, Lakshadweep, which is a new approach in the country. The exploratory surveys conducted in different pristine reef islands revealed hidden diversity with discovery of three shrimp species, which is new to Science; *Periclimenella agattii*, *Urocaridella arabianensis* and *Actinimenes koya* and new distributional & associational records, *Thor hainanensis*, *Lysmata hochi* and *Argeiopsis sinhai* with *Stenopus hispidus*. Besides, over 3,000 individuals of 17 species of ornamental shrimps were collected from the wild and captive raised. These fascinating ornamental shrimps exhibit myriad colors, semiotic association with other groups, behaviors and body forms, which make them attractive to the hobbyists, suggesting potential avenues for promoting marine ornamental trade in India, besides supporting the livelihood of the island communities.

The rearing technology on marine ornamental shrimps is being transferred to the islanders and two community aquaculture centers for ornamental shrimp rearing is under operational at Agatti island.

The functional target is to conserve the wild collected parents in captivity and utilize F2 generation, to help in generating supplementary income for the islanders. Mostly, such coastal communities are close to the fragile reef systems, have limited livelihood options and skills and more prone to adverse impacts of changing climates. The diversified livelihood options and supplementary income can help such communities to remain resilient and at the same time sensitive to protecting the ecosystems.

The technological interventions and innovations, validated through capacity building involving native communities will help building value chain, which will implement sharing the benefits directly through enhancing their family incomes and other social tangible benefits such as empowering woman, family health and nutrition. The interventions of mainstreaming available biological resources, with the available enabling policy will lead to scaled-up production, procedural tools for certification and traceability of the produce, as a part of the framework to protect interests of the native communities. The functional models of mainstreaming biodiversity and the lessons learnt can be shared to establish such programs with an aim of enhancing livelihood options for island and coastal communities, not only in other parts of India but, other interested nations also.

Germplasm conservation is a potential way for the documentation of marine ornamentals in coral reef region. Breeding and rearing of marine ornamentals are an only way to protect the destruction of marine bio-resources and maintain the ecological balance. Furthermore, hatchery production, adaptation and supply of marine ornamentals by the coastal and island community will be created more employment opportunities in this region and it will raise the hope of the people and their living standard. The small-scale community aquaculture centers require only a marginal investment, diminutive working area, limited water volume and very minimal manpower.



The rapid increase and great demand for fish and invertebrates of marine origin within the pet and hobby trade poses the threat of increased harvesting on natural resources. Especially, recent development of marine aquarium keeping has resulted, over exploitation of natural stock and consequent destruction of reef area. There is a report point out that, around 3002 marine ornamental species (2278 fishes and 724 invertebrates) are imported into the US between the years 2008 -2011. However, no clear details about the species are available in the trade due to the unorganized, multifaceted and fragmented supply chain. The sustainability of this growing industry has been questioned because of controversies associated with its heavy reliance on wild collections.

Conservation of biodiversity in coastal system depends on the successful resolution of developmental challenges. In general, the coastal and island communities are committed to fishing practices to generate their income for a large number of dependants in each family. Subsequently, the fishing community find themselves in a downward spiral of resource degradation and increasing poverty as overfishing happens. So, the communities lying in the coastal and island belts are exploiting the habitats of reefs for the aquarium industry as their livelihood.

India is rich in marine biodiversity and ornamental resources, which are abundant in the Gulf of Mannar and Palk Bay in Tamil Nadu, Gulf of Kutch in Gujarat, Malvan coast, in between Maharashtra and Goa, Kerala coast, in between Kovalam to Kanyakumari, and Andaman and Nicobar and Lakshadweep islands. Our waters contain 400 species of ornamental fishes belonging to 175 genera and 50 families. However, only around 100 species are found in the trade. The exploitation and trade of ornamentals caught in the wild are contributing to the economy of dependent community. Hence, it has been considered as a major conservation challenge in the biodiversity rich regions of the country.

About 500 species of invertebrates, other than coral are popular and roughly ten million of them are traded each year.

These include mollusks (gastropods, bivalves and cephalopods), echinoderms (starfish, urchins), actinarians (sea anemones), crustaceans (shrimp, crabs and lobsters) and polychaeta (feather dusters and Christmas tree worms). Of this group, cleaner shrimp of the genus *Lysmata*, boxing shrimp of the genus *Stenopus* and sea anemones of the genus *Heteractis* compose the high value non-coral invertebrates. Still there is no continuous breeding technology for this highly traded group. Continuous exploitation of these resources from reef region should be restricted and captive propagated organisms have to be introduced in the trade.

