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The journey of coldwater fisheries in India

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Dear Readers,

I am delighted to introduce to you the September(maiden) edition of AQUA POST. We have been covering the fisheries/ aquaculture sector in detail forthe last five years. Enthused by the trust of our readers and the quest for quality information about the growing aquaculture industry, we have come out with the sectoral publication.

The aquaculture magazine, AQUA POST, is in a class of its own for its inventiveness and quality content. It is our endeavor to cater to the aspirations of the growing blue economy in India in particular and around the world in general. It is apolitical. It is unbiased. It is a readers' magazine giving plenty of leeway to farmers, entrepreneurs, scientists, industries, traders and all other stakeholders to express their thoughts and ideas on current trends, challenges and possible solutions. This magazine will provide a single-windowplatformfor all sorts of information starting from the best aquaculture practices to the government schemes and programs, majorly in India, to boost the aquaculture sector.

We have interesting stories for this editionfeaturing the 'return of black tiger shrimp farming in India' to 'Indian on the cusp of transforming seaweed sector' to 'special interview of Shri J N Swain, IAS, Secretary-Fisheries, Government of India' to trend-setter 'Abhiram Seth' in seaweed culture and many more articles and column including 'alternative aqua feed', 'cold water fisheries in India' , 'preventing whitewash', 'bio-floc technologies in the North East Region' and jobs/admissions in different fisheries institutes.

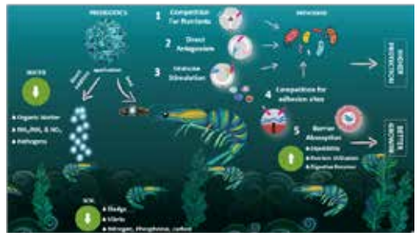
The aquaculture sector is emerging as an alternative to providingfood and nutritional security to people across the globe. Several multinational companies have varied business interests in different countries whether it is seed, feed or any other technology. And the changing dynamics of geopolitics post-Covid and post US withdrawal from Afghanistan are expected to influence the seafood trade in the coming days. We will try to capture the current scenario in the coming editions and give all aqua farmers and traders insightful information.

We invite expert views and opinionsof all our esteemed readers. We want to update the farmers withthe latest innovations and technologies in shrimp and fish farming. We aimto be a medium to bridge the information gap between theresearch institutes and the end-users including farmers/ entrepreneurs/industries. We invite all of you to share your ideas at aquapostnews@gmail.com. Nevertheless, the process of gathering quality information and news requires the support of the industry. We invite the companies to advertise with AQUA POST and make it a vibrant voice of the aquaculture sector.

Have a good read,

Bharath Bradhan

aquapostnews@gmail.com



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MPEDA opens ELISA Lab at Haroa, West Bengal

Responding to the demands from the aqua farmers of North 24 Parganas district in West Bengal, MPEDA has opened its 16th ELISA Laboratory at Haroa on 10th September 2021. The laboratory is expected to cater to the antibiotic testing needs of aqua farmers in entire North 24 Parganas district.

The farmed shrimps meant for export to EU are mandated to undergo Pre Harvest Testing (PHT) in the ELISA Laboratories set up by MPEDA. The raw material is screened for the presence of banned antibiotic residues such as Nitrofurans and Chloramphenicol. MPEDA has set up the lab for this Pre Harvest Testing certification programme in the farming clusters of coastal states right from Gujarat to West Bengal.

The lab was formally inaugurated by K.S. Srinivas IAS, Chairman, MPEDA, in presence of I.P.R. Mohan Raju., President, Prawn Farmers Association of India, Hyderabad and Rajarshi Banerjee, Member, MPEDA and President, Seafood Exporters of India, West Bengal region, Apurba Saha, Director, M/s. Blue Sea Aquaculture Pvt. Ltd., S. G. Dwivedi, Joint Director, EIA, Kolkata. The function was attended by Dr. M. Karthikeyan, Director, MPEDA, Dr. Ram Mohan M.K., Joint Director (QC), MPEDA, Anil Kumar. P, Joint Director (M), MPEDA, Mahesh, Deputy Director (Lab), Archiman Lahiri, Deputy Director, MPEDA, Regional Division, Kolkata, farmers, and other MPEDA officials.

In his felicitation address, Mohan Raju appreciated the initiative taken by the Chairman to open an ELISA lab at Haroa and told that this will help the exporters to check the quality of shrimps grown by farmers thereby reducing the antibiotic rejections instances. Banerjee recalled the request placed by him to Chairman, MPEDA on the need for the ELISA laboratory and said that it will go a long way in sourcing quality raw material from the region.

The MPEDA Chairman, while inaugurating the ELISA Screening Lab, emphasized on the need to contain the detection of antibiotic residues in farmed shrimp consignments in markets such as EU, USA and Japan for enhancing our market share by ensuring the quality. He urged the farmers to utilize the laboratory services at its maximum so that they will get a better sales value by ensuring the quality and traceability of the produce.

Fish prices, market information available weekly on NFDB website

The Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying through the National Fisheries Development Board (NFDB) is implementing a Fish Market Price Information System (FMPIS) for collecting price details of different commercially important fish species from different fish markets. This information was given by the Minister of Fisheries, Animal Husbandry and Dairying, Shri Parshottam Rupala in the Loksabha in a written reply today.

Based on these details, an analytical report is uploaded on the NFDB website on a weekly basis. This aims at promoting trading of commercially important fish species. FMPIS facilitates better marketability (fisher/seller) and accessibility (consumer/buyer).

Fish is a perishable item and the price of fish products is market driven and dependent on several factors like demand, arrival of fish in market, fish size, species, type, season, accessibility, consumption pattern and region etc.

NFDB inks MoU with PNB to extend credit assistance to fish farmers

The NFDB inked an MoU with PNB to help fish farmers get easy access to credit linkages for farming activates.

The credit assistance will be provided under the Fisheries & Aquaculture Infrastructure Development Fund (FIDF) Scheme and Prime Minister Matsya Sampada Yojana.

The FIDF, an interest subvention scheme, was created in 2018-19 with a corpus of over Rs 7000 crore which was to be raised by lending agencies such as NABARD, NCDC and all scheduled banks and disbursed among the beneficiaries. However, the scheme did not see much progress as it failed to get support from the banks despite directions from the Reserve Bank of India.

