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Commercial farming of agarophytes Gracilariadura and G. debilis

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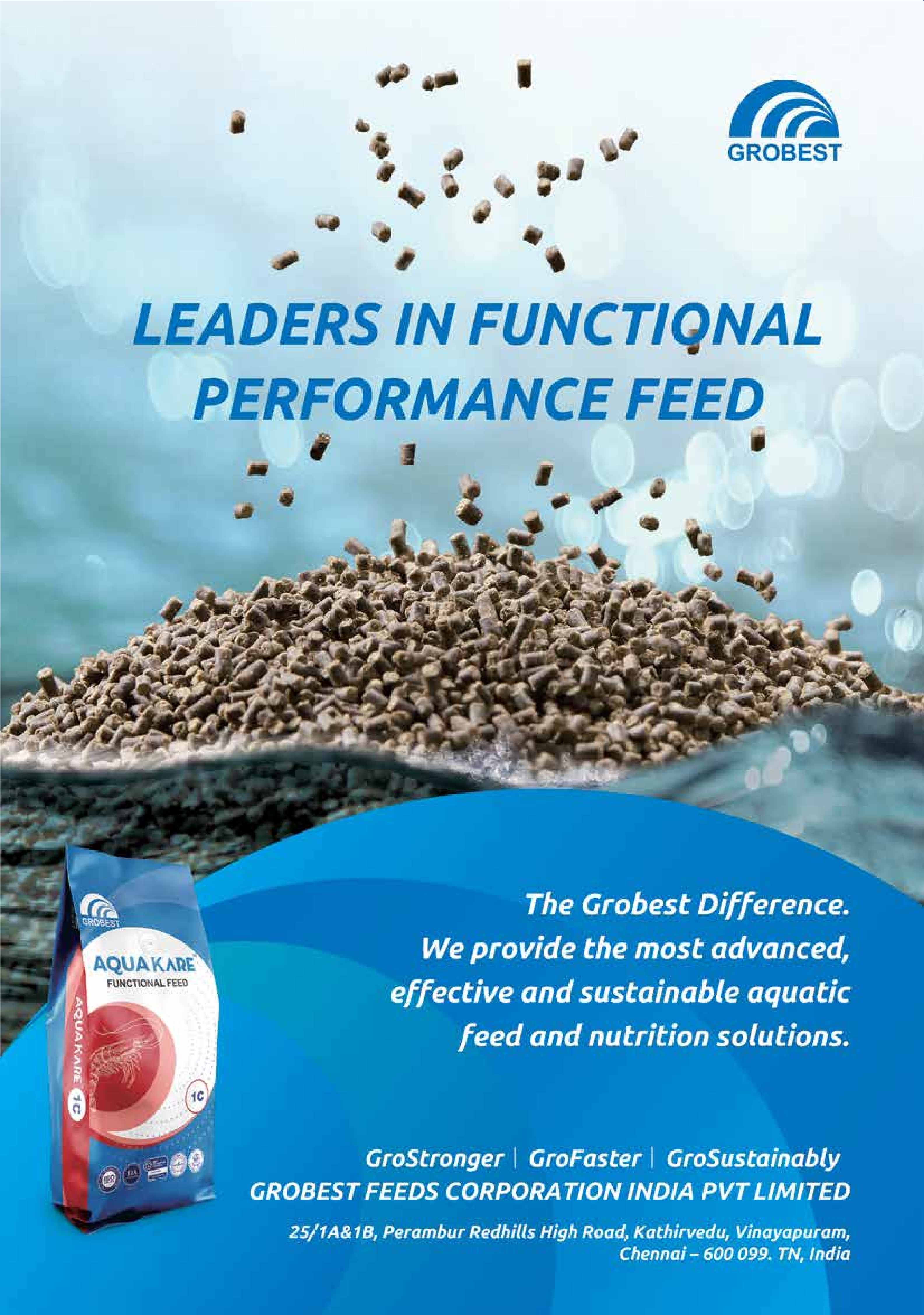


# AQUA POST

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# Less is productive

The Government intervention and support for the fisheries sector has increased, more so post Blue Revolution 2.0. It has announced a budget outlay of about Rs20000 crore to reduce the infrastructure gaps in fisheries sector. It is indeed a welcome move. The policy paper indicates doubling the fish production and export in the next five years. With increasing reforms and investments, growing threats of climate change and environmental stress,additional rules and regulations and their strict compliance are also inevitable.

The government interventions for augmenting development of the sector are sure to bring both positive as well as negative effects. It may impact both the small-scale family farming as well as commercialfarming activities. However, incentives in the form of easy access to institutional finance at low interest rate, infrastructure development, ecosystem restoration and people's led climate actions are expected to bring net benefit to aquaculture and fisheries not only in terms of productivity and production increase but also will enhance the contribution of the sector in rural livelihood development, better income and nutrition to farming households.

Let's have a look at the growth of agriculture sector for the last fiveto seven years. In between 2014-2019, the Fisheries sub-sector growth rate was 7.45% whereas livestock, and fruits & vegetables grew at 6.38 % and 2.45% respectively. The fisheries sector witnessed highest growth rate even with very low public investment and little government intervention. Such results have led to increasing trend in private investment. The livestock sub-sector also showed good growth with MMPO liberalized, no market regulation and little or no subsidy. Notably the cereals, oilseeds an pulses (MSP crops) registered very low growth rate at 1.15 with higher subsidy, over-regulated APMC act and little corporate investment in production and marketing.

Post-independence period have witnessed maximum policy reforms in the agriculture sector starting from production to marketing of the agriculture produce. But the growth rate on an average is declining over the years. It is less than 2% now which is due to several factors..

Let's look at the fisheries sector. Though the first blue revolution ushered in during the seventh five year plan (1985-1990) by the central government of India, yet there was hardly any discernible public investment and policy reforms in the fisheries sub-sector. But, with alittle support, the sub-sector has grown on an average at a rate of 4.5 to 7 %, starting from 1960's to till 2019-20.

Thus, if you compare the traditional crop sub-sector with fisheries sub-sector, two-three points are noticeable- more liberalized the sector, higher the growth; lesser the government intervention, higher the growth; putting more subsidies and regulations not necessarily leading to growth. Further, it is also to be noted that subsidies given to fisheries sub-sector is minimal compared to other sub-sectors.

Any future policy decisions must reflect the long term sustainability and growth of the fisheries and aquaculture while ensuring quality and effective implementation through capacity development at all levels. The shrimp sector has witnessed phenomenal growth with the introduction of SPF seeds, albeit fully dependent on import. However, the recent disease outbreak does not guarantee SPF seeds will continue deliver high growth even in future. Even clean disease free seeds of our native species – tiger shrimp has earlier delivered sustainable growth. With strict guidelines and better compliance,the government regulating agencies should encourage clean disease free seeds, instead encouraging monopoly of SPF seeds. The less regulated the sector, the more sustainable and profitable for the farmers and entrepreneurs.

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# New driver of economic growth: Lakshadweep turns to seaweed farming

After fisheries, coconut and tourism, the Lakshadweep administration has prioritised seaweed farming as the next major development driver of the islands. A demonstration farming of seaweed was launched in nine inhabited islands of Lakshadweep with the technical support of the ICAR-Central Marine Fisheries Research Institute (CMFRI). The initiative is in line with a CMFRI study that revealed immense potential for production of quality seaweeds in serene and pollution free lagoons of Lakshadweep for high-end utilization like the pharmaceuticals, food and nutraceuticals.

The indigenous red algae, Gracilariaedulis and Acanthophoraspicifera are the species being farmed in nearly 2500 bamboo rafts benefitting 100 families belonging to 10 women self-help groups in different islands.

"Known for its unique tuna fisheries and myriads of beautiful corals, reef fishes and other creatures, the marine sphere of the islands are more likely to be known as the seaweed farming hub of India soon", said Dr K. Mohammed Koya, Scientist of CMFRI.

The island territory has a potential of producing 30000 tons of dry seaweed worth INR 75 crore per year, says a CMFRI study. It also revealed an unprecedented growth performance of indigenous seaweed species in various lagoons of Lakshadweep with nearly 60-folds growth in 45 days for the species Gracilariaedulis.

Following the early success story, the Lakshadweep Administration joined hands with the CMFRI for multi-locational trial farming and capacity building of stakeholders. Thus, experimental-scale trial farming was conducted in the islands of Kiltan, ChetlahKadmath, Agatti and Kavaratti during 2020-21 with promising results.

# ICAR-CIFRI extends support to cyclone Yaas-affected fish farmers

In a bid to alleviate the sufferings of the farmers affected by cyclone Yaas in Odisha and West Bengal last year and rejuvenate their livelihood, the ICAR-CIFRI conducted outreach activities by providing fisheries inputs for their small and marginal ponds.

The support is being extended under the Scheduled Caste Sub-Plan to 14-gram panchayats of two CD Blocks (Gosaba and Basanti) covering 32 hamlets having a pond size of 0.02 ha to 0.04 ha in their backyards.

This includes 20 per cent of women SC beneficiaries also. The inputs such as 105 kg of feed, 750 nos of advanced fingerling and 20 kg lime were provided to each fisher. The lime was initially provided on August 25 to improve the pond water condition prior to one week stocking of fish fingerlings.

Cyclone Yaas had caused extensive damage to the fish stock with the influx of saline water in small scale fisheries.

Founder President of KultaliMilonTirtha Society in the Sundarban area of West Bengal applauded the ICAR-CIFRI intervention, which was the first of its kind in the region.

A two-day awareness camp-cum-input distribution programme was also organised in collaboration with Rotary Club of Bhubaneswar Royal and Kultoli Milan Tirtha Society at





NarayantalaRamkrishnaVidyaMandir playground of Kultoli, South 24 Parganas covering 500 beneficiaries (250 beneficiaries in each day).

Dr B. K. Das, Director of the Institute inaugurated the programme on September 2, highlighting ways to increase income as well as livelihoods. Before this, ICAR-CIFRI has also distributed inputs to the Fani affected fishers, who were benefitted from such types of interventions.

Dr A. K. Das, In-charge, Training & Extension Unit, Dr P. K. Parida, Nodal officer, SCSP of the Institute were also present and summarized how the programme will benefit the individual fishing community. The programme was supported by Sujit Chowdhury, Dr A. Saha, and Dr SreyaBhattachrjya of ICAR-CIFRI and staff of MilonTirtha Society.

# CIFT-AARDO meet: MPEDA Chairman stresses on value added fish exports


Kochi based ICAR-CIFT organized of four-day long AARDO sponsored international virtual training programme, second in a row on "Value chain management in fisheries"from 13-16 September, 2021 for strengthening the research and technology collaboration of India with AARDO member countries in the realm of fishing and fish processing. The programme received overwhelming response from AARDO member countries as per the feedback of the 73 participants from 22 AARDO member countries in Asia and Africa.

Dr. Manoj Nordeosingh, Secretary General African –Asian Rural Development Organisation (AARDO), New Delhi said that many developing countries failed to maximise the value of fish owing to various constraints like large-scale post-harvest loss and challenges in production, distribution and marketing due to lack of technologies that creates an alarming situation in aquaculture value chain. The Secretary General said that the programme may give an impetus to our effort to bring a balance in the Asian – African region in fishery value chain management system that may help in furthering the value of fish, its quality and distribution along the value chain. Highlighting the keen interest of various countries, he said that AARDO may facilitate the technology collaboration between ICAR and AARDO member countries in its future endeavour.

Presiding over the event, Dr Ravishankar C.N., Director, ICAR-CIFT emphasised on the importance of fisheries sector in ensuring nutritional security and also the need for reducing post-harvest loss in fisheries sector by developing better cold chain facilities. He assured that ICAR-CIFT with its rich legacy in developing innovative, high-end post-harvest technologies in fisheries will meet the expectations of the participant AARDO countries through this online training programme and suggest innovative ways of overhauling the livelihood of million stakeholders along the fisheries value chain. The programme was attended by resource scientists from ICAR-CIFT and officials from AARDO, New Delhi.

# AIIMS doctors now just a call away for fish farmers in Chhattisgarh

The fishing community in Chhattisgarh can now reach out to the AIIMS doctors at Raipur and physicians in different districts for distant locations through the telemedicine facility to avail treatment.

The initiative was launched on a pilot-scale in September after it was found that the fish farmers had difficulty consulting a doctor because of distance, poverty was Covid-led restrictions on movement.

"This (initiative) would ensure that members of the fisheries cooperatives in Chhattisgarh, whenever in medical need, will be able to approach health specialists of AIIMS, Raipur from their remote locations through telemedicine facility," said Union Minister for Fisheries, Animal Husbandry and Dairying ParshottamRupala.