Ornamental aquaculture is usually conducted in a closed production system at a much smaller scale. Breeding of marine ornamentals not only provide an alternative supply for the market, but also provide new information on the reproductive biology and life history of the species. Marine ornamental aquaculture can be an environmental friendly way to increase the supply and helping to reduce the pressure on wild populations. Recent advances in hatchery production technology, including improvements in food for different life cycle stages will enable more species to be cultured in the controlled conditions. However, to date, successful rearing has been scientifically reported for only few species.

Since, the coastal and island community are weak in financial systems and depend on seasonal jobs and become dwellers of coral and mangrove ecosystems, there is an urgent need to develop a long-term management strategy for regular employment and routine income generation. Additionally, there is a need to conserve the marine living resources. Inadequate alternate livelihood opportunity and insufficient entrepreneurship capacity are the causes of development stagnation of the coastal and island people.

Captive propagation of some of the most collected and traded species would contribute to relieving the current pressure on coral reefs and also for ex-situ conservation of the selected species. This is important to avoid over harvesting of species that potentially disturb the ecosystem due to unauthorized anthropogenic activities. Marine aquarium trade is an excellent opportunity for community-based, conservation-focused aquaculture initiatives in the coastal and island regions. Reducing the exploitation of vulnerable marine ornamental species, aquaculture could relieve much of the conservation concern over their status in the wild. Thus, the way forward can be bio-based interventions and capacity building to the coastal and island people about community based, cluster mode ornamentals culture.

India, is a peninsular country with vast marine aquatic resources and conducive for marine ornamental aquaculture. In this milieu, the ICAR-NBFGR's integrated sustainability program on marine ornamental germplasm resource centre in Lakshadweep focusses on livelihood promotion, climate resilience and conservation of marine biodiversity.

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## FIGURE LEGEND

Fig. 1. *Periclimenella agattii*

Fig. 2. *Urocaridella arabianensis* marine ornamental shrimps, discovered from Lakshadweep

Fig. 3. *Thor hainanensis*

Fig. 4. *Argeiopsis inhacae*, an ectoparasite with *Stenophus hispidus*, new distributional and associational records from Indian waters

Fig. 5. Captive propagated *Thor hainanensis*

Fig. 6. *Ancylocaris brevicarpalis*





# A NEW STAR IS BORN IN THE AQUACULTURE UNIVERSE

FOUNDATION FOR AQUACULTURE INNOVATIONS  
AND TECHNOLOGY TRANSFER (FAITT)

S. SEETHARAMAN, and M. DHANARAJ

FAITT, CHENNAI, TAMILNADU (INDIA)

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(N.B: UN LOGO ON RHS USED WITH SPECIAL OFFICIAL PERMISSION & AUTHORIZATION FOR PARTNERSHIP CO-BRANDING FROM UN )

## THE GENESIS

Foundation for Aquaculture Innovations and Technology Transfer (FAITT) is a nascent and highly unique Non-profit Private Research and Development (R&D) Foundation in the field of Aquaculture – primarily for Research, Publishing, Skill Development Trainings & Social Empowerment activities.

It was incorporated as a Pvt. Ltd. company in 2020 In Andhra Pradesh and branch office established in Chennai, Tamilnadu, India in 2021 to uniquely focus on “AQUACULTURE RESEARCH and DEVELOPMENT” – both Nation-wide and Globally.

FAITT believes in the maxim : “Human knowledge belongs to the entire world for the benefit of all, and thus collaboration is better than competition”. Hence, it was established as a unique and pioneering Corporate sector Non-profit Foundation, the “First of its kind in India”, by a group of eminent scientists who have considerable expertise both academically and industrially, in the Aquaculture sector.

The technical team of FAITT are well qualified, highly educated and technically sound in the field operations, who understand the farmers problems and the day to day issues in the Aquaculture industry. Hence, the team can easily grasp and observe the problem and immediately focus on the R&D aspects in order to find out readily applicable and highly reliable solutions for the industry.

## FAITT AIMS TO PROMOTE SUSTAINABLE AQUACULTURE

In essence, Foundation for Aquaculture Innovations and Technology Transfer (FAITT) has a unique, highly inclusive business model and is based on promoting Aquaculture, especially in FISH FARMING and SHRIMP FARMING.

This will be accomplished by setting up special R&D Units, specialized Training Units, Labs, Sustainable and Eco-friendly Aquaculture farms, Innovative Technology use for Diseases Management and increased Sustainable Fish & Shrimp Production, Special News and Research Publications etc, to benefit all Stakeholder segments.





In addition, collaboration with National and International Partners for use of Latest Technologies and Innovative mechanisms will be undertaken in order to enhance both the Quantity and Quality of the Farm produce

## **JEWELS IN THE CROWN OF FAITT**

In an incredibly short span of time, FAITT has achieved many world-class recognitions and awards.

FAITT is the only TRIPLE ISO certified Non-profit Private Research and Development (R&D) Govt of INDIA recognized Start Up Firm in the field of Aquaculture in INDIA !