"Against this backdrop, the National Fisheries Development Board (NFDB) reached out to the bankers at the respective apex offices to sort out the issue and we received an enthusiastic response from Punjab National Bank (PNB)," said Dr Suvarna, Chief Executive of NFDB.

The Managing Director of PNB Mallikarjuna Rao, the Zonal Manager of Hyderabad and the rest of the PNB team pro-actively extended their hands of support to implement the FIDF, she added.

FIDF seeks to create and modernise the infrastructure in the aquaculture sector, reduce post-harvest losses and improve domestic marketing facilities, among others.

Animal feed prices eases after Centre allows import of soya de-oiled cake

In a big relief to the poultry industry reeling from sky-high input costs, the Centre has allowed the import of soya de-oiled cake for livestock feed. The development could bring down the prices of chicken meat that is trading between Rs 200-240 in the open market.

The decision was conveyed by the Department of Animal Husbandry and Dairying to the All India Poultry Breeders Association on Wednesday. Chairman of the association Bahadur Ali had requested the Department in a letter on August 6 for the import of the de-oiled soya meal for the manufacture of the animal feed. High input costs are also reflected in the rice in egg prices.

He hailed the Centre's move, saying it will safeguard the interest of more than 10 crore livestock farmers and another five-crore people who are engaged in livestock employment directly or indirectly. It will also ensure that the nation's livestock is fed and citizens can purchase milk, chicken, fish and shrimp regularly and at an affordable price.

Ali lauded the support extended by the Narendra Modi government for the poultry sector, which has been significantly impacted over the last two years since the Covid-19 outbreak.

It began in March 2020 when the country went for a general lockdown following the covid outbreak. Unfounded apprehensions about chicken meat

consumption and linking it with the spread of the virus exacerbated the crisis for the industry.

Avian influenza in January once again hit sales. But as things looked up, the rising feed prices pushed back the industry to the corner once again.

In its letter, the Animal Husbandry and Dairying department also referred to the communications from the Ministry of Environment and Forest which had expressed its no objection to the import of soya de-oiled cake since it "does not contain any living modified organism".

The item can be imported subject to the payment of the existing duty tariff and other applicable taxes.

Grobest India introduces new functional performance feed, Aqua Kare

Grobest India launched a Functional Performance Feed (FPF), Aqua Kare on August 13, 2021 during a webinar organised by the company on "Improving the health and growth of shrimps through Functional Performance Feeds". Farmers from seven locations, West Godavari, East Godavari, Nellore, Prakasam, Guntur, Tamil Nadu and Gujarat, had joined in the online launching program. About 160 farmers and dealers, more than 100 people from academics and various industries all around the world had joined the technical webinar and product launching event.

Speaking about the Grobest and its belief in Functional Performance Feed, Mr. Samson Li, CEO, Grobest Group said that Grobest is very focused to lead the market in Functional Performance Feed, including Growth Enhance and Immunity Enhance. With all the Functional Performance Feed, Grobest is committed to help the farmers in mitigating the risks and to have a healthy harvest. We are for farmers and we strive to make our farmers more successful, he added.

Dr. Decamp Olivier, Technical Director, Grobest Group added thatGrobest is the pioneer in Functional Performance Feed in the Asian Market and very well positioned to recommend Functional Performance Feed to our farmer friends. FPF contains proprietary ingredients that helps in strengthening the immune system of the shrimp and helps the shrimps to respond better during environmental stress. We have a lot proven success stories that our FPF helps the shrimp to encounter the pathogens that causes severe economic loss to the farmers.

RamakantaNayak, Chairman, Grobest India said that feed is one of the significant components affecting cost of production. Grobest India is more committed to impart and spend time with the farmers helping and educating them to think and consider where they can save costs and improve their margins. Also, he insisted that Functional Performance Feeds are the need of the hour for Indian Shrimp Aquaculture Industry.

Aqua Kare Launch

Introducing the Aqua Kare, Dr.V.Rajaram, Technical Director, Grobest India said that feeds must be formulated with functional ingredients to combat the pathogens, which cannot be achieved by top dressing with feed additives. From our R & D trails, we understand that top dressing the feed with functional ingredients doesn't reach the gut unless they are blended with all the ingredients during manufacturing process. In fact, top dressing deteriorates the quality of feed pellet, water stability and leads to nutrient leaching.Using the functional performance feed at recommended dosage helps the shrimp to better survive and combat the opportunistic pathogens faced in the pond environment.

Chennai's Aquaconnect selected by 'Google for Startup' accelerator

Aquaconnect, India's leading aquaculture technology platform, has been selected for the fifth class of Google for Startups Accelerator (GFS) India. The Google for Startups Accelerator for India is focused on supporting great startups that are solving societal and economic challenges specific to the country, using advanced technology. Out of the 700 start-ups screened for the program, Aquaconnect, along with 15 other start-ups, has been selected to be part of the GFS India program.

Founded in 2017, Aquaconnect is a full-stack technology aquaculture technology venture that pioneers in the development of machine learning and satellite remote sensing technologies. The company works with 35000+ fish and shrimp farmers using AI predictive tools for better farm productivity and connects them with formal finance, insurers, and processors to improve Indian aquaculture value chain efficiency.

On the selection in the eminent GFSA program, Mr Rajamanohar Somasundaram Founder & CEO of Aquaconnect, said "We are excited to be part of the Google startup accelerator. We believe that this is a great validation for our technology-enabled impact work with shrimp and fish farmers. We are looking forward to receiving mentorship and support from the network of Google and industry mentors for more inclusive solutions to navigate the challenges in the aquaculture value chain."

Under the GFSA-India program, Aquaconnect has an opportunity to work with Google mentors and industry experts on tech guidance, machine learning, product strategy, UX and design, leadership workshops, networking opportunities and Public Relations support.

Currently, in addition to a farm advisory and a digital store for farm care inputs and equipment, Aquaconnect creates efficient market linkages for farmers to connect value chain players and get formal finance, insurance and sell their harvest produce. The company raised $4 million in July in pre-Series A round led by Rebright Partners and Flourish Ventures. AgFunder and 6G Capital also participated in this round, along with existing investors Omnivore and HATCH-Norway.