The facility is being helmed by AIIMS, Raipur for the next three years. Apart from AIIMS, the project is being launched on a pilot mode from five centres such as PHC Patan (Durg district), PHC Saja (Bemetara), PHC Ratanpur (Bilaspur), PHC Dhamtari (Chamtari), said a government statement.

The Central Government, the Chhattisgarh Government, National Cooperatives Development Corporation (NCDC) and AIIMS Raipur have joined hands to launch the telemedicine facility.

"The idea is to extend healthcare facilities to members of fisheries cooperatives societies in remote areas as well as cut down their medical expenditure. The penetration of quality healthcare services in remote areas will also create health awareness among the fisheries community," said NCDC MD Shri Sundeep Nayak.

# IoT-based solutions to aid bumper harvest in Indian fisheries sector

With an aim to introduce IoT-baaed solutions in the aquaculture and fisheries sector, the National Federation of Fisheries Cooperatives recently joined hands with US-based Skylo, a pioneer in this technology.

The partnership will help the sectors enhance fish yield and profitability with the monitoring of oxygen and pH level, capturing different water quality parameters, besides SOS alerts and harvest reporting.

Further, it will enable farmers make more informed and immediate decision, said a statement following the announcement of the partnership.

Skylo's technologies will be made available to 33 members of the cooperative, thereby bringing about digitisation of small-scale farmers and fish farming business in India.

"Tenchnology will transform the fishery sector in areas such as safety, production, sustainability and greater profitability. The future of fisheries management depends on innovation. Skylo is providing end-to-end data solution to digitise fleets and aquaculture farms disruptively affordable prices to anyone who wants it," said Skylo COO Angira Agrawal.

Managing director of FISHCOPFED and COFFED RishikeshKashyap said Skylo has been selected to initiate the demonstration of satellite-based IoT technology after careful validation of multiple IoT solutions. "FISHCOPFED is dedicated to the betterment of the entire fisheries ecosystem and this partnership is a major step towards that goal," he said in his statement.





# An *Atmanirbhar Bharat* in SPF tiger shrimp seed

Pravash Pradhan

**With the increasing incidence of diseases even in vannamei shrimp culture farmers in many countries are looking back at black tiger (P. monodon) resulting in steep increase in its demand. This is an opportunity which calls for a top priority government intervention in facilitating genetic improvement programme for the species as followed by several major black tiger shrimp producing countries including Vietnam and Thailand. Besides developing our own stock of SPF black tiger, efforts would also be needed to facilitate establishment of appropriate and adequate hatchery facilities to meet the ever increasing demand.**

There is a long tradition of brackish water aquaculture systems in India which has sustained for hundreds of years. Such system was highly diversified with the use of culture practices, management measures, farmed species, integration with crop system, etc. Notably are Pokkali system of Kerala, Bheriesof West Bengal Gheriesof Odisha, etc. In the traditional system, the tidal water is allowed to enter in the ponds with resident shrimp and other fish species where they are retained for a considerable time before being harvested from time to time.

With a strong initial drive during the 1970s and 80ssupported by ICAR research institutes like Central Marine Fisheries Research Institute (CMFRI), Central Institute of Brackishwater Aquaculture (CIBA) and Central Inland Fisheries Research Institute (CIFRI) with regards to breeding and larval rearing of shrimps, scientific farming of tiger shrimp, P monodon and Indian white shrimp P. indicuswere cultivated in the country.

The Central Inland Fisheries Research Institute (CIFRI) started breeding and culture brackishwatershrimp and fin-fish in Kakdwip in West Bengal in 1973, followed by several brackish water fish farminginitiatives in West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala and subsequently in Goaand Gujarat. This led to the realisation of the economic importance of shrimp farming and its potential in India's economy.

The commercial shrimp hatcheries were set up by MPEDA way back in late 1980s which includes Andhra Pradesh Shrimp Seed Production Supply and Research Centre (TASPARC) and Orissa Shrimp Seed Production Supply and Research Centre (OSPARC). With the enhanced availability of shrimp seed from these commercial hatcheries there was a sudden increase in the number of shrimp farmers resulting in higher demand of shrimp seed. Such situation also encouraged private entrepreneurs to set up commercial hatcheries leading to large scale development of shrimp farming in the country. Such development was marked by acquiring foreign technologies and technical assistance.

Industrial scale shrimp culture was exclusively dependent on tiger shrimp, (P. Monodon). Early nineties was the period which marked an unprecedented growth in shrimp aquaculture with dominance of black tiger not only in India but most of the South, Southeast Asian, East Asian countries and also first such spurt in South American countries. This period was also marked by establishment of more and more farms along the coast of India. India witnessed a phenomenal increase in the area under shrimp farming which occurred between 1990-1994 and the growth rate was exceptional till outbreak of WSS in 1995.

In fact, farmed shrimp production recorded over fivefold increase from 28000 tonnes in 1988-89 to 144346 tonnes in 2006-2007 and operating at around 100000 tonnes over the years.

The growth trajectory of tiger shrimp aquaculture in Indiais illustrated below.





| Year | Quantity | Trend |
|---|---|---|
| 1994-95 | 74,000 tons | Introduction of Scientific farming of P monodonfrom 1985 -95 |
| 1995-96 | 64,000 tons | Striking of WSSV viral disease and declining production |
| 1997-98 | 60,925 tons | Declining trendcontinued leading to the lowest level of production |
| 1998-2000 | 73,700tons | Stabilisation and revival trend of P. monodon through PCR Screening, Quality seed |
| 2001-2007 | 1,44,347 tons | Awareness, Adoption of PCR Screening method by hatcheries, farmers demanding for PCR tested seeds, Adoption of BMP, Pond preparation, disinfection, biosecurity, stocking , quality seed, feed and other inputs |
| 2007 – 2009 | 97650tons | Relapse of WSSV and other diseases like a loose shell, MBV |

## Reasons of failure

As an undomesticated species without specific pathogen-free seed has limitations for further development in a farming system, and more importantly due to the crop losses due to viral pathogens such as lethal white spot syndrome virus (WSSV), the shrimp farming sector was forced to look for alternate species such as exotic specific pathogen-free (SPF)Vannamei. It is an irony that theSPF stocks have not been developed for any of the indigenous species, and therefore, it was inevitable to import exotic SPF P. vannamei to sustain Indian brackishwater shrimp farming.

From the hatchery side, WSSV was the most important disease of concern followed by MBV and bacterial disease. Again in farming, reduced survival, growth rate, size variation, soft shell, protozoan infection subsequently took the major toll.

The final stroke why people started abandoning monodon was the dip in international priceand demand, volume of production and more importantly outbreaks of WSS and other disease problems.

## SPF seeds

After conducting elaborate risk assessment of the introduction of exotic SPF Vannameiby the Union Ministry of Agriculture and Cooperation in consultation with the ICAR-Central Institute of Brackishwater Aquaculture (CIBA)& National Bureau of Fish Genetic Resources (NBFGR), gave the clearance for the import of SPF vannameifor its introduction in shrimp aquaculture in India in 2009. There wasa phenomenal growth in shrimp aquaculture because of the introduction of SPF– vannamei as the species was cultured under high stockingdensity leading to higher productivity, production and market demand and with minimised shrimp health risk.

This upward trend continued till 2015 when other emerging diseases like RMS, IHHNV also hit the growth of the sector hard. Further, from 2015-16 onwards the declining trend continued due to outbreaks of new disease entities like WFD and EHP and later IMNV.

Owing to such development now the farmers and entrepreneurs are looking desperately for a complementary species, may be a native species like black tiger and indicus..The introduction of SPF monodon by two enterprising companies have shown its potential in changing the landscape of shrimp farming in India. The initial crop of SPF monodon got a very good response as growth rate and production was commendable. With the sharp increase in the demand the current supply is unable to meet the seed demand. Currently there is a long waiting period of about 6-8 months after booking and also the price has also gone high. As a result many farmers are being deprived and discouraged to taking up SPF monodon. Besides, due to the disparity, it also reduced business opportunities for most of the farmers interested in tiger shrimp. Looking at the high demand for even the non-SPF monodon seed, many dubious hatcheries starting to produce monodon seed without proper screening, biosecurity and protocols. If this practice continues, this could be potentially very disastrous for the sector.

## Concerns

More than 90 per cent of the shrimp farmers in India are small landholders owning less than two hectares. The major problem for both the P monodon and L vannameiculture is the disease problem. Health management requires a lot of efforts, more working hourswhich also increases the labour cost along with the high cost of medicines ultimately leading to higher costs of production.

Another major constraint for shrimp farming is the high cost of inputs. One of the major inputs used in shrimp production is feed. Feed solely accounted for around 60 to 70% of the total variable costs.Then, the other major constraint is the availability of quality seed, low survival and perishability of the produce, among others including skilled labour. All these factors affect culturepractice.

Thus, any government decision must be based on the sustainability and profitability of shrimp farmers. The Coastal Aquaculture Authority's decision to allow two hatcheries to produce and sellSPF seeds throughout India may further increase the seed cost. The government must either encourage the import of more SPF broodstockor allow the existing other hatcheries to produce high-quality clean seed under strict scientific supervision and regulations.





## Tackling seed imbroglio

How best to tackle this problem?

a) Looking at the scenario and demand for the monodon seeds, more hatcheries should be allowed to start production of SPF monodon to meet the surging demand. Government agencies should facilitate this at the earliest.

b) Globally there are a few SPF monodonNucleus Breeding Centre (NBC) whichcan provide the required stocks for further development in to SPF brooder for the increasing demand in the sector. It is high time for India to initiate its own program for extensive genetic improvement programme leading to SPF by establishing infrastructure similar to NBCs and BMCs to become self-reliant.

c) Till the imported broodstock SPFmonodonavailability could increase and more hatcheries are granted permission for the SPF seed, clean monodon seeds from certified hatcheries and labs who are following all the protocols very strictly should be encouraged.

d) Even there should be a proper effort by the Government agencies, especially Coastal Aquaculture Authority(CAA), to inspect and monitor these hatcheries during the production cycle. Also the performance evaluation of the native variety vis a vis the SPF variety is very important to understand and give a future direction

e) Presently the deliberation by the regulatory authority (CAA) finally lead the government to allow only two hatcheries having the capability of producing SPF monodon. All other hatcheries who have the licence and capability to produce clean disease-free monodon seeds should also be given a fair chance.

f) Attempt should be made urgently to roll out our SPF monodon which had been initiated through a project in A & N island by MPEDA-RGCA a decade ago. If these desi SPF monodons can perform well in the field, it will give a big boost to the industry.

g) The research institutes should be funded to carry out time-bound research on the indigenous P monodonfor production of clean disease-freeseeds. Surprisingly, the SPF stocks have not been developed for any of the indigenous species in the country and also it is high time to initiate the program for Indian white shrimp.

Like the agriculture sector, the main reasons for farmers' distress are high input cost and lack of market linkage. Though market linkage for the shrimp does not seem to be an issue, the high input cost and prevalence of disease are the major impediments.

Since the demand for tiger shrimp seedwill increase in the coming days, the government must take immediate measures to curb the unregulated and spurious seed production and simultaneously, facilitate increasing production of clean disease-free seeds. The public and private investments may be encouraged to make India Atmnanirbhar (self-reliant) in developing SPF shrimp seeds especially for native species like tiger shrimp and Indian white shrimp.

# Cage aquaculture offers untapped potential to boost fish production

**India has a reservoir resource of 3.51 million hectors but about 0.34 million tons of aqua products are harvested in these water bodies. Cage technology promises to alter this discrepancy and quantitively improve inland fish production. Sagar Mehra, Joint Secretary, Department of Fisheries, Government of India speaks at length on the opportunities and potential available in an interview with AQUA POST Editor Pravash Pradhan.**

**Q.What are the prospects of aquaculture in reservoirs in India?**

Ans: At present, as against the potential of 2 million tonnes from 3.51 million hectors of Indian reservoirs, only 0.34 million tons is being tapped. Indian reservoirs resources have the potential to contribute a significant quantity of fish to the total inland fish production basket by enclosure aquaculture like cages, which offer scope for increasing production by utilizing only a modest fraction of their surface area without the need for more land-based fish farms as these are installed in open water bodies. Cage technology has an immense scope in fisheries as it efficiently utilises the water





bodies and harnesses their natural productivity as it is an eco-friendly, economically viable, socially equitable and technically feasible culture practice.The high production potentials of 500 kg/ha and 250kg/ha in medium and large reservoirs can be achieved by cage culture of diversified high valued fish species.