1. FAITT is ISO 9001- Quality Management System Certified
2. FAITT is ISO 14001 – Environmental Management System Certified
3. FAITT is ISO 45001 – Health & Safety Management System Certified
4. FAITT is also StartUp India , NIPA – Govt. of India Certified.
5. FAITT is also certified by UN – United Nations, in this “2022 – International Year of Artisanal Fisheries and Aquaculture” !!
6. FAITT is also one of the few Unique Start-up ventures in its field, which has been awarded official “START- UP RECOGNITION” – by DIPP, Ministry of Commerce & India, Govt. of India.

## **FAITT PLANS EXCITING FUTURE DEVELOPMENTS**

Aquaculture is a major food sector which is highly diverse and encompasses the food production and fisheries development.

Thus it touches a wide array of scientific discipline, FAITT endeavours to facilitate R&D, Education and Training across various scientific disciplines, to Aqua Farmers, Technicians, Stakeholders and Entrepreneurs.

In juxtaposition with this, FAITT would endeavour to provide Scientific and Innovative, Sustainable

and Environmental friendly solutions to foster a great and vibrant Aquaculture Food Industry in India by 2025.

In this 2022 UN declared “YEAR of AQUACULTURE” , FAITT uniquely aims to solve the problems in the AQUACULTURE Industry by using

1. Unique Technology based solutions in various Aquaculture sectors.
2. Provide National and International scientific & Technical collaboration based Professional Education and Practical Training Programs for Aquaculture Farmers, Interns, Technicians, Rural Youth, etc
3. FAITT will Form a Unique AQUACULTURE COMMUNITY HUB – to foster both innovation and Knowledge exchange, for National and Global Aquaculture industry.
4. FAITT is already Organizing SEMINARS, PR Events, WORKSHOPS, etc – to help boost Innovative Technologies and Best Practices in Aquaculture Industry.
5. FAITT is already undertaking Unique Research and development in Aquaculture
6. FAITT will also Publish National and International News and informative articles to disseminate and assist in Augmentation of existing Knowledge Resources for Aquaculture Community in INDIA. This will also help all stakeholders to enhance their cognizance with use of modern technology for Quality Outputs and Healthcare improvements in our Aquaculture Farms.



## FAITT BELIEVES IN STRONG VALUES

FAITT, in all its services and operations, is committed to the following 10 core values: 1) Ensuring High QUALITY, 2) Constant INNOVATION, 3) SUSTAINABLE Solutions, 4) ECO-FRIENDLY Practices, 5) Use of Latest TECHNOLOGY, 6) Protection of HEALTH, ENVIRONMENT and NATURAL Resources. 7) SOCIAL Responsibility, 8) CUSTOMER CENTRIC Focus, 9) INTEGRITY and 10) SERVICE Excellence.

## AQUACULTURE RESEARCH AT FAITT

FAITT plans to enhance the human cognizance on Eco-friendly Aquaculture practices by Education, Training And Demonstration. It also plans to develop novel and innovative Aquaculture technology solutions, in a sustainable an eco-friendly manner, to address the variety of Aquaculture and Marine sea-food farming and production issues.

The R&D unit of the FAITT is, at present, primarily focused to develop new, novel and eco-friendly innovative formulations on aqua-feed and various feed additives.

FAITT has its own team of eminent research consultants, collaborators and advisors from reputed national and international Colleges, Universities, Research Institutes and Industries from South Korea, Israel, China, USA, Germany, Malaysia and so on. The R&D solutions carried out at FAITT emanate from the accumulated best ideas of such potential experts.

## FACILITIES AT FAITT

FAITT has sophisticated facilities of Microbiology Unit, Biochemistry Unit, Water Laboratory, Training Unit, Spirulina Cultivation Unit, Biofloc System and RAS Unit. Each Unit performs their Corresponding function in an efficient manner to develop quality formulation and technology in various aspects of Aquaculture. The Spirulina Cultivation Unit, BioflocSystem and RAS Unit provide training to the individuals, based on both theory and practical demonstrations.

## TECHNOLOGY TRANSFER

The effective formulations on feed and feed additives and its related technologies are processed for patent and then processed for technology transfer to farmers, entrepreneurs and stake holders for the benefit of the aqua industry.

## TRAINING PROGRAMS

FAITT experts frequently conduct training programs on:

Spirulina Cultivation, Biofloc Technology, Raceway Aquaculture System (RAS) and other aquaculture related trainings to the farmers, technical personnel, socially weaker sections and unemployed youths on a regular basis.

## MEMBERSHIP NOW OPEN IN FAITT

Any individual engaged with aquaculture or fisheries business, entrepreneur, marketing professional, technical professional, stakeholders, student, scholar and faculty can become a member of the Foundation.