Demand-based ecosystem critical for nurturing vibrant seaweed industry in India: Fisheries Secretary

With seaweed cultivation and production in India remaining abysmally low, the Centre on 26 August pitched for active industry support to create a demand-driven ecosystem that promotes sustainable growth and reduces the country's dependence on imports.

Inaugurating the two days virtual international conference, Seaweed India 2021 on 26 Augsut, organized by SMART AGRI POST, Union Fisheries Secretary, Jatindra Nath Swain spoke of Government's initiative under Pradhan Mantri Matsya Sampada Yojana (PMMSY), while underscoring industry partnership to supplement efforts for the fledgling industry.

The Union Fisheries Secretary alluded to the role of the processing sector in creating a vibrant aquaculture industry and stressed replicating a similar model in the area of seaweed cultivation to unlock India's potential in this sector.

India has an 8000 km long rich bio-diverse coastline but its contribution to the global seaweed production stands at around 2500 tons. Smaller South-East Asian nations, in comparison, enjoy a broad-based and well laid out thriving seaweed industry.

Swain in particular referred to the sugarcane cultivation to buttress his observation and mentioned

the significant impact the sugarcane industry has brought to the lives of the farmers through assured offtake and remuneration.

The country has set a production target of 11.5 lakh tonnes in the next five years, even as the global seaweed market size is projected to reach USD 25 billion by the turn of this decade.

To give a boost to the cultivation, the secretary indicated the establishment of multipurpose seaweed parks in the coastal states to promote seaweed cultivation in a big way. The first of such parks is coming up in Tamil Nadu, the detailed project report of which is being finalised.

He said the States should look into framing unambiguous rules for seaweed farming to avoid legal issues and focus on the creation of seed banks for sustained cultivation.

Referring to the Independence Day address where Prime Minister Narendra Modi laid stress on seaweed cultivation, Swain voiced optimism that the industry-led growth will help India attain its initiative towards a 'blue revolution'.

Aquaculture and seaweed farming, he said, is also critical in India's context in the coming decades when the overgrowing population will lead to the saturation of land available for traditional agriculture farming. "We have to (then) move from land-based production system to sea-based production system".

Seaweed farming can also transform coastal areas into commercial hubs, generating incomes and improving the livelihoods of the farming community living on the margins.

DDG-Fisheries, ICAR, Dr J K Jena said the time has come for India to show its accomplishment in the aquaculture sector and potential for seaweed cultivation. He emphasized technology to ramp up production initiatives including climate resilience technology.

While highlighting issues and challenges such as nutrient enrichment, Dr Jena strongly recommended the availability of quality seed for farming with the establishment of seed banks at several locations.

Joint Secretary in the Department of Fisheries Dr J Balaji emphasized on the availability of seed, the scale of production and sales to give the required push to the sector. "We wanted a head start and included seaweed cultivation under PMMSY. The Finance Minister in her budget speech this year has also announced a seaweed park for Tamil Nadu to help the sector to take off".

Dr Balaji informed that projects worth Rs 25 crore was approved last year and added that some major industries have also come up in Tamil Nadu to exploit the potential of seaweed farming.

"We are late but we can learn from other countries," he said. Talking about the economic opportunities, he drew attention to some farmers of Tuticorin in Tamil Nadu who earned Rs 1.5 lakh last year in midst of the Covid outbreak from seaweed cultivation.

New driver of economic growth: Lakshadweep turns to seaweed farming

After fisheries, coconut and tourism, the Lakshadweep administration has prioritized seaweed farming as the next major development driver of the islands. A massive 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 large-scale 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, now 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.

CMFRI study

Recent studies by the CMFRI 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, Chetlah Kadmath, Agatti and Kavaratti during 2020-21 with promising results.

"The studies revealed that the island territory has a potential of producing nearly 30,000tons of dry seaweed per year worth Rs 75 cr by farming only 1% (200ha) of its 21,290 ha of lagoon area (inhabited islands only) at the rate of a modest 150 ton per hectare", Dr Mohammed Koya said.

Climate Smart

Terming it as a climate-smart initiative, he further said: “The sea being the major sink of carbon and the seaweeds well known for its carbon sequestration properties, the farming of seaweed at such a scale would sequester nearly 6500t carbon dioxide per day adding a huge carbon credit to the nation while providing a climate resilient livelihood to the islanders”.

Led by coordinated efforts of various Departments of the administration such as Fisheries, Environment & Forests and Rural Development as well as the CMFRI, the demonstration focuses on popularization of seawee d farming in the islands, capacity building of stakeholders and pre-feasibility and impact assessment of seaweed farming for a planned development of seaweed farming enterprise in the islands.

Providing a sound scientific basis for a sustainable seaweed farming enterprise, the CMFRI and the Lakshadweep KrishiVigyan Kendra of the institute is at further studies for assessing the carrying capacity of the lagoons, spatial mapping of suitable farming sites, standardizing farming methods for year-round farming in deeper areas and means to ensure quality seeding materials of indigenous seaweed species jointly with the Lakshadweep administration.

MPEDA launches year-long Golden Jubilee celebration

The Marine Products Export Development Authority (MPEDA) ushered into its 50th year of eventful and glorious existence by lunching year-long Golden Jubilee celebrations, the first of its kind in the history of the organization making way for the participation of hundreds, including pensioners, exporters and all its regional divisions and societies, through virtual platform.

The function, which began on 25 August was live-streamed on MPEDA’s social media platforms also.

Mohammad Yousaf IRS, Commissioner of Customs, Kochi, who was the Chief Guest, inaugurated the Golden Jubilee celebrations by lighting the lamp in the presence of KS Srinivas IAS,Chairman, MPEDA, who presided over the function.

In his presidential address, Srinivas made a presentation on the growth and achievements of MPEDA in the past five decades and gave insights into a road map for the next 50 years. He emphasized the hard work and efforts made by all stakeholders for the exponential growth of the seafood exports.

To mark the occasion, MPEDA has come out with an e-STAT package which automates the export statistics collection and analysis. Yousaf launched the ‘e-STAT’ package, marking a giant leap for MPEDA.

Higher returns attract farmers for swift transition to tiger shrimp

Black tiger shrimp is back in business as farmers are increasingly realizing its potential for higher returns. But the transition has been rather swift from Vannamei post pandemic. Against this backdrop, Mr Jignesh U Contractor, Proprietor,Vaishnavi Aquatech talks to AQUA POST about black tiger shrimp, its economic prospects and the overall market scenario.