Hence, cage aquaculture is a hope for new opportunities to boost fish production from the lentic waters like reservoirs by diversification of cultured species and also imparting new skills to fishers and entrepreneurs to augment their income. Attempts to increase reservoir fish production can bring fundamental changes in the society by empowering women and generating livelihood sources benefiting the rural population residing in nearby areas of a reservoir.

**Q. What are the central government's schemes to encourage entrepreneursfor cage culture?**

Ans: To augmentholistic development of fisheries sector, increase fish production through a scientific approach, strengthentraditional/local fishers communities, fish farmers and aqua-pruners, the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India is implementing Pradhan Mantri Matsya Sampada Yojana (PMMSY) – a scheme to bring about 'Blue Revolution' through sustainable and responsible development of fisheries sector in India with an investment of Rs 20,050 crore for 5 years from the FY 2020-21 to FY 2024-25.

Cage culture is a centrally sponsored sector component of the PMMSY, hence, the funding of the proposals are shared by the State and central governments. Central funding as admissible shall be provided as per the funding patterns of the blue revolution scheme.Total Government assistance would be restricted to 40 per cent of the actual cost with a ceiling of Rs 1.20 lakh per unit for the general category and 60 per cent of the actual cost with a ceiling of Rs 1.80 lakh per unit for SC/ST/Women categories.

Apart from these, a Mission Cage Culture-2022, under the Blue Revolution Scheme has been implemented by the National Fisheries Development Board (NFDB) to provide technical and managerial inputs and accordingly, guidelines for cage culture are also issued to assist the stakeholders. Successful cage culture practices in Tilaiya and Chandil dams of Jharkhand are living examples of such endeavours.

**Q. There are certain issues regarding the allocation of water resources like reservoirs and rivers. Local fishermen/communities resist**

**allocating reservoirs to private entrepreneurs. How do you want to address this issue?**

Ans: Considering India's rich and varied open water resources like reservoirs, lakes and floodplain wetlands, enormous scope exists to increase production through leasing water bodies to augment fish production.Implementation of schemes like PMMSY, which do not differentiate between private or public organizations, has paved a way for the bright future for the fisheries sector by allocating water resources andincreasingthe national average production of 20 kg fish/ ha of reservoirs.

Moreover, the guidelines for cage culture have already been issued by NFDB which are mandatory for allto follow. The states and union territories have also framed rules andregulations for the leasing of water bodies.Apart from these, awareness campaigns, training and capacity building programmes are being organized for the fisher communities to remove any disparity.

**Q. There are environmental concerns due to the use of aquafeed. Is there any technical study done by the ministry or research institutes regarding environmental hazards/ sustainability? What is your view?**

Ans: The aquaculture systems rely on feed quality, feeding practices and feeding management for profits, sustainability and viability. Studies in this aspect along with others carried out byvarious researchers, World Fish Center,ICAR-organizationsi.e. CIFRI, CMFRI, DCFR and various state agricultural universities reveal that farmers are interested in high rate of feed consumption to ensure maximum fish production and increase earnings.

However,the unmanaged, surplus or unutilized feed corresponds to an increased waste generation, economic loss,increases fish stress and environmental pollution. Environmental deterioration caused due to aqua-feeds can be curbed by good feed quality and storage, preparing feeding schedule, observing climatic conditions, avoiding overfeeding, following optimal feeding frequency, instalment of feeding trays for sinking feed, grading of fish in regular periods and regular assessment of fish stoked in cages or any other water body.Thus in pisciculture,feed should be fed in such a way as to minimize waste, optimize growth, allow for efficient conversion, and maintain fish health.





# 'Grobest focusses on alternative nutritional approach for high-quality functional feed'

**Ramakanta Nayak, the new chairman of Grobest Feed Corporation (India) Pvt Ltd shares his thoughts about the evolving aqua feed sector, his vision, strategies and the overall view of the shrimp feed business in an exclusive interview with AQUA POST.**

**Q: Congratulations for being appointed as the Chairman of Grobest Feeds Corporation (India) Pvt Ltd. What would be your priority for India?**

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

**Q:What are the new products you are envisioning for Indian aquaculture market? How will your products be different from others?**

Ans: Grobest India is involved in manufacturing high-quality shrimp feed. Though we produce daily health care feeds, our focus remains on our high-quality functional performance feeds. We have been dedicated to use a different nutritional approach to develop functional performance feeds to help farmers culturing healthier shrimps. We have a range of functional performance feeds such as Aqua Supreme, Aqua Prima. In addition, we have introduced a new functional performance feed Aqua Kare recently. In near future, we also have a plan to introduce nursery feed to have a full range of feeds across the growth cycle.

**Q:Shrimp farmers in India (also around the world) are vulnerable to the fluctuating prices of fishmeal, while managing evolving diseases crises at the same time. What is your take on the same?**

Ans: Feed raw material prices are increasing due to various reasons which is impacting the price of finished feed cost. It is inevitable for aquafeed companies to increase the cost. At this crisis, farmers are likely to skip cycles so as not to lose money. Instead, farmers must be wise enough to select and use good-quality feed with proven nutrition and researched feed formulation, combined with the correct feed management practices. This may provide shrimp with a balanced nutrient profile, allowing them to thrive and grow and enabling shrimp farmers to see an increase in feed efficiency and a good economic return on their production.

Q:Alternative ingredients for aqua feed are growing rapidly as more stable sources of protein. What is Grobest's strategy in this regard?

Ans:Feed aquaculture relies on basket of protein rich ingredients such as fish meal, fish oil, soybean meal etc. At present, aquaculture feed industry is confronted with pressing issues like limited availability and escalating cost of raw material. It is need of the hour to find less expensive alternative protein sources, while focusing on reformulation using alternative ingredients. We consider that reformulation doesn't affect the nutritional value of feed as well as shrimp. Formulation is our strength and we never compromise on the same. We are working on balanced formulations based on alternative protein sources which



result in improvement in the overall nutritional quality as well as considerable reduction in the formulation costs.

**Q: Grobest is known for pioneering in R&D and supplying aquatic functional feed. Please let us know your plans for Indian market regarding functional feed.**

Ans:With our R & D we have invested a lot with several universities around the world where we bring in secrets of ingredients which are available naturally, but we bring it in such a way through our functional performance feed which helps in improved health and growth of the animal. We are the first one to introduce functional performance feeds in Asian Market. With our proven successes of introducing different functional performance feeds in Vietnam and Thailand, we started campaigning as well as standing by our farmers and educating them about our functional performance feeds. Our functional feeds contain specialty ingredients that help in strengthening the immune system of the shrimp and helps the shrimps to respond better during environmental stress. Our farmers are happy with the usage of functional feeds as it helps to reduce stress and improve the immune system to counteract the opportunistic pathogens present in the culture environment. It also helps in minimizing the impact of diseases and assures crop security to the farmers. The usage of functional performance feeds is the best strategy in preventing diseases and we recommend farmers to use from the beginning of the crop.

**Q: Several multinational feed companies are trying to capture India's growing market. It has become a challenge to get trained and skilled human resources and retain them. What is your view in this regard?**

Ans: We really value and support our human resources, provide a better workplace and maintain strong manager-employee relationship. We have a strong sales and technical team that is experienced and skilled enough in the field of shrimp aquaculture. Apart from their skills and knowledge in the aquaculture field, we do educate our team about our products and recent developments in the field of aquaculture. We happily invest a lot for professional development of our team and give constant support, encouragement, and rewards. It is inevitable that some team members will leave us sooner than we would like. We do continuously re-evaluate our efforts and strategies to have a strong team.

**Q: There is stiff competition among the feed companies to acquire new farmers and retain existing farmers' base. In this scenario, what would be Grobest's strategy to win the trust of farmers and increase its footprint in different states?**

Ans: Grobest is the functional performance feed company. It helps to improve the farming outcomes in a sustained manner. In next few years, we want to fortify and become a company to be known as "Farmers Friend" where we will be to bring the latest technology and cost savings to the shrimp farming community. We want to be recognized as a company which can solve farmers challenges be it cost of production or disease mitigation. We provide solution to the farmers by promoting growth and boosting immunity, health through innovative formulation and in-house functional feed additives. We are for farmers and we fight to make our farmers successful.

# 10 point program for profitable shrimp farming

**Dr Manoj Sharma, MD, Mayank Aqua, Surat**

Shrimp farming has seen immense growth after 2009 and has made India stand tall as one of the highest shrimps producing nation in the world. The intensification in the shrimp farming practices led to increase in the organic matter accumulation in the surrounding water bodies which led to increase in the pathogenic microorganisms. During recent years shrimp farming in India has been facing production issues due to various disease outbreaks and has impacted the profitability of the shrimp farmers. Hence, it is important for the shrimp farmers to maintain certain protocols for the sustainable shrimp farming. Herein below are the 10-point rule guide which a shrimp farmer should follow to ensure his profitability.

1. As water is crucial to the shrimp farming, it is really important to improve the farm design to meet the water demand. Double settlement and double treatment of water should be done to avoid excess organic load entering the culture ponds. The farm design should dedicate 40% of its area for the water treatment system.
2. The purpose of the water filtration system should be to avoid the disease vectors, mechanical carriers and unwanted aquatic species entering the culture ponds. Utilizing 4-step filtration system will ensure extra safe water. Use of 20, 40, 60 and 80 mesh nylon nets for filtration and they can be installed in the water intake or feeder canal.
3. It is important to maintain the pond bottom soil to ensure better protection against pathogenic microorganisms especially EHP. Pond bottom soil conditioning can be done by increasing the soil pH more than 10 by use of CaO at 5000-6000 Kg per ha. Mix lime in top layer of pond bottom, moist well with water, keep for 3-4 days to disinfect the spores. Flush out excess lime with water and dry

**Shrimp'nomics**

4. Water preparation for culture is key to a successful crop. After the filtration and disinfection of the pond, apply good quality pre-biotic and probiotic products to develop beneficial microbes in culture pond. It is very important to have good numbers of phytoplankton and zooplankton as natural food as it gives immunity to the shrimps
5. Seed quality is of prime importance for the shrimp farming success as the bad seed quality will have detrimental effects on the culture ponds. New emergent diseases must be identified at hatchery level. Ensure proper seed quality at hatchery personally. Farmers should personally check the shrimp seed status and should never trust directly on hatchery supply.
6. Feed and feeding management is of vital importance in shrimp farming as 55% of the shrimp production cost is dedicated to the feed. I strongly recommend 4 meals in the first month, 6 meals in the second month, 8 meals in the three months and 10 meals in the fourth month for better growth and less feed wastage. Usage of auto feeders are very helpful.
7. Sludge management is in great fashion and beneficial to large extent, but sludge removal from pond should be disposed of responsibly. Keep extra sludge pond or pit mandatory and never dispose of sludge directly into creek.
8. Shrimp health monitoring is very important on regular basis. Keep a close watch on the size and shape of the hepatopancreas of the shrimp. Regular water quality analysis will help control water parameters especially bacteria like Vibrio spp.
9. Biosecurity is insurance to shrimp farming. Farmers should invest in practical biosecurity at their farm. Steps like vehicle wash, bird and crab net, foot and hand wash will give you extra safety.
10. Finally, it is important to grow the shrimps as per the market demand. Do not follow the old thumb rule of growing less than 30 counts. It is better to have a pre-contract with the shrimp processor and grow the shrimp suitable to the market demand and requirement.

Wish you all the best, Happy shrimp farming.





# Entrepreneurial possibilities of Indian Catfish

Debtanu Barman & Amit Bera

**The DesiMagur and Singi are known for fetching high returns, not only because of the inherent demands but also due to the medicinal properties associated with them. This article offers a detailed end-to-end account of the selection, management and breeding procedures of these varieties.**

## Introduction:

DesiMagur and Singi or stinging catfish is widely distributed in the Indian sub-continent. It is a popular air-breathing catfish having high food value owing to its medicinal importance and a suitable species for aquaculture diversification. It grows to a size of 150g to 400g. The breeding and seed production technology has been extended to almost all the states of the country.

## Brood Fish Management:

- Brooders require extremely good water quality and proper feed to attain maturity in captive conditions.
- Breeds in captivity during monsoon season, but seed procurement from natural resources is very difficult.
- Cement tanks with the provision of soil base of 4-6 cm thickness are used for brood rearing.
- Brood fish are brought into the cisterns at least 2 to 3 months prior to the breeding season to avoid collection problems in ponds during the rainy season.
- Brooders are fed twice daily with fish meal-based feed containing 30-35% protein @ 3-5% of the body weight.
- Water quality in brooder tanks should be maintained at optimum level by exchanging 20-30% water at fortnightly intervals.