## BENEFITS TO THE MEMBER OF FAITT

- ☑ The member can obtain technical advice from our experts related to Aquaculture.
- ☑ The members can avail 25% concession on all the training programs conducted by FAITT.
- ☑ The members can avail 25% concession in all the seminars / conferences / workshops organised FAITT.
- ☑ The members get the first priority in utilizing the facilities at FAITT.
- ☑ The members get first priority in technology transfer and formulation protocol.
- ☑ For memberships, please Email : [info@faitt.org](mailto:info@faitt.org).





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# LAUNCH CEREMONY OF “HATCHERY BRED MARINE ORNAMENTAL SHRIMPS AND NANO AQUARIA”

A NEW INITIATIVE IN INDIA, INTRODUCED BY THE ICAR-NBFGR,  
LUCKNOW AND VGP MARINE KINGDOM, CHENNAI

**T. T. Ajith Kumar**

Principal Scientist and Scientist in Charge PMFGR Centre of the ICAR-NBFGR, Kochi

Email : ttajith87@gmail.com

A ceremony to launch Hatchery Bred Marine Ornamental Shrimps and Nano Aquaria for country's hobbyists, was concluded in the premises of VGP, Marine Kingdom, Chennai on 20th May 2022. Mr. Anitha R. Radhakrishnan, Honourable Minister for Fisheries and Animal Husbandry, Govt. of Tamil Nadu has presided over the function and launched the marine ornamental shrimps with Nano aquaria. The ceremony was held in the presence of Director, ICAR-NBFGR, Chairman and Managing Directors of VGP group and other dignitaries and scientists from different institutes.

The minister addressed the gathering and informed the initiatives of the fisheries Department for the betterment of the fishers of the state for improving their livelihood options for them. He emphasized the need for the initiative, which will help in maintaining the sustainability of the marketing component of the envisaged concept and the possibility of expanding the same across various states of the country. He appreciated the efforts taken by the ICAR-NBFGR and VGP Marine Kingdom on the new concept of Marine Nano aquaria with captive raised shrimps. During the program, Dr. K. K. Lal, Director of ICAR-NBFGR explained the initiatives of ICAR-NBFGR, the concept of community-based ornamental aquaculture and the need of collaborative involvement with market leaders such as VGP Marine Kingdom. Mr VGP Ravidas, Managing Director of VGP group explained about the VGP marine kingdom and the pioneering efforts in establishing the first oceanarium in the country at Chennai.

The ICAR - NBFGR has established a facility for conservation and captive breeding of marine ornamentals at Agatti island, Lakshadweep. An initiative of the ICAR-National Bureau of Fish Genetic Resources (NBFGR) at Agatti Island of Lakshadweep on breeding and dissemination of

marine ornamental organisms (shrimps and fishes), through community aquaculture units for improving the income of native women has been undertaken at Lakshadweep. The facility has provided capacity building training to 82 local islanders (77 women). The facility is hand-holding community aquaculture units, maintained by the trained women groups to raise the marine ornamental shrimps from seed to marketable size, for alternate income. This is a unique venture, where science and Societal development are converging together by utilizing the indigenous resources for livelihood development and support empowerment of native women of Agatti, Lakshadweep island. During 2021, ICAR-NBFGR and M/s VGP Marine Kingdom, Chennai signed a Memorandum of Understanding (MoU) for procuring the marine ornamental shrimps/finfish raised by women groups for further trading in the market. Nano aquarium is a table top aquarium needing small footprint and ease of maintenance, will be packaged with ingredients and beautified with ornamental shrimp *Thor hainanensis* (sexy shrimp) or *Ancyllocaris brevicarpalis* (peacock tail shrimp) and sea anemone.

Taking forward, this model has potential to create a hub in Tamil Nadu for new marine ornamental organisms which in turn empowers native communities and build a case history of successful access-benefit sharing based on indigenous genetic resources. The launch program jointly organized by ICAR-NBFGR, Lucknow and VGP Marine Kingdom, Chennai is a leap in this direction.





Dr Kuldeep K Lal, Director, ICAR-NBFGR Lucknow, speaking about the program and collaboration with VGP Marine Kingdom during the launch ceremony.



Honourable Mr.Anitha R.Radhakrishnan, Minister for Fisheries and Animal Husbandry, Govt. of Tamil Nadu receiving from Mr VGP Premdas, CEO, VGP Marine Kingdom, the first Nano aquarium with hatchery bred Ornamental Shrimp from ICAR-NBFGR supported women group at Agatti at the launch ceremony.



Ornamental shrimp, Thor hainanensis from Lakshadweep island is raised by women groups using hatchery bred seed.