Q.Several farmers are opting for black tiger shrimp in recent times. What are the reasons?

Ans: Few years before Black Tiger was considered as one of the favorite species of farmers for farming as the returns were on higher side. From year 2013, we have observed fall in black tiger species due to lack of availability of SPF tiger shrimp seeds and introduction of Vannamei. Farmers were enthused to try Vannamei, the new species which gave a scope for diversification and Vannamei farming was done at high density compared to low density of Black Tiger.

To bring back the legacy of Black Tiger in India, Vaishnavi Aquatech has partnered with M/s. Moana Technologies LLC for establishment of Brooder Multiplication Centre.

It took us seven long years to get Moana Technologies back to India after many negotiations and concerns.

SPF P.Monodon (Black Tiger Shrimp) has natural resistance towards infectious myonecrosis virus (IMNV), low stocking and low risk. The other advantages are less noof DOC compared to other species.

Farmers who stocked this type of shrimp can harvest successfully

with better survival and bigger size. Hence, farmers make very good returns with black tiger compared to Vannamei and better returns are attracting more farmers towards black tiger.

Q. One of the primary issues confronting the shrimp industry is the short supply of quality seeds. What is the demand and supply scenario of tiger shrimp seed in the country?

Ans: Yes, the sudden switchover from Vannamei to black tiger is the cause of short supply. The reason is the unexpected performance of black tiger seeds. We are thankful to Maona Technologies for providing us healthy brooders. The other factor is late arrival of brooders because of restrictions on flight movement due to the Covid-19 pandemic.

We are planning to produce about 2.5 billion black tiger seed for the next year 2022. By this calendar year end, we will be close to 500 million.

Q. How is VaishnaviAquatech poised to fill the gap?

Ans: The Vaishnavi Aquatech has solely sold around 350 million black tiger (Moana) seeds to date and is still trying its best in fulfilling the demand. It is tying up with few more hatcheries for post larvae (PL) production for the coming year. Vaishnavi Aquatech is coming up with BMC (Brooder Multiplication Centre) which in turn will be helpful to avoid dependency on international imports. Total number of brooders imported till date are 1400 (pairs).

Q. Black tiger shrimp mainly depends on the export market. Do you not think that higher production will be subjected to higher market risk due to the volatility of the international market?

Ans: Overall, the export from India is 7 lakhs tons in which currently maximum export is of Vannamei. Black tiger alone cannot meet the huge requirement of import market. It solely depends on the export market as black tiger is preferably harvested in bigger sizes. These bigger sizes will not fall under competition with vannamei considering exports. Even if farmers switch from vannamei to black tiger, there will be less material available considering the low-density stocking. I think there will be no issue up to 1 lakh tons production of black tiger.

Q. Have you developed any mechanism to assess the performance of the seeds?

Ans: It starts with hatchery where we adopt the best practice and follow stringent protocols, post-selection of healthy nauplii and high-quality diet. So far what we observe,more than 90 per cent of farmers have harvested below 20 counts. As of now, the seed performance has been excellent compared to other seeds. Many farmers are getting benefited by doing black tiger farming. Farmers are benefitted in many ways such as FCR, Less DOC and low usage of medicines. And the most important point is farmers are keen to harvest at15,20,25,30 counts which allow them to get good returns.

Q. What are the future plans of Vaishnavi Aquatech?

Ans: The Brooder Multiplication Centre (BMC) will be fully functional from December 2021 and will be able to supply brooders from August 2022.We are in discussion with few hatcheries for supply of Brooders for the production of Post larvae Seeds. We are planning for a hatchery with best in class of technology with advance laboratory.

Fisheries and Aquaculture Infrastructure Development Fund

Introduction:

Fisheries and Aquaculture Infrastructure Development Fund (FIDF) envisages creation of fisheries infrastructure facilities both in marine and inland fisheries sectors in our country. Under FIDF, the entrepreneur / entities can apply on 20 different activities. Each activity has a unit cost attached to it. An applicant can propose for innovative projects also under FIDF, for which there is no cap on the project cost.

FIDF entails an estimated fund size of INR 7,522 crore, comprising of INR 5,266.40 crore from Nodal Loaning Entities (NLEs) like National Bank for Agriculture and Rural development (NABARD), National Cooperatives Development Corporation (NCDC), all Scheduled banks; INR 1,316.60 crore as beneficiaries' contribution; and INR 939.48 crore as budgetary support from Government of India (GOI).

Objectives of FIDF

- Creation and modernization of capture & culture fisheries infrastructure
- Creation of Marine Aquaculture Infrastructure
- Creation and modernization of Inland Fisheries Infrastructure
- Reduce post-harvest losses and improve domestic marketing facilities through infrastructure support.
- To bridge the resource gap and facilitate completion of ongoing infra projects

Implementation of FIDF Scheme:

The nodal implementing agency for FIDF in the country is National Fisheries Development Board (NFDB), Hyderabad. Under FIDF, the eligible entities can

apply on 20 different activities. Each activity has a unit cost attached to it. An applicant can propose for innovative projects also under FIDF, for which there is no cap on the project cost.

Applicant has to submit the Detailed Project Report (DPR) to the NFDB enclosing all approvals necessary for operationalization of the project. The projects proposed shall be bankable project. The DPR will be technically reviewed by NFDB and the same will be recommended to Central Approval Monitoring Committee (CAMC) for approval. Upon approval from CAMC, the applicant can approach for loan from the Nodal Loaning Entities like, National Bank for Agriculture and Rural Development (NABARD), National Cooperative Development Corporation (NCDC) and All Scheduled banks

Under FIDF, an individual / entrepreneur / Cooperative Society/Fishery Federations/ Government entity can avail loan over a period of five years i.e. 2018-2023, with maximum repayment period up to 12 years inclusive of moratorium of two years on repayment of principle.

The project under the FIDF shall be eligible for loan up to 80% of the estimated/actual project cost. Beneficiaries are required to contribute at least 20% of the project cost as margin money. The contribution of margin money in case of States Governments / UTs implemented projects shall not be mandatory. Up to 3% interest subvention will be provided on the loan amount upon approval. The lending rate will not be lower than 5% per annum for all eligible entities. NFDB is the Nodal Implementing Agency of the scheme.