## Selection of Good Quality

## Brooder:

- Magur usually breeds from June to August.
- Brood fishes of 100-150gm are considered the ideal size for induced breeding operation during June-August.
- Male has elongated and pointed genital papilla near anus whereas the female has round and button-shaped genital papilla and in case of fully matured female, bulgy abdomen and reddish vent indicate readiness to spawn.
- Female maturity stages can be examined by gently inserting the soft-flexible catheter into the vent.
- The female is suitable for breeding when egg size is 1.2 to 1.4 mm.
- Singhi usually breeds during monsoon season.
- Mature female Singhi fish are identified by the bulged abdomen and round vent, and males have a slender body and pointed anal papilla.
- Fully mature Singhi females and males are segregated in the ratio of 1:1 for breeding.

## Breeding Procedure of DesiMagur:

- Synthetic hormones such as Ova-Fish/Spawn Pro and Carp pituitary gland extract are successfully used as an inducing agent for Magur.
- Successful induced breeding requires 2 ml/kg body weight synthetic hormones (Ova-Fish/Spawn Pro).
- The optimum dose of carp pituitary gland extract is 30-40 mg/kg body weight.
- The females are stripped after 16-17h of injection to get ovulated eggs.
- As the male brooders do not respond to stripping, the males are to be sacrificed for the collection of testes. The male with creamy white testis is selected for sperm solution preparation.
- The sperm solution can be prepared by macerating testis in normal saline solution (0.9 % Sodium Chloride, NaCl) to get sperm suspension.
- The ideal sex ratio for higher fertilization is 1 male and 2-3 female.
- Female of 100 gm gives 4,000-5,000 eggs.
- Eggs are round, dark brown and adhesive.
- Fertilized eggs after 3-4 times washing after stripping are transferred to the hatchery tubs/tanks.
- The eggs are hatched in 24-26 h and yolk-sac is absorbed in 70-80 h.
- Spawn is reared in indoor tanks @ 1,000-1,500/m2 for about two weeks.
- Larvae are fed with live feed (Tubifex, Brine Shrimp etc.) followed by compound larval feed to obtain a survival level of 80% at fry stage.





**Backyard Catfish Hatchery Estimated cost:**

| Economic Analysis | | | | |
|---|---|---|---|---|
| Sl. No. | Component | Quantity | Price (as per market) | Amount |
| 01. | Brood Fish (M/F) | 4p (250gm) | 600 per kg | ₹150.00 |
| 02. | Scissor | 1 | 50 | ₹50.00 |
| 03. | Tweezer | 1 | 30 | ₹30.00 |
| 04. | Plastic Tub | 2 | 250 | ₹500.00 |
| 05. | Steel bowl | 2 | 45 | ₹90.00 |
| 06. | Cotton Net (Small size) | 1 | 40 | ₹40.00 |
| 07. | Hormone | 1 (10ml) | 380 | ₹380.00 |
| 08. | Injection Syringe | 1 (1ml) | 10 | ₹10.00 |
| 09. | Air Pump (Small) | 1 | 120 | ₹120.00 |
| 10. | Air Pipe & Stone | 1 Unit | 40 | ₹40.00 |
| Total | | | | ₹1,410.00 |

*(Views expressed are personal. NFDB-MANAGE, Aqua One Centre (AOC, Kolkat*

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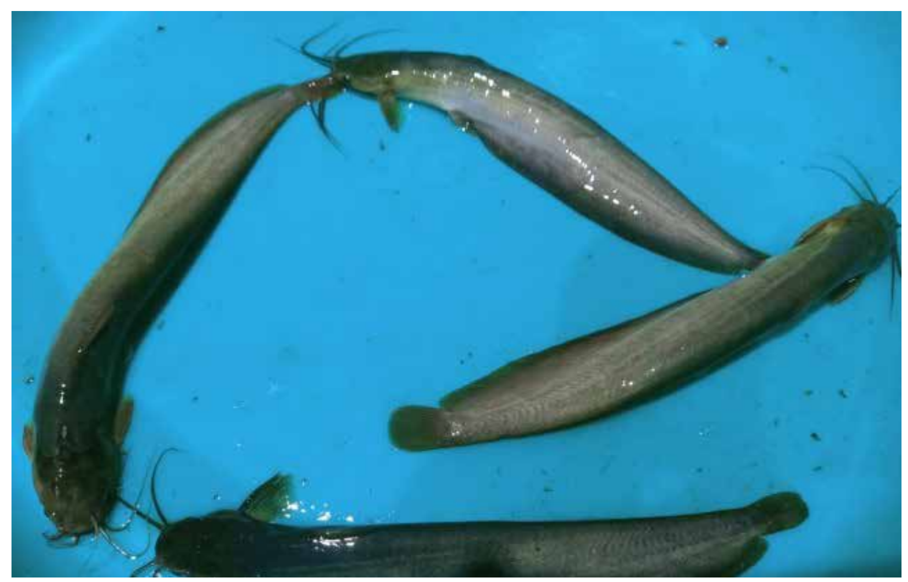

## Breeding Procedure of Singhi:

- Females are injected with hormones like Ova-Fish/ Spawn Pro @ 1.5-2ml/kg body weight or pituitary extract @ 15-20 mg/kg.
- Stripping is generally done 10-12 h post-injection.
- The male milt-suspension in normal saline is prepared before stripping.
- Stripped eggs are mixed with milt-suspension and washed 3-4 times with water.
- Eggs are spherical, dark-brown, adhesive having a diameter of 1.4-1.6 mm.
- Eggs are incubated in flow-through hatchery where hatching occurs at 22-24 h.
- Generally, the fish lay 1,500-2,000 eggs/g ovary weight.
- Newly-hatched larvae are 2.6-2.8 mm in length.
- Yolk-sac is absorbed on the fourth day.
- Larvae are reared at a density of 3,000-5,000/m2 for 12-13 days in the hatchery.
- They are fed with mixed zooplankton or Artemia nauplii or Tubifex worms to get 12-15 mm size fry.

# Domestic aqua feed market to reach USD 2.3 billion by 2023

Shiba Shankar Giri, Baidya Nath Paul,
Sangram Ketan Sahoo, S. Ferose khan, Ashsis saha

## Introduction

World fish production has reached 178.5 million tonnes (mmt) with an aquaculture production of 82.1 mmt in 2018. The global aquaculture market is set to reach USD 245.2 billion by 2027. During this time, total 156 million tonnes were used for human consumption, equivalent to an estimated annual supply of 20.5 kg per capita.

With average annual growth rate of 6.6 per cent since 1995, aquaculture became the potential contributors to food and nutrition security and livelihoods at global level. The world aquaculture production of fish was accounted for 46 per cent of total fish production (including for non-food uses) in 2018 compared to 12.7 per cent in 2000, and it is predicted to increase to 50 per cent of the total projected fish production of 189.1 million MT in 2030.

However, the contribution of aquaculture in Asia has already crossed over 50 per cent of the total fish production. In India the annual fish production is 14.16 mmt with export value of 46662.85 crore rupees with an aquaculture production of 7.066 mmt.

## Aquafeeds

Feed is the major contributor in aquaculture and shares about 50-80 per cent of the total production cost. Feed has got a significant impact on the quality, safety and nutritional value of farmed fish. The feed requirements of





fish vary in quantity and quality according to the feeding habits, physiological stages of the species and environmental variations viz., temperature and the amount, and type of natural food availability in the culture system.

In India the bulk of the finfish aquaculture production takes place in semi-intensive earthen pond farming systems. The great majority of these farming systems and in particular freshwater non-carnivorous finfish production (which accounts for over 80 per cent of the total finfish production in India) depends on farm-made feeds as supplementary feeding. The natural pond productivity contributes significantly to the nutrient requirement of these species, reducing the feed costs.

In India three categories of feedings are followed in aquaculture, (i) use of industrially produced pelleted feed (intensive), (ii) use of industrial and farm-made feed mixes (semi-intensive), and (iii) use of on-farm farm-made feeds consisting of a mixture of locally available feed ingredients (traditional/ extensive).

As a common practice, carps and omnivores are fed with bran-cake mixture with a FCR of 3.0-4.0 in semi-intensive system of aquaculture. The FCR for industrially compounded feed for fish and shell fish ranges between1.5-2.0. There are three factors to consider in the choice of feed ingredients for aquafeeds,(a) quality - nutrient composition and presence of any anti-nutrients (substances that interfere directly with the absorption of nutrients or contaminants); (b) quantity – quantum of availability and is in regular supply; and (c) price of ingredients. Also, the other challenges of fish feed management are feed formulation, feed processing, storage, handling and transport.

The total production of aquafeeds in 2014 in India was estimated at 1.25 million MT of which shrimp feed production was approximately 600,000 MT, and fish feed production was 650,000 MT. This was only 43.4 per cent of the total feed requirement for aquaculture in the country.

If the feed production of all smaller feed mills are included, the total feed production in 2014 was more than 1.5 million MT. As thumb rule, in India the ratio of farm-made and commercial feeds used in aquaculture is 70:30. At present approximately 3.3 million MT of farm- made feed is used. At present over 7 million t of feed is used for the aquaculture industry in the country, with an annual feed production growth rate of 10.4 per cent. India imports more than 50 per cent of

aquafeeds from other countries. So there is huge scope of domestic manufacture of aquafeeds. At present, the retail price for shrimp feed is approximately USD 1.10 to USD 1.40 a kilogram.

Farmers paying cash are given a discount of 10-15 per cent, while dealer discounts are usually 10-15 per cent. The feed mill profit is 10-15 per cent. The India Aquaculture Feed Market was valued at USD 1.20 billion in 2017 and is expected to register a CAGR of 10.4 per cent during the forecast period (2018-2023) and to reach USD 2.3 billion. India feed mills have the capacity to produce 2.88 million metric tonnes fee per annum.

## Farm-made Aquafeeds

Carps are the mainstay of South Asian aquaculture. They are of omnivore in feeding habit and mainly fed on plant based feeds. As normal practice, carps are grown in semi-intensive earthen ponds polyculture system, across the region. Supplementary feeding is practiced and majority of the micronutrients get available from the pond.

The natural productivity of ponds is maintained by application of animal and poultry excreta and chemical fertilizers. Across the world, about 50 per cent of the aquaculture production is feed based, but in India the fed fish production is less than 20 per cent only. Many of the small and marginal farmers grow carps in back yard ponds (extensive system of aquaculture) without feed. They are also not aware that fish require feed for growth.

Keeping in view the high target of fish production of 22 mmt fish production with a target 12 kg fish consumption by 2025 in Prime Minister's Matsya Sampada Yojana (PMSSY), while capture fisheries production is almost static at present, the feed based aquaculture is the only solution to meet the future fish demands. To achieve the goal of 3-4 times of present fish production growth, at least 70-80% fish should be raised with feeds.

During 2017 1.5 mmt of industrially prepared feed and about 5.5 million mmt of farm-made feeds were used in aquaculture. Generally 3.0-4.0 kg farm-made feed is used for a kg of carp production. In polyculture carps are fed either deoiled rice bran, or oil cake or combination of rice bran and oil cake at a ratio of 10:90 cake:bran mixture.

The juveniles are grown only on deoiled rice bran to reach 350g of body weight, and above that body weight the fish are fed on deoiled rice bran and oil cake mixtures. Mustard oil cake, ground nut oil cake and cotton seed cakes are used as oil cake sources. Animal proteins are never used in carp polyculture in India. Daily, 8-10 perforated bags, containing 5-18 mash feed in each bag, are hanged in an acre of pond water area for feeding during the grow-out period of 8 months, till harvesting.

The Indian Council of Agricultural Research (ICAR) during 11th Five Year Plan of India lunched an outreach program on "Fish Feeds" which also continued in 12th Pan period in a network mode with participation of 6 ICAR Fisheries Research Institutes. The project aimed to address certain vital issues in the development of quality feeds and its management in achieving the enhanced production of prioritized fish and shrimp species to meet India's growing demand. The objectives were designed to develop both live and formulated farm-made feeds for improved larval survival and growth, feed management strategies in tune with biological rhythms for grow-out culture, to explore the possibility of improved feed utilization through the application of biotechnological principles and metabolic responses.

Over a dozen of farm-made feeds were formulated and developed for freshwater, brackishwater, marine water and cold water





species and cage culture to strengthen the culture practices and made available for mass use and popularization in different sectors (DARE Annual Report, 2012).

Inventory of feed ingredients availability across the country, their chemical compositions were tabulated, and feed formulations with use of locally available cheap ingredients were prepared and published (Mohanty et al. 2012). Several skill development programmes in terms of hands-on trainings and participatory demonstrations were organized to reach the fish farmers. Farmers could produce 4-6 MT of carps/ha pond/ year, on feeding farm-made feeds with 1.5-1.6 FCR, from their earlier production of 1.0-1.5 MT/ ha, with use of farm-made feeds (Rath et al, 2014; Paul etal 2017).