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# FS Feed™: LARVAE NEW LIVE FOOD REPLACEMENT

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Larval culture feed formulation and nutrition have improved considerably, especially due to conforming to the dietary requirement of cultured species. However, early stages of larval culture still depend on live food to survive, and this commonly consists of phytoplanktons (generally *Chaetoceros*, *Isochrysis*, *Skeletonemna*, *Tetraselmis*, *Chlorella*) and zooplanktons (rotifer, *Brachionus*, *Artemia*). Among those, *Artemia* is widely used commercially in the form of packed dried cyst, mainly harvested from certain countries with saturated high salinity seawater ponds.

However, increasing global demands for *Artemia* has somewhat limited its supply and availability for the fast-expanding aquaculture sector. Consequently, the price of *Artemia* has been increasing yearly to present price of between USD 120-145/kilogram for high quality *Artemia* feeds. In lieu of the limitations and increasing costs of such live foods, our group have developed an artificial feed for larval culture that could potentially replace live foods as a nutritional feed in the aquaculture industry.

The FS Feed is considered to be highly nutritious and with customizable formulation based on the needs of targeted fish larvae. FS granules categorically sized from 125 µm to 500µm, and suitable to accommodate to differences in mouth gape of early-stages of most fishes. FS Feed has been successfully tested on fish larvae such as carps (*Barbonymus gonionotus*, *Cyprinus carpio*), catfish (*Clarias gariepinus*) and seabass (*Lateolabrax niloticus*), and proven to be a superior feed compared to conventional *Artemia* diet with significant increase in survival rate.

FS feed can be given directly to the larvae without any need of a pre-culture treatment, rendering this feed from hassle-free pre-treatment, pathogen-free and continuously available. FS feed is furthermore easily digested and absorbed by fish larvae and prepared from 100% organic material consisted of fish oils and sustainable protein source (soya) as its main ingredient.

Live food cultures often require both time and a trained technician to ensure availability for larval requirements. But, FS feed can be used instantly and this simplifies the job of hatchery operators.

Furthermore, FS feed™ simplify the feeding process with 1.0 gram of FS feed can support 100,000 newly fish larvae stocking. By using FS Feed™ we can minimize contamination from unwanted pathogens that may be introduced through live foods.

Figure 1: Zebra fish larva on FS Feed™



Fig 2: FS Feed™ in packets



Fig 3: Highly nutritive and affordable FS Feed™



Figure 4: *Barbonymus gonionotus* larva fed on FS Feed™





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# SUSTAINABLE BLESSING FROM NATURE

## An Awareness Workshop on “Spirulina Algae”

G. Balaji

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Foundations For Aquaculture Innovations and Technology Transfer (FAITT) conducted a highly knowledge-oriented awareness workshop on the theme : “Sustainable blessing from nature”, on September 3rd and 4th, 2022. The event was held at Falcon Nest at Bhimavaram, Andhra Pradesh in collaboration with Cresco Algae.



Dr. D.Manikandavelu, Adjunct Professor, Dr. M.G.R. Fisheries College and Research Institute, established in 2012 in Nagapattinam district under Tamil Nadu Fisheries University Act, 2012 at Ponneri, Tamilnadu, and affiliated to J. Jayalalithaa Fisheries University (TNJFU), was the Honorable Chief Guest on this occasion.

Specialized in the field of aquatic environment management, Dr. Manikandavelu has conducted many successful projects



including Training programs with focus on aquaculture for self-help groups, coastal fisherwoman, etc., on various aspects like value added fishery byproducts, tilapia production as feed for mud crab farming, fisheries biodiversity conservation, Advanced ornamental fish culture, etc.

He is a recipient of “Young scientist fellowship” by Tamilnadu State Council for Science and Technology (TNSCST) and has received “Lifetime achievement Award” by Aquatic Microbiology Forum, Chennai at SRM Institute of Medical Sciences. He has also designed and fabricated cheap and simple devices for use by aquaculture farmers and technicians such as water sampler, sediment sampler, aggregating screen for prawn, etc.



Dr. Manikandavelu shared his valuable insights and experiences on spirulina algae cultivation and value addition for aquaculture operations and development. About 25 aquaculture professionals, primarily aquaculture technicians, benefitted from this awareness program.