Component-wise unit cost of the Eligible Investment Activities under the Fisheries Infrastructure Development Fund (FIDF)

Sl No.	Components	Unit	Unit Cost (Rs. in lakhs)
(i)	(ii)	(iii)	(iv)
1	Establishment of Fishing Harbours	No.	15000.00
2	Establishment of Fish Landing Centers	No.	1000.00
3	Construction of Ice Plants (both Marine and Inland Fisheries Sectors)	No.	100.00
4	Construction of Cold storage (both Marine and Inland Fisheries Sectors)	No.	100.00
5	Fish Transport Facilities (Marine & Inland Fisheries Sector)	No.	20.00
6	Integrated Cold Chain (Marine & Inland Sector)	No.	500.00
7	Development of Modern Fish Markets	No.	100.00
8	Setting up of Brood Banks	No	1000.00
9	Development of Hatcheries	No	50.00
10	Development of Aquaculture	Ha	7.00
11	Modernization State Fish Seed Farms	No.	500.00
12	Establishment of state of art of Fisheries Training Centres	No.	500.00
13	Fish Processing Units	No.	4674.00
14	Fish Feed Mills/Plants		
	(a) Feed mills of minimum 4 to 5 tonne per day capacity	No	10.00
	(b) Feed mills/plants of minimum 10 tonne per day capacity	No	650.00
15	Establishment of Cage culture in Reservoir	No.	3.00
16	Introduction of Deep Sea Fishing Vessels	No.	80.00
17	Establishment of Disease Diagnostic Laboratories	No.	150.00
18	Development of Mariculture		
	(a) Sea cage culture	No	5.00
	(b) Hatcheries	No	50.00
	(c) Nursery Area	Ha	6.00
	(d) Seaweed/Bivalve/Pearl cultures	With a total lump sum amount of Rs.4225.00 lakh	
19	Establishment of Aquatic Quarantine Facilities	No.	2500.00
20	Any other innovative projects/activities designed to enhance fish production/productivity/value.	Lump sum	

Optimism, reforms, investment: India on cusp of transforming seaweed sector

India has a long rich bio-diverse coastline that provides livelihood to millions. While traditional aqua farming has helped shape the coastal economy over the years, the country has been rather obtuse in adopting seaweed cultivation, an allied agricultural sector that holds immense prospects for the nation's economy.

Things, however, are beginning to gather steam. The Narendra Modi government has, sought to give the sector a heady start through strategic policy intervention, alive of the significant and emerging

opportunities for seaweed-based products and produces in the national and international markets. The Pradhan Mantri

The following table shows the major seaweed producing countries in the world.

Country/area.	Seaweed aquaculture production	
	Tones (wet weight)	Share of world total (%)
World	**32 386 189**	**100.00**
Asia	**32 231 955**	**99.52**
China	18 575 280	57.36
Indonesia	9 320 298	28.78
South Korea	1 710 500	5.28
Philippines	1 478 301	4.56
North Korea	553 000	1.71
Japan	389 800	1.20
Malaysia	174 083	0.54
Africa	**112 815**	**0.35**
Tanzania	104 550	0.32
Madagascar	5337	0.02
Americas	**31 984**	**0.07**
Chile	21 178	0.07
Oceania	**14 040**	**0.04**
Solomon Islands	5 520	0.02
Papua New Guinea	4 300	0.01
Kiribati	3 650	0.01
Europe	**5 396**	**0.02**
Russian Federation	4 527	0.01

Fig.1. Seaweed aquaculture production in the world in 2018 (source FAO-SOFIA 2020)

Matsya Sampada Yojana has earmarked over Rs 600 crore for bringing vibrancy to the sector and to raise the level of production from 25,000 tonnes in 2020 to 1,12,000 tonnes by 2025. The scope is endless for the sector and a palpable sense of optimism was visible at a two day Seaweed India meet where top government officials and policymakers engaged in constructive and thought-evoking discussion with veterans of the industry, academicians, agriculture experts and business leaders from India and abroad.

The conclave, organised by SMART AGRI POST & AQUA POST on August 26-27, came against the backdrop of a renewed thrust on the sector fuelled by strategic policy intervention, even as India is warming up to the idea of seaweed farming as a key enabler in shaping India's aquaculture landscape in coming decades.

The deliberations among 28 speakers spanned over eight and a half hour that provided a rich repository of ideas for the growth and development of seaweed sector, about the umpteen potential, challenges and opportunities.

Initiating the discussion, Shri Jatindra Nath Swain, Secretary-Fisheries Government of India drew attention to the PM's Independence Day speech when he encouraged stakeholders 'to take full advantage of the new possibilities that are emerging in the cultivation of seaweed".

The fisheries secretary alluded to the role of the processing sector in creating a vibrant aquaculture industry and stressed replicating a similar model in the area of seaweed cultivation to unlock India's potential in this sector. He said the states should look into framing unambiguous rules for seaweed farming to avoid legal issues and focus on the creation of seed banks for sustained cultivation.

Aquaculture and seaweed farming, he said, is also critical in India's context in the coming decades when the overgrowing population will lead to the saturation of land available for traditional agriculture farming. "We have to (then) move from land-based production system to sea-based production system".

Seaweed farming can also transform coastal areas into commercial hubs, generating incomes and improving the livelihoods of the farming community living on the margins.

Dr J Balaji, Joint Secretary, Department of Fisheries, Govt of India said there is a huge possibility of developing seaweed sector. He said India should lay focus on '3 S' such as seed, scale and sale of seaweed products" to give the much-needed growth trajectory to the sector.

Picking up the thread, **Dr J K Jena, DDG-Fisheries, ICAR, Govt of India** said "We need to have seed banks in several locations and

focus on generic improvement programmes. We need to see that the whole value chain is created so that seed to selling is not an issue".

The observations of other speakers are as follows:

Director, Cluster Innovation Centre & Centre for Himalayan Studies of Delhi University Prof Dinabandhu Sahoo appealed to the research bodies to go for targeted innovations and identification of suitable seaweed cultivation areas in consultation with the concerned states, the Centre and with the industries. He underlined the need for a buyback arrangement from seaweed farmers at a predetermined rate, apparently indicating towards bringing the seaweed products under the MSP regime.