## Opportunities in Aquafeed Market and Industry

- The increasing purchasing power, changing food habits and increasing exposure to global cuisines by the Indian population are the factors of increased fish consumption, which ultimately indicating the future positive growth of the feed market in the region.
- The aquaculture industry in the country has been transformed from backyard activity to integrated and technology driven farming on a large scale. This approach has transformed aquaculture activities in to a profit making organized sector and looking for the feed based aquaculture but huge quantities of aquafeeds are still imported.
- Fish and fish products are considered healthier, nutritious and is available at relatively cheaper prices than the other animal proteins. Due to these reasons aquaculture feed industry in particular is seeing good growth.
- In recent years, shrimp segment has geared up to meet the demands of export markets and is expected to grow further.
- The annual per capita fish consumption in India is still one of the lowest on a global level. This is an opportunity for further integration as well as growth in the industry and also the feed market.
- The aqua feed industries are largely unorganized and traditional feed as their major product. This is a clear indicator of the scope of entry of newer companies to make the markets more organized and bring a shift from traditional feed to better commercial feed.

## Outlook

Exploration and identification of alternate indigenous feed resources and formulation of region specific, cost effective farm-made feeds can reduce the feed costs and minimize future feed demands from aquaculture. The guide lines for farm-made feed processing and manufacturing, handling, packaging, labeling and on-farm storage are the way forwards to maximize feed utilization, reducing feed wastage.

For better resource management to meet the future challenges of feed scarcity and to prevent pond bottom sediments deposition for clean water fish farming, large fish farmers may be educated to use pellet feeds in aquaculture. At the same time, to increase production and more farm returns, small and marginal farmers must be educated on importance of feeding in aquaculture, and trained on farm-made feeds preparation using locally available cheap ingredients. Enhancement of natural pond productivity would reduce the feed use as well as cost of production.

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*Natural habit*

# Commercial farming of agarophytes Gracilariadura and G. debilis

Vaibhav A. Mantri, V. Veeragurunathan,
Monica GajananKavale, S. Thiruppathi

**Seaweeds are increasingly being farmed rather than collected from the wild. The recent estimate suggests that commercial augmentation has reached a new milestone with 32.39 million tons year-1 production (97.1 per cent account to farming) with a market value of over USD 13.3 billion.This article illustrates two industrially lucrative red alga Gracilariadura and G. debilis from Indian waters. It describes the habit, taxonomy, various farming methods for sustainable production of biomass and economics of farming.**





## Introduction

Generally marine aquatic forms of macroscopic algae are known as seaweed, and the microscopic forms suspended in marine as well as freshwater columns are planktons. Both the forms are crucial as primary producers of the marine ecosystem and for ecosystem servicing. Based on pigment composition and stored food reserve, seaweeds are divided into three classes ~ Chlorophyceae (Green), Rhodophyceae (Red) and Phaeophyceae (Brown). They form economically important, marine, renewable resources supporting humankind directly, through unique phycocolloids such as agar, alginate and carrageenan. The phycocolloids obtained are employed in the several commodity products like toothpaste, cosmetics, ice-cream, textile which are indispensable part of our daily routine. Although the hydrocolloid industry has registered 2-3 per cent growth per year; burgeoning populations are bound to exert considerable pressure on demand supply economics. Considering the importance of this unique product, farming practice is established globally for the sustainable production of raw material. It is an appropriate opportunity for livelihood creation to the coastal community as well.

The need of augmenting agarophyte resources in India was originally felt during post–World War II. The Board of Scientific and Industrial Research at the Research Department of the University of Travancore during 1942 – 1946 prepared a small quantity of agar that was used for preparation of cholera vaccine. The subsequent efforts for capacity building in indigenous agar production and sporadic export trade based on wild exploitation propelled cottage-scale industry especially in and around Madurai. The establishment of seaweed landing centers in Gulf of Mannar and also along the Palk Bay yielded production of ~ 30 t by mid 1960s. Today India requires 1000 tons of agar annually, of which only 30-40 per cent is being produced domestically, leaving us heavily dependent on import.

CSIR-Central Salt and

*Natural habit*

Marine Chemicals Research Institute undertook pioneering experiments for the first time in the country to ascertain the feasibility of agarophytes farming – G. edulis – in the lagoon area of Krusadai island. The vegetative fragments were used by adopting the 'Long line rope method'. Three harvests were made with effective crop yield of 3.5 kg fresh m-1 rope. Wherein pilot scale farming experiments yielded 20 tons dry ha-1 yr-1 in three harvests. Several methods such as Long line rope method, Net culture, Single rope floating raft technique (SRFT), Floating bamboo raft, Bottom culture method, Suspended stone method etc were further developed for different agarophytic seaweeds (Subba Rao et al. Although these experiments proved efficiency of farming techniques, it was not until recently that commercial cultivation was attempted. The domestic agar industry still heavily depends on wild biomass. The harvest at the landing center along Tamil Nadu coast ranged between 102 – 560 dry t year-1 for Gelidiellaacerosa and 105 – 982 dry t year-1 for G. edulis. The cumulative harvest for these two principal agarophytes recorded 13,698 dry t and 12,421 dry t during 1978 – 2016. The agar yield from common species ranged from 25 – 40 per cent d wt with gel strength of 195 – 300 gm/ cm2 thus has not been acknowledged for superior quality.

It may be noted that with the advent of new processing technologies, protocol for extraction of high quality polysaccharide from select agarophytes was developed by CSIR-CSMCRI. The user-friendly technique for production of agarose of high gel strength >1950 g cm−2 (1 per cent gel at 20 °C), with yield of 20–22 per cent from G. dura was reported It may also be noted that, superior quality non-methylated and low-sulfatedgalactans 490 - 650 g cm−2 (1.5 per cent gel at 20 °C), with yield of 13.1 – 14.8 per cent from G. debilis was reported. While the ormer has applications in molecular biology, biotechnology and medical microbiology and later as viscosifier, stabilizer and emulsifying compound in food and dairy industry. But industrial exploitation can only be possible if these resources are farmed at commercial scale.

CSIR-CSMCRI has recently developed the viable technologies for farming these two agarophytes. The pre-commercial farming of these two seaweed was undertaken under two different programs. National Fisheries Development





Board, Hyderabad has funded a project where farming of Gracilriadura was attempted on large scale along Simar, Gujarat during 2017 – 2019. Pre-commercial farming of G. debilis was undertaken under Council of Scientific and Industrial Research funded program at Thonithurai, Tamil Nadu during 2014 – 2016. The farmed biomass was tested by two leading agar industries for its yield as well as gel characterization for benchmarking in the market products. The product from G. dura has been approved by M/s. Himedia Laboratories Mumbai, India and M/s. Madurai Agar and Alginate Manufacturing association, Madurai, India for G. deblis. These developments along with success of pre-commercial trials have promoted the farmers to start cultivation of these taxa. This commentary describes, biological, ecological and farming methodologies for these two potential agarophytes of Indian species.

## Two emerging agarophytes of Indian coast:

### Gracilaria dura

**Brief description of the plant, habitat, taxonomic position**

Plants grow in intertidal region, green to reddish brown, dark pink color, 3-7cm in height; cartilaginous, cylindrical up to 0.5 cm in diameter, irregularly branched, discoid holdfast at basal end. The branches are broader at the base and successively become narrower towards the tip with pointed apex. Cystocarps spread on thallus and globule shaped. Tetrasporophyte is bigger in size than gametophytes and have long and slender branches. It has a known range of distribution in the Indian Ocean; whereas along the Indian coast it was reported from Veraval coast, Gujarat; Alanthali to Manapad, Nallathanni island, Tamil Nadu.

Taxonomic synonyms: Sphaerococcusdurus, Gigartinadura, Gracilariarubra

## Methods of farming:

Although experimental farming was carried out by five different methods namely, floating raft, polypropylene net, hanging rope technique, net bag and net pouch method along the South eastern coast of India; commercial farming along the Gujarat coast used monoline method and tubular net method. The cultivation was viable for eight months from September to April.

The methods are described below.

## Mono-line Method:

It consisted of vegetative seed material (5 to 10 gm) tied to 25-meter long polypropylene ropes. The plant material is held along the rope with the help of tie-tie technique (material tied with birder rope and then again with cultivation rope). A single monoline was seeded with approximately 1.5 to 2 kg seed that generally grows around 3 to 6 times within 30 to 40 days of growth cycle. The monoclines were transplanted in the open sea parallel to the wave action, anchored with stones and fitted with floats for bouncy.

## Tubular net method

The tubular net (25-meter) made up of HDEP food grade plastic having 10cm diameter and 1.5 cm mesh size was used. The tubular net was seeded with the help of PVC pipe (lesser diameter of tubular net) and polypropylene rope (details given elsewhere). Each net was seeded with 10 kg of initial biomass that generally grows around 3 to 6 times within 30 to 40 days of growth cycle. The tubular nets were transplanted in the open sea similar to that of monolines and anchored.

## Economics

Approximately 4.5 hectare area is required for two cultivators which incorporates about 1080 tubular nets (@6 tubular net day-1). To initiate with 4.5 hectares, one has to invest, yearly input cost of 2394.88 US$ for initial infrastructure (boat, anchor stones, polypropylene ropes, plastic floaters). Among these infrastructure, boat (@ 680.36 US$) is one-time investment, anchor stones (@ 0.13 US$/ stone), plastic floaters (@ 0.34 US$ piece-1) can durable for 3 to 5 years; polypropylene ropes (@ 2.92 US$ kg-1) can utilised twice while tubular net (@ 0.61 US$ piece-1) will be recurring for each cycle. Six cycles of 30 days can be obtained during October to April. Two cultivators can produce 3.24 tons of dry weight @ 3 kg tube-1. This had an economic value of 4408 USD (at the prevailing market value of 1360.73 US$ ton-1 of dry weight). The cost towards infrastructure of tubular net method was found to be 2.394.88 USD (only for five cycle). The infrastructure cost including one set of tubular net would be provided by NFDB for initiating commercial farming. The fishermen only need to spend on tubular net for further five cycles. The estimated profit was 3850.86 US$ which corresponds to 160.74 US$ person-1. The break-even point came after 23 days.

## Gracilariadebilis

Brief description of the plant, habitat, taxonomic position

Plants grow in intertidal and subtidal areas, cylindrical, succulent in nature, dichotomously branched at the upper end, branches joined together, dark green and red in color,6-10cm height (Fig. 1b). Tuticorin, Krusadaiisland, Pulluvinichalli island, Upputhanni island, Anaipar island Pamban, Tiruchendur, Tamil Nadu; Saurahtra coast, Gujarat; South west coast, Kerala, Nicobar islands.

Taxonomic synonyms: Gracilariaobtusa, Gracilariafergusonii

## Method of farming

**"It may be noted that over 200 seaweeds are harvested from the wild from 32 different countries; however, only 12 of them are being cultivated on a commercial scale. Despite economic slowdown in the seaweed trade, agarophytes are the only taxa for which the commercial sale has increased in the last decade. The regional farming efforts have enormously contributed towards feedstock availability for the industries to cater to the domestic needs. "**

Floating bamboo raft method employed for commercial farming along Ramnad coastal region, South east coast of India. Year round cultivation is possible by this method and higher growth from September to April. The methods are described below.

Floating Bamboo Raft method:

It consisted of a 2 x 2 m square frame and 20 vegetative seed material (13 to 25 gm) tied to 2.5-meter polypropylene rope at 5 cm intervals by nylon thread following tie-tie technique (material tied with nylon thread and then again with cultivation rope). A raft with 17 seeded ropes had an initial seedling density of 4.42-5.1 kg fr. wt. The underside of the raft was covered by fishnet in order to prevent grazing and drifting material from seeded ropes. The rafts were anchored at the average depth of about 1.5m with natural stones

## Economics of cultivation

As per economic model proposed by Veeragurunathan et al, 15 beneficiaries are able to place 2700 rafts from which yield of 56.7 t dry. wt can be obtained from 6 harvests of 45 days each (@ the rate of 3.5 kg. dry wt. raft-1). This had an economic value of 34719 US$ (at the prevailing market value 612.33 USD ton-1 dry. wt). The cost towards infrastructure was found to be 7.62 US$ raft1 and the total cost for the infrastructure was 20574.22 US$ (for 2700 rafts). However, the group can avail the existing subsidy of 9606.75 US$ (50%) given by the State Fisheries Department. The estimated profit was 22611.24 US$, which corresponded to 125.72 USD per person per month. The break-even point came after 126 days when 19.8 t dry seaweed was produced which had a market value of 12124.10 US$.