# AQUA CULTURE EVENTS

## NATIONAL & INTERNATIONAL

SEPTEMBER TO DECEMBER – 2022

**Sept 24, 2022 and Dec 17th, 2022**

**International Conference on Fisheries And Aquaculture (ICFA)**

**Udupi, Karnataka, India**

<http://asar.org.in/Conference/33807/ICFA/>

**Sepr 25, 2022 and Oct 21-22, 2022**

**International Conference on Environment and Life Science**

**Shenyang, China**

<http://yanjiuconference.com/Conference/1346/ICELS/>

**Sep 25, 2022**

**International Conference on Fisheries And Aquaculture (ICFA)**

**New Delhi**

[https://www.conferencealerts.org/event\\_detail.php?e-v\\_id=589301](https://www.conferencealerts.org/event_detail.php?e-v_id=589301)

**Sep 18 – 23, 2022**

**5th Percid Fish International Symposium**

**Biology Centre CAS České Budejovice, Czech Republic**

<https://www.bc.cas.cz/en/events/detail/5831-per-cis-v-5th-percid-fish-international-symposium/>

**27 Sep 2022 – 30 Sep 2022**

**Aquaculture Europe 2022**

**Palacongressi Di Rimini Convention Bureau Della Riviera Di Rimini, ITALY**

<https://www.aquaeas.org/>

**Oct. 3 – 6, 2022**

**GOAL: Global Seafood Alliance's The Responsible Sea – food Conference 2022**

**Fairmont Olympic Hotel in Seattle, USA,**

<https://www.globalseafood.org/goal/>

**Oct 3 – 6, 2022**

**Mucosal Health in Aquaculture 2022 (MHA2022)**

**Hotel Rafael Atocha Madrid, Spain**

<https://www.mha2022.com/>

**Oct 5 – 6, 2022**

**The Aquaculture Roundtable Series (TARS) 2022 InterContinental Saigon Ho Chi Minh City, Vietnam**

<https://tarsaquaculture.com/program/>

**Oct 28 – 30, 2022**

**The Aqua Culture Expo 2022**

**India Expo Centre & Mart**

**Plot No. 23 –25 & 27– 29 Knowledge Park – II Gautam Budh Nagar uttar Pradesh 201306 India**

<https://indiaexpomart.com/index.php/event/-the-aqua-culture-expo-2022/>

**Nov 4 – 6, 2022**

**Aquaex India**

**Bhimavaram, Andhra Pradesh**

<https://aquaexindia.com/visit>

**Nov 17 – 18, 2022**

**4th International Conference on Aquaculture and Marine Biology**

**Goa, India**

<https://conferencemind.com/conference/a-quacultureandmarinebiology>

**Nov 29, 2022 – Dec 2, 2022**

**World Aquaculture Singapore 2022**

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# CRESCO ALGAE FORT

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## The Genesis

CRESCO ALGAE FORT is a nascent startup firm in the field of aquaculture. It was incorporated in Andhra Pradesh in 2021 and is a Government of India registered Firm.

**CRESCO** is involved in manufacture and retail of Food products relating to the aquaculture industry, especially pertaining to feed and additives.

The ALGAE – algae such as special types of microalgae like spirulina, etc., pertain to production of color pigments in aquatic life forms like prawns, salmonid fish and ornamental fishes.

## CRESCO Objectives

**CRESCO** aims to cultivate and produce huge quantitative of Algae for Aquaculture Industry for use as Feed and Nutrition agent. It aims for Mass production of Spirulina and value added products with an initial Target of 1Ton per month.

Gradually it aims to develop large scale Algae ponds and be one of the largest producer of Spirulina – both for domestic consumption and also for International exports.

## ALGAE as NUTRITION Source

Algae is well known for its ability to absorb and recycle carbon dioxide from the atmosphere. It also help in treatment of wastewater by removing excess Nitrogen and phosphorous elements. Today, a vast majority of commercial algae production is for human and animal nutrition. Currently 30 per cent of the world algal production is used for animal feed. In aquaculture, Algae is mainly for fish and shrimp.





Algae can be easily cultivated in open-pond algae farms. There is enough carbon dioxide in the air to produce more than a billion tons of algae a year. A lot of Algae Plants in foreign nations help produce omega-3 fatty acids from natural marine algae for animal nutrition.

The most challenging ingredient in fish feed is the fish oil that boosts the omega-3 content in the feed. Algae are rich in omega-3s as a sustainable source that can supplement fish oil.

**CRESCO AND MICROALGAE PRODUCTION**

**Cresco aims to produce large quantities of Algae and Microalgae.** This would encompass production of economically important algal species like Spirulina sp,Chlorella sp,Dunaliella sp, Hematococcus, sp, Nannochloropsis sp, Diatoms,etc. These are highly useful in the Aquaculture industry as Fish Nutrition.

The Unicellular, Freshwater and Wastewater Algae can be very useful in further production of Bio-fuels, Animal Nutrition feed, Ethanol, Biomass protein, etc. Microalgae contain numerous bioactive compounds that can be harnessed for commercial use. Microalgae such as Dunaliella salina, Haematococcus pluvialis and Spirulina sp. are also used as a source of natural pigments for the culture of prawns, salmonid fish and ornamental fish.

Chlorella sp. And Spirulina sp. are commonly included into feeds for ornamental fish, where colouration and healthy appearance is the main market criterion.