Dr Ira Levine, Professor, Natural & Applied Sciences, Fulbright Scholar Maine, USA:

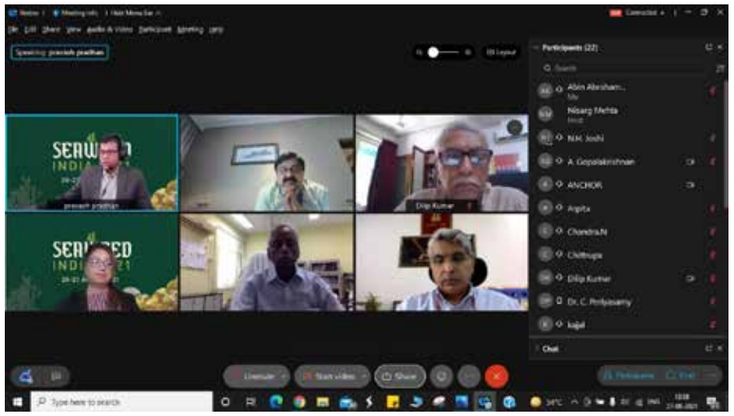
"India has the infrastructure and human power to succeed in seaweed farming. What we need is confidence and support to sell products at a proper price, a guaranteed purchasing".

Shrikumar Suryanarayan, Co-Founder, Chairman & CEO, Sea6 Energy:

"If we can improve labour productivity, it is possible to reduce the cost of sea plant. Even bio fuel can become viable. Besides, we must focus on applications of seaweed because of versatility".

Dr. Anicia Q. Hurtado, Scientist-Consultant in Seaweed, Tissue Culture & Aquaculture, Philippines:

"There is a need to have an established land-sea based nurseries for year round availability of seedlings, sustained farming, stable income and a robust, strong



and sustainable industry".

Dr. Lim Phaik Eem, Deputy Director, Head of Marine Biotechnology Research Unit, Institute of Ocean & Earth Sciences, University Malaya:

"The way forward for seaweed industry is continuous supply of robust, versatile seeds, biosecurity application, increased cultivation area, diversifying value chain and cultivated species."

Dr Stefan Kraan, CSO, The Seaweed Company Purple Turtle, Tamil Nadu:

"There is a need for mechanization. To compete with China, Philippines, Malaysia is not easy...., (mechanization) this aspect can be explored. We need licensing issues to be addressed".

Prof. CRK Reddy, CEO, Indian Centre for Climate and Societal Impact Research:

"India need to have a strong S&T programme, infrastructure facilities, nodal agencies to promote the industry. Further, we need to focus on HR development because no university in India at present offer courses on seaweeds and seaweeds cluster development".

Dr. Alan Critchley, The Verschuren Centre for Sustainability in Energy and Environment, University of Cape:

"There are few differences in the principles of agronomy and phyconomy. Do not repeat the mistakes in the marine sector. Do not distribute limited genetic crops around the world. Investigate indigenous diversity for best applications and invest in indigenous efforts".

Dr. Vaibhava Mantri, Principal Scientist & Divisional Chair Applied Phycology and Biotechnology Division, CSIR-CSMCRI underlinedthe potential of tech intervention for good yield in India. He gave an insight into the research that has been carried out in the last couple of years in understanding the process of cultivation and adopting new technologies for improving the production in the country.

Dr. Johnson. B, Scientist, ICAR-CMFRI Mandapam Centre said, 'Along with seaweed farming, Integrated Multi-Trophic Aquacultureis increasingly gaining global traction as a means of environmentalsustainability and economic stability. He offered an incisiveaccount of the economic benefit of seaweed farming and innovativemeasures for better yield for fish farmers in India'.

Dr. Muruganantham, Manager, Sathyam Group of Companies, Madurai:

"Seaweed extracts under bio stimulants, the market of which has grown rapidly. The products are natural, biodegradable and non-hazardous in nature".

Dr. Kajal Chakraborty, Principal Scientist, ICAR-Central Marine Fisheries Research Institute. (ICAR-CMFRI):

"Seaweeds are exceptional store house of bioactive natural products with pharmaceutical and functional food applications. Marine flora has, however, remained largely unexplored and approximately 71 per cent of the molecular entities listed in the dictionary of marine natural products have novel molecular structures compared to 40 per cent of those in the dictionary of natural products".

Dr. P. K. Anil Kumar,Scientist, TIFAC:

"Support can be extended for seaweed value addition with technology upgradation of traditional seaweed processing units. Seaweed based start-ups should be provided seed fund, market access etc. Besides, commercial production of seaweed-based pharmaceuticals should be taken up.

Director of AquAgri, Tanmaye Seth also recommended formulation of a clear policy specifying the area where the cultivation is not permitted. Such areas should be demarcated with GPS coordinates to remove ambiguity. He also suggested the introduction of insurance from the government for seaweed growers as protection against natural calamities.

Dr C Periyasamy, Assistant Professor & Head, Department of Botany, Pasumpon Muthuramalinga Thevar College said that the expansion of this seaweed cultivation has not yet flourished after 2011 as expected due to various factors. The probable reasons would be lack of promoting agencies, lack of proper practices, lack of crop data, lack of viable seed material, lack of feasible cultivation methods in open waters and lack of public awareness, besides lack of Government support.

S Vasu of Thashava Marine Products, Seiyappa Goundan Puthur drew attention to the issue of imposition of GST on seaweed products, contending that the 14 per cent tax rate is having a detrimental impact on the industries. As opposed to the earlier 5 per cent tax regime, GST has increased their burden and have blunt the prospects of competing with other countries, he contended.

Alluding to the challenges facing the sector, **Director, ICAR-CMFRI Dr A Gopalakrishnan** suggested a leasing policy for seaweed farming for the benefit of the sector. The policy can spell out the modalities for leasing of coastal water and so on, a view shared by several speakers while pointing to possible litigations and legal disputes.

Dr M V Gupta, World Food Laureate & Former Assistant Director-General of World Fish Centre said,"Seaweed farming is a livelihood activity for women in coastal areas. This is an alternative source of livelihood. The per capita income of women is low. They were not involved in processing. Most of the profit is being taken by the middlemen. We need to address this issue to catch up with other countries and be in the reckoning."