In order to develop capacity in seaweed farming, around 150 fishermen were given hands-on experience in seaweed farming along Gujarat coast while 600 fishermen were trained along Tamil Nadu. The aim was to create diversification of livelihood along Gujarat and provide alternative livelihood to fishermen in Tamil Nadu. There are 14 coastal villages in the Gulf of Mannar region from which 1555 fisher (1270 women and 285 men) engaged in harvesting agarophytes from natural habitat. The continuous harvesting of agarophytes for the past few decades has dwindled the resource to the alarming extent that there is urgent need to restore natural beds. CSIR-CSMCRI moved ahead to promote it through Public-Private-Partnership (PPP) mode. In November 2019, a meeting was organised wherein the beneficiaries who were trained by CSIR-CSMCRI were brought together with the stakeholder user industry (M/s Aquagri Processing Private Limited, New Delhi and Indian farmer's Fertilizer Cooperative, IFFCO) to commemorate the commencement of commercial seaweed cultivation in Simar, Gujarat. IFFCO assured the buy-back of seaweed produce at a pre-agreed rate and also agreed to provide initial support to establish the infrastructure for seaweed cultivation and preservation of germplasm.

## Opportunities and constraints:

The agar industries in India exclusively rely on harvesting of natural resources for raw material processing. However, in the natural collection the possibilities are higher for contamination with other unwanted seaweed (internationally or unintentionally) as there are no pure strands of single seaweed. Such seaweeds are generally 60-70% pure (Subba Rao et al., 2004). The value of naturally collected seaweed ranged from 0.13-0.27 US$ kg-1 dry wt. But if the cultivated seaweed is harvested there would not be contamination with other weeds thereby the cost of raw material (homogeneous pure quality) industries are ready to procure such material with 2-fold increase. The other problem in natural collection is that, it also brings sand and other debris with 35 – 25% moisture content due to lack of post-harvest protocol, the cultivated material would be free from such impurities and can be processed to reduce moisture content to get higher and reliable yield. The majority of agar industries in India prefers the production of food grade agar rather than pharmaceutical and bacteriological grade agar. These two potential species would provide ample opportunities for quality biomass that can fetch better market profit, further the constant biomass supply would ensure indigenous production thereby reducing dependency on import.

The major constraint is continuous seed supply of viable planting material. CSIR-CSMCRI has established proof of concept of production of seed via-clonal propagation in G. dura from apical fragments (Saminathan et al., 2015). This method is being scaled-up under CSIR Mission Mode project on seaweeds to ensure constant supply seed for commercial operations. The second hindrance is feasibility of undertaking commercial activities is not yet established beyond Gujarat and Tamil Nadu. It may also be noted that CSIR – CSMCRI would be undertaking the PAN-India seaweed farming project during 2020 – 2023 along 120 select locations of all the coastal states including union territories. The efforts of these initiatives would certainly help in diversification of livelihood and saving on foreign exchange by indigenous production of agar and agarose.

*(The authors are associated with the CSIR-CSMCRI, Bhavnagar. They can be reached at vaibhav@csmcri.res.in)*

# Non-edible seed protein isolates formidable source for sustainable aqua production

By Manish Jayant and Dr Narottam Prasad Sahu

**The ever-expanding aqua industry today is increasing looking at exploring alternative high quality protein feed sources as a substitute. As conventional feed sources confront with challenges such as reduced productivity, this article pitches for investing resources in non-edible seed for protein isolates as an ideal approach to meet the nutritious feed requirement and sustain aquaculture production.**

## Introduction

Feed represents the single largest input in aquaculture operation and accounts for 40-60 per cent of the total cost of production based on the intensification of the culture system. Presently, the global production of commercial aqua-feeds stands at about 1.07 billion tons, and 40 million tons is shared by the aquaculture sector. Unlike the terrestrial animal, the protein requirement of fish and shrimp is higher.

Soybean meal (SBM) is at present the most studied and commonly used alternative protein source for many aquaculture species, accounting for about 50 per cent of the protein sources in the diets of freshwater herbivorous/ omnivorous fish species. This is due to its high protein and energy contents, high digestibility and relatively well-balanced amino acid profile. Its feeding value is unsurpassed by any other plant protein source and it is the standard to which other protein sources are compared.

The rapid expansion of aquaculture and the increasing cost of soybean meal has fueled the





demand for alternate high-quality plant protein sources.Irregular rainfall, reducing productivity and consistent demand for the conventional feed ingredients and direct competition with other food-producing sectors have affected the feed ingredients' price.

Marginal or steadily growth of present agriculture systems i.e. rice/paddy, wheat and oilseeds production is the foremost challenge to fulfilling the extra demand of wheat bran, de-oiled ricebran and different oilseed cakes for different animal production sectors. Therefore, there is a need to explore the substitutes for these conventional feed ingredients to achieve sustainable animal production, especially fish production.

Alternate protein sources should be widely available, nutritionally compatible for cultured species, and cost-efficient for sustainable aqua-feed development. Hence, there is a need for its replacement with affordable non-conventional plant protein sources, which are available in large quantities, and would be beneficial in reducing the aquafeed costs. Therefore, in the present scenario, non-edible oilseeds cake or kernel would be the most preferred choice provided they are made free of toxic and antinutritional factors.

Non-edible oilseeds as feed ingredients

Non-edible oilseeds contain more than 30 per cent oil and could be used to produce bio-diesel. In India, Jatropha (Jatropha curcas), castor (Ricinus communis), mahua (Madhuca indica), karanja (Pongamia pinnata), neem (Melliaazadirachta), and rubber (Hevea brasiliensis) etc. are the major non-edible seeds. Production of these non-edible oilseeds is around 11.0 million tons per year. These oilseed trees are widely present in different parts of the country such as Gujarat, Odisha, Bihar, Madhya Pradesh, Tamil Nadu, Chhattisgarh, Rajasthan, and Tripura etc.

These oilseeds comprise two by-products i.e. oil and cake. The


*Figure 1: Non-edible oilseeds in India*

oil extracted from these plants is being used to prepare different products like soaps, varnishes, lubricants, candles, cosmetics, etc. While the residual i.e. cake contains 25-50 per cent crude proteins and is used as fertilizer or substrate for pyrolysis. However, despite the moderate to high protein contents, incorporation of these oil cakes in the animal feed is not encouraging due to the adverse effect on growth owing to the presence of toxic factors mainly phorbol esters, ricin, cyanogenic glycosides, azadirachtin and karanjin in jatropha, castor, rubber seed, neem, and karanj, respectively.

The presence of other anti-nutritional factors such saponin, tannin, trypsin inhibitor and phytates either inhibit nutrient utilization or interfere with the digestive enzyme activities. Different processing methods such as moist heat treatment, water soaking, application of lye (alkali), solid-state fermentation and exogenous enzymes could be applied to reduce their anti-nutrient contents. However, it was observed that these physical, chemical and biological methods were not able to detoxify the oilcake or meal completely.

## Preparation of protein isolates from non-edible seed cakes

The preparation of protein isolates from the non-edible seed could be an ideal approach for the efficient utilization of these seeds. Techniques for the production of protein isolate from protein-richplant ingredients are relatively well known and documented. Different methods like alkaline extraction and isoelectric precipitation, solubilized extraction, alcohol extraction, etc. are used to prepare the protein isolates from the different oilseeds (soybean, canola, and groundnut oilseed cakes etc.). Alkaline extraction followed by isoelectric precipitation is the most common method used to prepare protein isolate from non-edible oilseed cakes like jatropha, rubber, neem and castor oilcake.

Production of plant protein isolate from defatted seed cake has been described as a way of reducing the contents of anti-nutrients and toxic components with high levels of protein, which often have digestibility similar to

**Researchers have concluded that fish fed with protein isolate exhibited better or similar growth performance and digestibility, and nutrient utilization than fish fed with fishmeal or soy protein isolate.**

**Table 1: Crude protein contents (%) of oilcake and protein isolates of non-edible oilseed**

| Nonedible seed | Oilcake | Protein isolate | Reference |
|---|---|---|---|
| Jatropha seed | 42.59 | 87.52 | Fawole et al. (2018) |
| Rubber seed | 22.10 | 90.80 | Fawole et al. (2016) |
| Neem seed | 23.45 | 82.04 | Gopan et al. (2019) |
| Karanj seed | 34.56 | 90.27 | Gopan et al. (2020) |
| Castor seed | 58.61 | 92.54 | Jayant et al. (2021) |

**Table 2: Major anti-nutritional factor of oilcake and protein isolates of non-edible oilseed**

| Nonedible seed | Anti-nutritional factors | Oilcake | Protein isolate | Reference |
|---|---|---|---|---|
| Jatropha seed | Phorbol ester (mg/g) | 4.60 | 1.40 | Fawole et al. (2018) |
| Rubber seed | Cyanide (mg /kg) | 75.6 | 27.0 | Fawole et al. (2016) |
| Neem seed | Azadirachtin (mg/kg) | 162.29 | 46.68 | Gopan et al. (2020) |
| Karanj seed | Karanjin (g/kg) | 0.37 | *ND | Gopan et al. (2021) |
| castor seed | Ricin (mg/kg) | 897.55 | 45.37 | Jayant et al. (2021) |

*ND- Not detected.



**The production of high-value protein isolates could be an alternative approach to replace heavily dependent soybean meal and open a new market avenue for their use as a new feed resource.**

or higher than that of fishmeal protein. Crude protein contents and major anti-nutritional factors of different non-edible oilseed cakes and their protein isolates were illustrated in Table 1 and Table 2.

Protein isolates are enriched in total proteins and have low amounts of lipids, soluble carbohydrates, phenols or fibres. They are a good alternative protein source for fish owing to their high nutritional values as characterized by high protein and amino acids digestibility, low anti-nutritional components, and consistent quality.

Protein isolate exhibited a more than threefold increase in protein content than the raw ingredients. It is often used to fortify and formulate food products, thereby making them an important protein ingredient in human and animal feeds. Nagel et al stated that preparation of protein isolate exhibited an enhancement in the nutritional value of non-edible oilseed cake or meal by lowering the inherent ANFs below the permissible limits.

## Utilization of protein isolates in fish feed

Fish fed plant protein isolate perform better in growth, protein and energy digestibility, and nutrient utilization than fish fed soybean meal-based diets. Consequently, using plant protein isolate/concentrate as a protein source will assure a healthier animal and better growth performance compared to using raw seed cake directly as a protein source in fish diets. Likewise, Jayant et alreported that dry matter recovery of protein isolate from defatted castor kernel meal was 49.83 per cent and could serve as a potential protein-rich ingredient for carps feed. Many studies have been carried out on the nutritional value of protein isolate/concentrates in different fish species with an improved feed intake, digestibility, nutrient utilization and growth performance without any adverse effects. Researchers have concluded that fish fed with protein isolate exhibited better or similar growth performance and digestibility, and nutrient utilization than fish fed with fishmeal or soy protein isolate.

Shamnaet al concluded that

**The annual production of major non-edible oilseeds in India is more than 11 million tons. These oilseeds contain 20-50 per cent of oil content and would generate around 5.5-8.5 million tons of residuals (oil cakes) every year.**

jatropha protein concentrate (FJPC) detoxified by solid-state fermentation with Aspergillus niger is a promising protein source for aquafeed and can be included up to 20 per cent (complete replacement of soy protein concentrate) in the diets of Labeorohita without compromising growth rate and feed conversion. Several reports have documented the use of protein isolates from different plant oilseed cakes such as rapeseed in turbot, Psetta maxima, rubber seed in rohu, Labeorohita,karanj seed in L. rohitaand Jatropha seed in common carp.

## Conclusion:

The production of high-value protein isolates could be an alternative approach to replace heavily dependent soybean meal and open a new market avenue for their use as a new feed resource. The annual production of major non-edible oilseeds in India is more than 11 million tons. These oilseeds contain 20-50 per cent of oil content and would generate around 5.5-8.5 million tons of residuals (oil cakes) every year.

There is a scope to use at least 50 per cent of the oilseeds cakes (2.75-4.25 million tons) for the preparation of protein isolates. The dry matter recovery for protein isolates obtained from non-edible oilseed cakes ranged between 20-45 per cent. Based on the calculation, 0.83-1.28 million tons of protein isolates would be generated annually, containing 85-90 per cent of crude protein. It had been reported that protein isolates obtained from non-edible oilseed cakes are nutritionally compatible with fishes and can completely substitute the soy-proteins in the fish diet. Hence, the produced protein isolates would be equivalent to 1.40-1.52 million tons of soybean meal (containing 50 per cent crude protein) used in aquafeed industries and able to reduce the dependency on the soybean meal-based proteins.