**CRESCO TO DEVELOP SPIRULINA CULTIVATION**

CRESCO plans to develop good infrastructure for both Small scale production and Commercial production of Spirulina for the Aquaculture Industry.

It has been found that the use of Spirulina as complementary feed in various sectors of Aquaculture results in fast and efficient growth factor and also enhances the pigmentation and immunity systems of the aquatic life forms.

Spirulina is considered as an excellent food, lacking toxicity and having corrective properties against the pathogenic micro organisms. It lacks cellulose cell walls and therefore do not requires chemical or processing in order to become digestible.

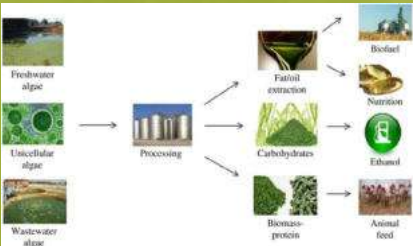


Fig 1: Application of algae in various industries

Fig 2: Overall production chart of Spirulina



# POSTBIOTICS AND THEIR APPLICATIONS IN AQUACULTURE

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Probiotics in the intestine produce "Postbiotics", which are by-products of the fermentation process. In other words, postbiotics are produced as a result of probiotics feeding on prebiotics (Fig 1). They are essentially probiotic "waste."

Normally, waste products do not appear to be very useful to us. Surprisingly, they are responsible for a number of important health-promoting functions in human and animal health. Organic acids, bacteriocins, carbonic substances and enzymes are examples of postbiotics. They are produced naturally by the existence of microorganisms in our intestines, but they can also be added directly through various therapeutic processes. Most of the positive effects that are attributed to probiotics are because of postbiotics, according to latest report.

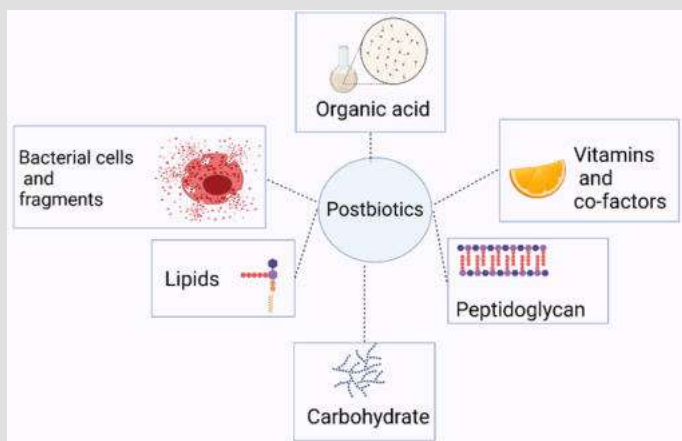


Fig1. Overview of postbiotics that could have health promoting effects via different metabolic pathways

## POSTBIOTICS IN AQUACULTURE

As aquaculture is evolving at a rapid pace, infectious disease outbreaks are also becoming more common. Antibiotic treatment leads to the development of antibiotic-resistant pathogens, necessitating immediate search for other treatment options. Among the various proposed alternatives, postbiotic was one of the strategies to be investigated. It may be useful in the aquaculture industry because of its benefits in the agriculture industry.

## ADVANTAGES OF POSTBIOTICS

Postbiotics have several advantages over probiotics and prebiotics, including availability in their pure form, ease of production and storage, the availability of a production process for industrial-scale-up, a specific mechanism of action, better accessibility of Microbes Associated Molecular Pattern (MAMP) during recognition and interaction with Pattern Recognition Receptors (PRR), and a greater likelihood of eliciting only targeted responses via specific ligand-receptor interactions.

Probiotic cultures are generally produced at the industrial scale using conventional batch fermentation with suspended cells. Similarly, Postbiotics are also produced. Hence it can be cost effective to produce them, just like the production of Probiotics, on an industrial scale.

Advantages of postbiotics over live probiotics in aquaculture industry Postbiotics can be used over probiotics, due to the easy availability of storage, and can maintain stability in the production process and because certain probiotics might cause adverse reactions. Live probiotics, on the other hand, have been reported to be affected by various host-specific factors in the gastrointestinal tract (GIT), which subsequently activate several bacterial genes for the degradation and production of various nutrients via various metabolic pathways (Fig 2). To address such issues, postbiotic components are likely to be beneficial and promising alternative supplements.

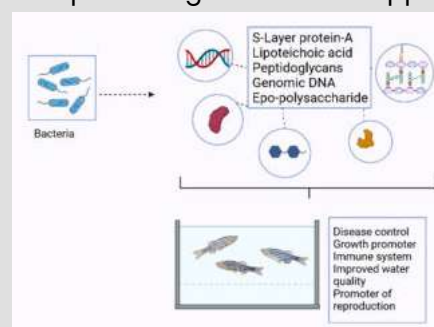


Fig 2. Different types of postbiotics for controlling fish diseases by promoting fish immunity, water quality, reproduction and health.