Summing up the two days conclave, Dr DilipKumar, Chairman, Board of Directors, Institute of Livelihood Research and Training (ILRT); Adviser International Civil Service FAO of the UN – Retired, suggested to use the term 'Sea plant' instead of "seaweed" which undermines the importance of sea plants which bear enormous potential for contributing to food, nutrition, livelihood security, and carbon sequestration. He has tried to sum up the deliberations as mentioned below.

Converting potential into realities – few recommendations

- Consideringthe resources, needs and aspirations of millions, India needs to follow the strategy of mass production of seaweed but unlike the West where this is exclusively a large scale and highly mechanized farming. India also needs to ensure that its approach should be primarily on increasing the income of the farmers rather than increasing production. The research institutes should, therefore, aim at developing need based technologies.
- Bringing the seaweed production from subsistence to commercial mode with technological inputs and integrating it with the industry to ensure a scalable and sustainable value chain.

Priority interventions points

- Need to conduct an extensive survey to identify the most suitable areas for the development of seaweed farming and making it

available in the public domain.

- Conduct a comprehensive market study on the demand, supply, price, export market, emerging areas for product diversification, etc.
- Isolation of bioactive compounds and possible areas for their application including technologies for their bulk production and utilization and quality assurance
- Creating a conducive regulatory environment for the sustainable growth of seaweed production and the processing industry.
- It was observed that, though seaweed cultivation is a labor-intensive system, it keeps the production costs high. At this stage it is important to introduce mechanization by developing small-scale, user-friendly and low-cost affordable harvesters, aggregators, etc., to bring down the production cost.
- Promotion of seaweed-based biofuel production
- Developing infrastructure facilities such as seed banks, facilities for aggregation and drying yards, transport and storage facilities in addition to developing land and sea-based nurseries for year-round availability of seed propagules.

Research thrust areas

- Selective breeding technologies for scalable inshore and offshore farming practices including location and collection of broodstock and domestication program.
- Development of In-vitro/ tissue culture technologies for quality seed production.
- Development of commercially viable seed production technologies to ensure adequate supply of seed for the primary producers.
- Promotion of IMTA systems combining sea cage and seaweed farming
- Developing and diversifying production technologies, conducting extensive field trials and fine-tuning before releasing such technologies for mass application.

Institutional strengthening and capacity building

Major production of seaweed for the industry still comes from the wild collection, while only a fraction of production comes from cultivation. For making the best use of the huge allocation of resources for the fisheries sector, both at the union and maritime states level, it is high time for promotion of seaweed farming and value chain development by strengthening extension services system, research - extension linkage, making easy availability of inputs including quality seed, easy access to institutional finance, and creating a coherent relationship between primary producers and the industries. Creating a dedicated unit for the development of seaweed farming in the maritime states deserves priority.

A strong coordination mechanism is required to foster functional linkages between the maritime state departments of fisheries, NFDB, fisheries universities and colleges and ICAR research Institutes to ensure smooth and sustainable delivery of technical assistance, the flow of technologies, and conduct of quality training for extension personnel and farmers. Encouraging innovations among the farming communities and processing sector is equally important.

Industrial development and market linkages in Seaweed sector key priorities of Govt: Fisheries Secy

The seaweed sector has the potential to generate income and employment, and stimulate the growth of new entrepreneurs and startups all over the coastal States/UTs, says Shri Jatindra Nath Swain, IAS, Secretary-Fisheries, Government of India, in a special interview to Pravash Pradhan, Chief Editor, AQUA POST

Q. India aims to increase seaweed production to 11.5 lakh tons in the next 5 years. Could you please briefly talk about government policies and programs to achieve the target?

Ans: Hon'ble Prime Minister in his address to the Nation from the ramparts of the Red Fort on Independence Day 2021, announced several major developments initiatives in the coming years. Exploring the full potential of Seaweed cultivation was one among them.

India has enormous scope for seaweed cultivation as it is bestowed with a coastline of more than 8000 km, embracing 821 species of seaweeds. Considering their use as a renewable source of food, fertilizer, energy, chemicals and medicines, the seaweeds have great demands in the international markets also.

The Department of Fisheries, under the 'Blue Revolution' Scheme, has started promoting this activity since 2015-16. As a result, several Self-Help Groups and coastal Fishermen Associations have come forward to take up seaweed cultivation as

an additional livelihood option and proven its potential in empowerment for coastal women.

The Government of India has recognized that the seaweed production potential of the country has not been explored in the way it deserves, despite the techno-economic ease for its intensification compared to other aquaculture sectors.

It is therefore under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), an amount of about Rs. 600 crores have been earmarked for the development of Seaweed farming, wherein Seaweed seed banks, nurseries, tissue culture units, processing and marketing units, etc. will be established over the coastal states and Union territories.

The support from the government will be extended to ensure the seaweed cultivation takes root in all the potential areas spread all over the country's coastal waters apart from the conventional farming areas where seaweed is being cultivated ona limited scale.

The Government has already laid down tentative targets for seaweed production with weightage in funding assistance as per the production potential for all the coastal states and UTs.

With these efforts, the Govt envisages boosting the seaweed cultivation to reach about 11.2 Lakh tones wet weight in 5 years.

Q. What are the major challenges in this sector and how do you plan to address the issue?

Ans: The major constraints on the seaweed cultivation and value chain at present are identified as:

i. Ready availability of good quality seaweed seed materials
ii. Species diversification in Seaweed farming
iii. Creation of processing facilities and marketing infrastructure for processed seaweeds/products.
iv. Leasing policies for seaweed farming in coastal areas.
v. Need for enhancing awareness about the vast potential of the seaweed-based by-product industry, other than phycocolloids among the public.

Govt of India is supported by the R & D institutions for the development of seed production technologies for the cultivable species in Indian waters.

Industrial development and market linkages in the Seaweed sector has been considered as one of the top priorities for the Government and efforts are progressing in that direction through interactions with appropriate stakeholders to form the industries and cooperatives on an urgent basis.

Q. What incentives are there for entrepreneurs? Several international companies are also interested in investing in the seaweed sector in India. What are the facilities available for them?

Ans: Government of India recognizes that the seaweed sector has the potential as a powerful income and employment generator, and stimulates the growth of new entrepreneurs and startups all over the coastal States/UTs.