When we are planning to double the aquaculture production, these protein isolates/concentrates would be the most preferred choice of protein ingredients in aquafeed for sustainable aquaculture production.

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# Sujit's fishlings woo fish farmers far & wide!

The landlocked Nabarangpur district in western Odisha, about 400 kms away from the sea, may not be an idle place to harvest fish and become a fishing magnet, but for this ingenious farmer who along with several ambitious fish farmers have set on course to transform the region into a coveted fishing destination.

Sujit Das, a native of Umerkote, was unlike any other farmer. He took to fish farming by choice, determined to make a difference in the community. If there was an illusion, he proved everyone wrong, diverting time and resources from a family-run business that included a garment shop and a restaurant.

With the able support of the Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar, which extended Rs 10 lakh under a scientific mission, he seemingly succeeded not only through his fish hatchery, but also helped the farming community in his place develop their own breeding ecosystem. In the process, the district is witnessing a consolidation in the aquaculture sector, wooing fish farmers from far off places for fingerling, besides traditional fish producing states such as Andhra Pradesh.

"Today we need not go to Kolkata for fingerlings where sourcing includes poor quality stuff. We are producing fingerlings right here of high quality and value, providing them to farmers who come from different parts of western Odisha, bordering states of Chhattisgarh and Andhra Pradesh," Das said to Smart Agri Post while narrating his story.

Conditions in the district were also not ripe for fish farming, but that changed as the determined tribe of the fish folks adopted scientific ways to ensure good harvest. "For example, we had abundant rainfall but had a history of negligible fish farming. The alkaline factor in water was low, unsuitable for farming. We developed ways to address this and ensured good harvest," he said.

## Fish farming!!

"The return from fish harvest is considerably higher than traditional farming and can fetch you Rs 3 lakh per annum apart from generating employment, but the initial investment can strain your resources," he narrated.

Das gave up the family business after being introduced to

fish farming at Pakhanjore, Chhattisgarh in 2014. The prospects appeared bright, far more remunerative than his existing businesses.

"I did not take a loan but made good use of my agricultural land spread over 5 acre. I adopted a new formula and divided my land into five units for year-round sustained yield and income. Side by side I began to invest in fish farming, running the two farming practices simultaneously, investing money in the aqua space earned from traditional farming," Das explained.

In 2017, he elicited the support of CIFA to start his hatchery, which provided training on breeding to the villagers including him and his brother. Some adivasi women and students in the village also underwent training in a group that comprised about 20 members. It was followed with the construction of hatcheries. CIFA provided broods and extended scientific assistance.

"Nabarangpur can become a success story, a fish production hub with the amount of support and scientific help provided by us to the fishing clusters," said Nagesh Kumar Barik, a CIFA Scientist, who has been actively involved with the farmers of the district.

He said Sujit's cluster has been one of the success stories as they have recorded high production.

"We have provided end to end input to all the clusters, right from providing better quality broodstock, equipment for farming to market linkages. There are 15000 ponds in the districts but hardly any fishing nets. We also provided the farmers with the nets," Barik said.

The support is gradually transforming the fishing landscape in the region and Barik hopes the results will be encouraging eventually, though it will take some time to manifest.

The full potential in the district can be achieved when the farmers become successful with 10 crore spawn production. But for this to happen, at least 100 acre is required involving as many people, with an anticipated profit of Rs 10-15 lakh per annum, he added.

As of now, as Sujit put it, they have achieved about 3.5 crore spawn production and are hopeful of meeting the target soon.

As for the market, farmers in the district are uniquely placed to reap rich harvest. As opposed to farmers in coastal Odisha, who earn roughly Rs 130 per kg of fish, farmers in Nabarangpur can mint Rs 200 per kg given that demand in Nabarangpur far outstrips the supply.

The large-scale settlement of the Bengali community in this area also lends a unique character to fish farming here.

"Today, there are 30-40 people working with me. I make their payments on time and together we can aspire to change the socio-economic profile of the place," Sujit said.

Recently, Nabarangpur collector Ajit Kumar Mishra has inaugurated a 'live fish market', with the hope that the initiative will give further impetus to the development of the aquaculture ecosystem.

In a tweet on August 1, Mishra informed that 3.5 crore spawn has been produced by the fish farmers in the district so far, while 40 lakh advanced fry has been sold to the locals and adjoining villages of Chhattisgarh.

The moderate climate also makes the district distinct for the development of ornamental fish culture as a livelihood mission. Keeping this in mind, an ornamental village cluster has been set up involving women SHGs.

While Sujit aims to become the biggest fish producer in the district, he is also planning to go for prawn cultivation in a big way.





# ICAR-CIFA for Sustainable Blue Revolution in India

India's marine fisheries sub-sector is now performing with a downward trend with 60% of Exclusive Economic Zone (EEZ) stocks over-exploited and the rest fully exploited. The marine fishery potential in the Indian waters have been estimated at 4.41 MMT constituting more than 47% demersal, 48% pelagic and 5% oceanic groups. The dwindling trend in marine capture fisheries limits the scope of further augmentation in harvest capture as out of 1,368 species available, 200 commercially important species also require attention for their survival due to their complex food chain and inter-dependent existence. Freshwater aquaculture in India has evolved from a state of homestead activity in few pockets of Eastern Indian states during 1950s to the present state of a vibrant enterprise that has spread wing all over the country. As the premier institute of aquaculture research in the country, ICAR-CIFA has a variety of technological offerings in its basket to augment the fish production: Technology packages for more than thirteen fish species, Jayanti Rohu- a genetically improved strain of Rohu which gives 17 percent additional growth in a year; CIFABROOD- a broodstock diet helps in early maturation of fish; FRP hatchery – a portable small size hatchery facilitates to undertake breeding programs even in hilly terrains; CIFAX- a therapeutic formulation to combat disease problems in fish. In addition, ICAR-CIFA advocates different approaches to the state governments and other stakeholders to maximise the fish production such as system diversification and species diversification concepts where the former focus upon to standardize different kind of aquaculture systems ranging from back yard ponds to super intensive systems, aquaponics and later concept thrusts upon bringing more species into culture system in order to increase per unit productivity of the water and culture system.

The ICAR-Central Institute of freshwater Aquaculture (ICAR-CIFA) is a premier research Institute on freshwater aquaculture in the country under the aegis of the Indian Council of Agricultural Research (ICAR), New Delhi. The present Institute has had its modest beginnings as the Pond Culture Division of Central Inland Fisheries Research Institute (CIFRI) established at Cuttack, Odisha in 1949 with a

limited portfolio to face challenges in the field of fish culture in ponds, tanks and other small aquatic bodies. Subsequently, CIFRI, in a major effort to give emphasis to freshwater aquaculture research, initiated the Freshwater Aquaculture Research and Training Centre (FARTC) over 147 ha campus at Kausalyaganga, Bhubaneswar, Odisha. The Centre gradually developed into its full capacity and became an independent Institute during 1987 as Central Institute of Freshwater Aquaculture (ICAR-CIFA). The Institute is also the Lead Centre on 'Carp Farming in India' under Network of Aquaculture Centres in Asia-Pacific (NACA). ICAR-CIFA has developed twenty-three technologies covering different aspects of freshwater aquaculture viz. captive breeding, seed production and grow-out culture, selective breeding, milt cryopreservation, portable hatchery, pearl culture, wastewater aquaculture, feed formulations, disease diagnostics and therapeutics etc. which are at different stages of adoption by farmers and aquaculturists.

ICAR-CIFA is located near the foothills of Dhauli hill in 147 ha sprawling campus, nearly 10 km from Bhubaneswar on Bhubaneswar-Puri national highway. ICAR-CIFA has one of the largest aquaculture farms in India spread in around 50 ha water spread area with over 380 pondsof assorted sizes. ICAR-CIFA also has hatcheries for IMC, minor carps, murrel, catfish, tilapia and freshwater prawn. This institute has world class laboratories engaged in cutting edge research in several areas of molecular biology and biotechnology. ICAR-CIFA also has five Regional Research Centres (RRCs) located in five states like Andhra Pradesh, Karnataka, Gujarat, Punjab and West Bengal to cater to the regional requirement of freshwater aquaculture research and development. Krishi Vigyan Kendra (KVK) of Khordha district is also located within the campus and working under the administrative control of ICAR-CIFA. There are 74 scientists catering to the research, training and extension need in breeding, culture, health, nutrition and physiology, genetics and biotechnology and social science aspects of freshwater fish and shellfish species.

India is the second largest producer of fish in the world, contributing 5.68% of global fish production by aquaculture. The historical scenario of Indian fisheries reveals a paradigm shift from marine dominated fisheries to a scenario where inland fisheries has emerged as a major contributor to the overall fish production in the country. The present inland fish production of 8.9 MMT constitutes more than 71% of the total fish production of the country. More than 75% of this inland production comes from fish farming in about 70% of the available 2.43 million ha of ponds and tanks resource in the country. Horizontal expansion, even to the 100% utilization level, may not be sufficient to cater to the fish demand in coming days. Though ponds and tanks have remained as the major resources for aquaculture production, the potential of the 0.2 million km rivers and canals, 3.12 million ha reservoirs, and the 0.8 million ha of floodplain lakes and derelict waters in the country is yet to be harnessed. Therefore, while it is necessary to increase the present average productivity from 3.0 t/ha to a level of 5.0 t/ha, holistic development of the other natural waters also needs to be explored to reduce the stress on pond resource and ensure sustainable development.

India is blessed with a huge biodiversity of cultivable aquatic species. The three Indian major carps viz., catla (Catla catla), rohu (Labeo rohita), mrigal (Cirrhinus mrigala) and the three exotic carps, viz., silver carp (Hypophthalmichthys molitrix), grass carp (Ctenopharyngodon idella) and common carp (Cyprinus carpio) form the mainstay of aquaculture. Besides, a large number of potential cultivable species viz., L. calbasu, L. gonius, L. fimbriatus, L. bata, P. sarana, Hypselobarbus (Puntius) pulchellus, Puntius jerdoni, P. kolus, P. carnaticus and Cirrhinus cirrhosaetc. can be brought under the umbrella of suitable candidates for culture. There is also a need to shift aquaculture from the low valued carps to high valued species to make it more remunerative. With the technologies available for breeding and culture of air-breathing (Clarias batrachus, Heteropneustes fossilis) and non-air breathing catfishes (Pangasius pangasius, Mystus seenghala, M. aor, Wallago attu,






Ompok pabda), butter catfish (Ompak bimaculatus and O. pabda), snakeheads (Channa striata and C. marulius), and climbing perch Anabas sp., there are plenty of scopes to diversify the aquaculture systems in the country. The freshwater prawns, Macrobrachium rosenbergii and M. malcolmsonii are already receiving keen attention with regard to the establishment of hatchery or grow-out systems. Breeding and propagation are standardized for a range of ornamental fishes including the indigenous fishes from hilly regions of the country. Further, the culture of Lamellidens sp. has become important in the context of the production of cultured freshwater pearls.

ICAR-CIFA plays an active role in the freshwater aquaculture development in the country and works in close association with the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt of India. ICAR-CIFA has conducted a national level stakeholder consultation and developed a Strategic Action Plan for increasing the aquaculture production in the country under the Pradhan Mantri Matsya Sampada Yojana (PMMSY).

ICAR-CIFA offers several need-based training courses for capacity-building of stakeholders, who in turn would transmit advanced technical know-how to the end-users. The programmes were demand-driven and the delivery was based on the principle of 'learning by doing' with adequate background in theory and sufficient hands-on practical exercises. Besides, extension officers in the state department of fisheries, college/university teachers, students, entrepreneurs and NGOs were also benefited from the courses

The institute has also strengthened its virtual presence via website, WhatsApp, YouTube, e-mail, webinar, online training programmes etc. to ease the transfer of technology process and dissemination of information. To cope up with the situation and reaching out to the farmers, ICAR-CIFA has launched the training programmes in virtual mode to expand the reach of ICAR-CIFA technologies. The website www.cifa.training.com is providing the online services like training application form, selection, confirmation, payment of fees, virtual classes, feedback form, e-certificates to the interested applicants. ICAR-CIFA has launched an Official WhatsApp no 7790007797 and an email (ask.cifa@icar.gov.in) for the benefit of the farmers.