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# FISH PRODUCTION POTENTIAL IN INDIA

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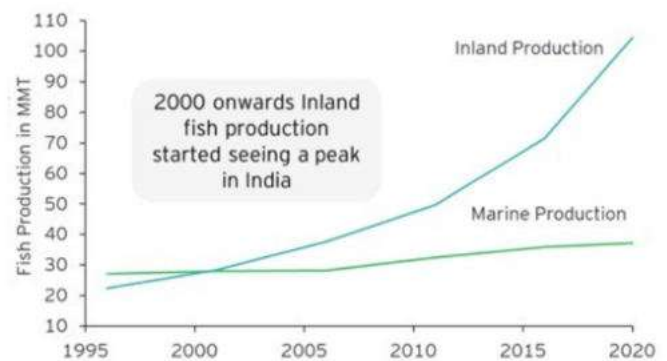
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India is the world's third largest fish producer and this accounts for around 7.7% of global fish production. This sector provides employment to 16 million fishermen and fish farmers. Since India is one of the world's leading seafood exporting nations, this sector is an important source for foreign exchange gains.

Apart from large-scale freshwater fish farming, ornamental fish farming and high-value marine fish farming have recently gained popularity. Fish output in India has expanded at a higher rate than in the rest of the world.

Between 1950-51 and 2018-19, global total fish production increased 9.26 times, whereas total fish production in India increased at twice the global rate during the same period. Inland fisheries had faster growth as a result of promotional and developmental measures such as infrastructure development, promotion and subsidy support programmes for fish farming, marketing, price realisation and extension services, among other things.

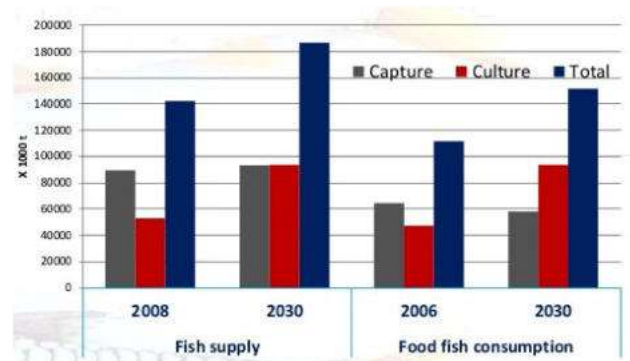
Nevertheless, fish farming in India has a lot of scope for improvement in terms of production and productivity. Indeed, 41% of the total fish production in country are obtained from Andhra Pradesh and West Bengal.



India's Fish Production (million metric tonnes)



Source: Department of Animal Husbandry and Dairying and Department of Fisheries, Economic Survey 2020-21





## Diversity

India possesses more than 10% of the world's fish biodiversity and is one of the 17 countries with the most biodiversity. There are about 3,000 fish species in India (Fig 1), with two-thirds of them are marine, a third being freshwater, and over 100 being brackish.

Freshwater species like Pangasius (a type of catfish) and tilapia are mostly preferred in aquaculture in recent years, apart from white leg shrimp in brackish water. Carp production, which has relatively modest feed intensities as compared to other aquaculture species like Pangasius or tilapia, is anticipated to continue to account for the majority of fish production in India.

More than 50 different species of fish and shellfish items are being exported from India to 75 countries across the world.

## Government schemes for promoting aquaculture

Government of India (GOI) launched the "Blue Revolution," with the goal of increasing fish production to 150 million tonnes by 2020 and 200 million tonnes by 2022-23. In order to promote aquaculture, GOI established 429 Fish Farmers Development Agencies (FFDAs) and 39 Brackishwater Fish Farmers' Development Agencies (BFDAs). To further develop fisheries sector, GOI launched "Pradhan Mantri Matsya Sampada Yojana (PMMSY)", with the objective to improve the value chain, which includes infrastructure development, traceability, production, post-harvest administration, and quality management.

## Benefits of PMMSY

1. Fish production will be increased to 220 lakh metric tonnes by 2024-25.
2. Export earning will be doubled to Rs.100,000 crores.
3. 55 lakh people will get employment opportunities.
4. Domestic fish consumption will be promoted and investments will be attracted.

## Fisheries and Aquaculture Infrastructure Development Fund (FIDF)

Government of India created FIDF to provide loan to farmers through kisan credit cards. Farmers can get loan over a period of 5 years, with a maximum repayment duration of up to 12 years. The fund also helps the aquaculture industry with pond construction, reservoir cage installation, and fish processing equipment, among other things.



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