The Institute, in association with the NFDB, has launched an online course mobile app, "Matsya Setu", to disseminate the technological information to the fish farmers. The app has been launched by the Honorable Former Union Minister Shri Giriraj Singh Ji on 06.07.21. The app has the Species-wise/ subject-wise Self-learning video modules, where renowned aquaculture experts explain the basic concepts and practical demonstrations on breeding, seed production and grow-out culture of commercially important fishes. Quiz/Test options were also provided for self-assessment and upon successful completion of each course module, an e-Certificate will be auto-generated. To solve any queries raised by the learner, an option has been given to submit the questions in the video chapter itself. Appropriate, specific advisories by experts will be sent to the app as push notifications.

The institute is implementing Govt of India Flagship schemes viz., Swachh Bharat Abhiyan, Mera Gaon Mera Gaurav, Soil Health Card, Bharat ka amrutmohotsav etc for creating awareness among the citizens of the country. Schemes like STC, NEH and SCSP are also being implemented in order to cater the socio-economic needs of the tribal people and other backward communities of our society. The Institute also places adequate emphasis on gender empowerment through aquaculture and ensures that at least 30 percent of the beneficiaries of developmental projects are women.

# Jobs, Admissions & Events

## Short Term Training Programs by Central Institute of Brackishwater Aquaculture, Chennai (CIBA)

Programme : Advanced Training in Aquaculture Nutrition and Feed Technology
Period : 1stto 10th December 2021
Course Fees : INR 8500.

Other programmes are as follows:

Prgroamme :Disease Management in Brackishwater Aquaculture Farming
Period : 6thto11thDecember 2021
Participant Limit : Maximum 10 participants
Course Fees : INR 2000

Programme : Recent Advances on Diagnosis and Management of Brackish waterFish Diseases
Period : 13th to 18th December 2021
Participant Limit : Maximum 10 participants
Course fee : INR 5000.

Programme : Brackish water Ornamental Fish Seed Production and Culture
Period : 22nd December
Medium : Online
Course Fees : INR1000

Programme : Advances in shrimp farming with special reference to the west coast of India
Period : 27th to 31st December2021
Medium : Conventional
Course Fees : INR 5000.

Programme :Bacteriological techniques for detection of pathogenic bacteria in the brackishwater shrimp farming
Period : 25th to 30th November 2021
Medium : Conventional
Participant Limit : Maximum 10 participants
Course Fee :INR5000.

For detailed information, please visit the official website of CIBA http://www.ciba.res.in/
Check the venue for conventional programmes, boarding, lodging etc.

# ICAR-DIRECTORATE OF COLDWATER FISHERIES RESEARCH

*(Indian Council of Agricultural Research)*

## Introduction

The Directorate of Coldwater Fisheries Research (ICAR-DCFR), erstwhile NRCCWF (National Research Centre on Coldwater Fisheries), was established on 24th September, 1987. The directorate is a national facility to strengthen fishery research in coldwater sector encompassing the Himalayan and peninsular parts of the country. The research programmes undertaken by the Directorate are designed with major thrust on conservation and management of open water fisheries and development of hill aquaculture. The directorate has well equipped state of art laboratory facilities for research in diverse areas. During the last three decades, the ICAR-DCFR has achieved commendable success in the area of coldwater fisheries research and disseminated need based technologies to different stakeholders. It has significantly contributed towards the enhancement of fish production, species and system diversification, health management of fishes, genetic characterization of important species, conservation of endangered fish species as well as human resource development through training and skill development. The directorate has strong national and international linkages with SAUs, universities, NGOs, Govt. departments, farmers and other stakeholders. The ICAR-DCFR is on its glorious path of virtually actualizing its vision by imparting boon of quality research in sustainable coldwater fisheries production, management and conservation.

## Mandate

- Basic, strategic and applied research in coldwater fisheries and aquaculture
- Act as a repository of information on the hill fisheries resources
- Human Resource Development through training, education and extension

## Mission

To become a national facility of excellence for assessing and managing coldwater fishery resources, develop technologies and models of hill aquaculture and provide critical inputs in formulating strategies for sustainable growth and development of the sector.

## Achievements

- GIS based aquatic resource mapping for planning, sustainable utilization and development of fisheries and aquaculture in Indian Himalayan regions.
- Technology developed for captive breeding of endangered golden mahseer, *Tor putitora* for its mass scale seed production.
- Developed flow through hatchery for golden mahseer, *Tor putitora* & rainbow trout, *Oncorhynchus mykiss* for seed production and rearing.
- For species diversification in aquaculture, developed breeding technologies for different food and ornamental fishes.
- Developed cost-effective starter feed for initial feeding of rainbow trout (*Oncorhynchus mykiss*) fry providing higher survival and better FCR values.
- Established and demonstrated Re-circulatory Aquaculture System (RAS) as a climate resilient technology for intensive rainbow trout culture under controlled condition.
- Developed multi-tier model for integrated fish farming using polytanks in mid hill region.
- Fish Disease surveillance for coldwater aquaculture and fish health management.
- Genetic characterization of important coldwater fish species for studying population structure and conservation priorities.
- Supported hill states of the country in developing coldwater fisheries and aquaculture.
- Training and skill development of state govt. officers, faculties, students, research scholars, farmers & NGOs,

**Directorate of Coldwater Fisheries Research, Bhimtal – 263 136, Nainital, Uttarakhand, India**

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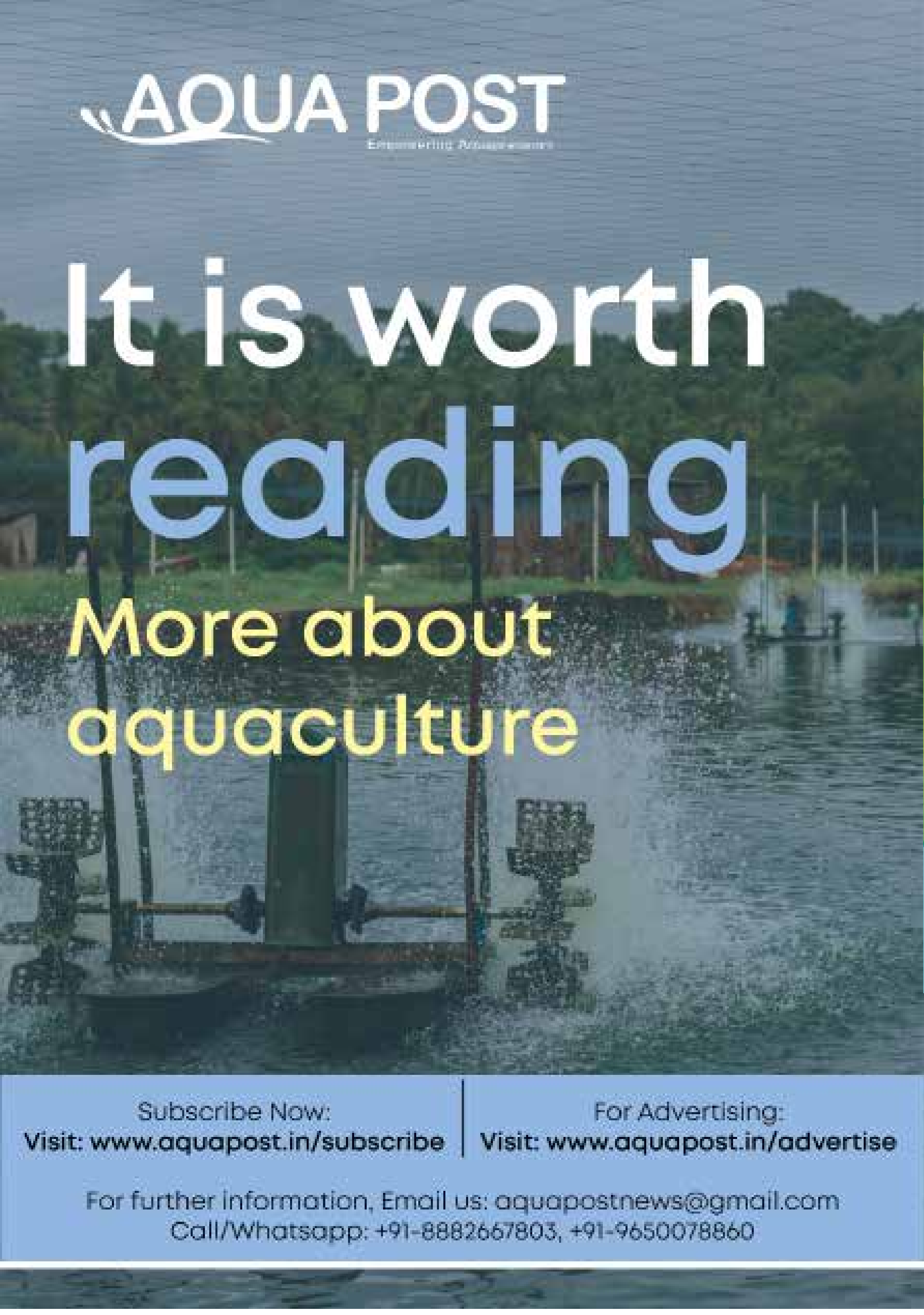
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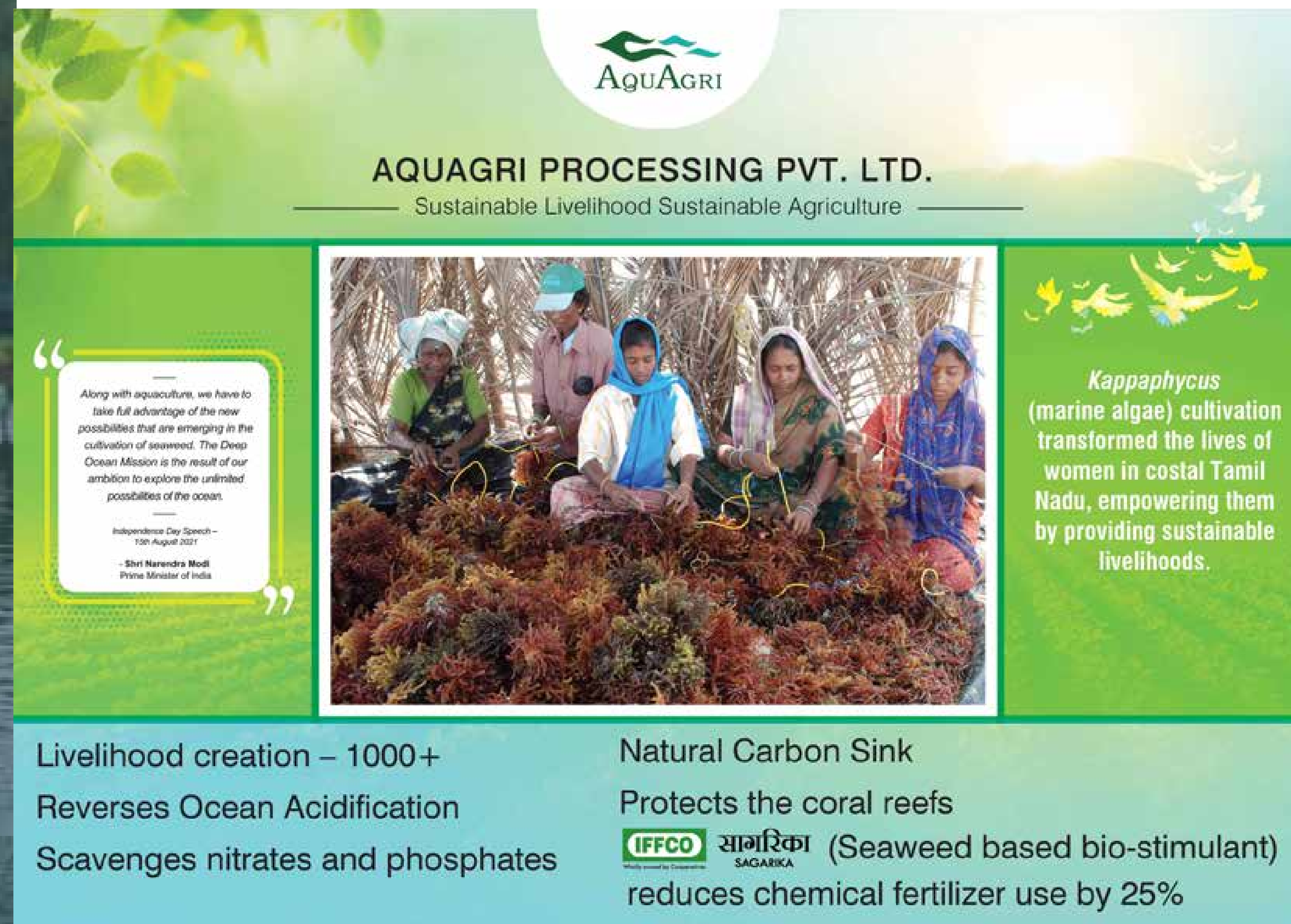
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