Apart from farming, the input-delivery-systems, marketing and exports, processing and product development also needs entrepreneurs as many of the modern technologies are complex from the traditional fishers' point of view, and professionals in the government sector cannot take up all the responsibilities to bring quantum change in the system.

Therefore, it has become the need of the hour to develop entrepreneurship in various sectors of fisheries, including seaweed cultivation and value chain with strategies for training and capacity building among

the traditional fishers, as well as mobilizing new entrepreneurs in the fisheries sector.

Under PMMSY financial assistance will be provided for taking up large scale cultivation in cluster area approaches for fisher groups, SHGs and Cooperatives. In addition, Govt. of India is encouraging investment in processing and value addition of seaweed for which the Govt is taking consultation with industrial players and state governments to engage entrepreneurs to establish seaweed value addition industries.

Further Govt. of India recognizes that the industry requires the scale of production. In this regard, the Fisheries Department is working for ensuring the minimum crucial biomass of seaweed. One of the important aspects is to create adequate raw materials for industries.

One of the important initiatives in this regard is the budget announcement made by the Hon'ble Finance Minister this year (2021-22) was the establishment of a multipurpose seaweed park in Tamil Nadu. The Park will have several activities catering to fishers, farmers, entrepreneurs and R&D institutions.

The Park would also support the establishment of seaweed value-added units, under one roof, and ensure easy access to raw material to the industry on a continuous basis, thus ensuring higher returns to the seaweed cultivators.

The establishment of Fisheries Incubation Centers (FICs) would also be supported under PMMSY both through the government and private sector. Fisheries Incubation Centers would provide opportunities to the incubatees like young professionals/ entrepreneurs' fisheries institutes, fisheries researchers, cooperatives/federations to showcase their innovations and innovative ideas, technologies and commercialize them for the benefit of fishers/fish farmers. This would also help in creating new businesses, entrepreneurs' development (aquapreneurs) and employment opportunities in the sector.

Q.What is the status of the Seaweed Park in Tamil Nadu?

Ans: Hon'ble Finance Minister in her budget speech FY 2021-22announced to establish a Multipurpose Seaweed Park in Tamil Nadu to promote seaweed cultivation.

The Seaweed Park in Tamil Nadu will be developed as a hub to serve as a one-stop park for the entire

seaweed value chain linking all the activities from pre-and post-harvest infrastructure, logistics, marketing, export promotion, innovation, technology incubation and knowledge dissemination for arriving at optimum outputs and thereby maximizing value addition, minimizing wastage and increasing the income of all stakeholders and creating employment opportunities.

Department of Fisheries (DoF), Govt. of Tamil Nadu has submitted a preliminaryproject proposal on the establishment of multipurpose seaweed park in Tamil Nadu during four years (2021-22 to 2024-25) at seven Coastal Districts (Thoothukudi, Ramanathapuram, Pudukkottai, Thanjavur, Nagapattinam, Thiruvarur and Mayiladuthurai).

The Dept of Fisheries and Govt. of Tamil Nadu had series of consultations for farming up the contours of the proposals during the meetings held on 15th May and 04th August 2021.

Govt. of Tamil Nadu is preparing a detailed project report. The project is likely to be approved by end of October-November, 2021). Based on that, more seaweed parks will be set up.

Q. Please tell us about the status of seaweed farming in the States and its potential.

Ans: Although the pioneer attempts in seaweed farming in particular commercial farming of Kappaphycusalvarezilhas gained wide popularity from the Mandapam coast, the seaweed production potential in India has been reported from all the coastal states and Union territories, with varying levels of productivity according to the geo-climatic conditions.

Presently the cultivation is picking up in certain coastal districts of Tamil Nadu, Gujarat and some other parts of the country.

I am happy to inform that during the COVID-19 first national lockdown, there was a fishing ban and seaweed farming was the only source of income for some fisherwomen owned family in the State of Tamil Nadu, by which her family and she could earn an income of Rs. 65,000. Seaweed farming activity has enhanced her self-confidence and empowered her to manage her family activities.

Considering its huge potential, the government has been actively working for bringing on board, research and development institutions such as CSIR-CSMCRI, CMFRI and concerned state departments in developing viable culture technologies as well as mapping new potential areas for seaweed farming in various states and UTs.

Till September 2021 a total of 31000 Seaweed culture rafts including inputs, with a total cost of Rs. 465 Lakh and 23,531 Seaweed culture monoline with a total cost of Rs. 1882.42 Lakh have been sanctioned under PMMSY for augmentation of seaweed cultivation to the states of Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu.

In addition, one Seaweed bank has also sanctioned to U.T. Administration of Dadra and Nagar Haveli and Daman & Diu with a total cost of Rs. 120 Lakhs. Apart from that, a proposal on Seed plant production of seaweeds worth Rs. 53.18 Lakhs have been sanctioned to CSIR-Central Salt & Marine Chemicals Research Institute (CSMCRI) and another proposal on establishment of pilot-scale farming of commercially valuable seaweeds in Andaman Coast worth Rs. 82.74 lakhs has been sanctioned to the U.T. Administration of Andaman and Nicobar Islands during the FY 2020-21.

Former PepsiCo executive's tryst with seaweed cultivation

Mr Abhiram Seth, an ex-PepsiCo executive, had a difficult choice to make in 2008-- switching over to the farm sector, seaweed farming at that, leaving behind a successful career in the corporate world. The odds were stacked against him, but not his confidence.

A decade later, Mr Seth presents a picture of a content man, a feeling of vindication. Mr Seth has not only cultivated his way through the seaweed farming sector adroitly, but has come out withhealthy yields and helped generate employment for 1000+ people in coastal Tamil Nadu Even though the business model of his company Aquagri Processing Private Ltd. (APPL) is proven, the desire to create at least 100,000 jobs in seaweed cultivation remains a dream. Though now there is light at the end of the tunnel as the production target set by the Ministry of Fisheries is pegged at 11.2 lakh tonnes by 2025 from the current level of 25,000 tonnes.

Entrepreneurial journey

This successful entrepreneurs tryst with seaweed farming started during his days with PepsiCo when he was introduced to it by an international customer. The idea looked fascinating and the potential immense and to achieve it an enduring partnership with the Central Salt and Marine Chemical Research Institute, PepsiCo carried out an exhaustive seaweed cultivation trials in the coastal Tamil Nadu. Trials were conducted in over 10 hectares of land.

"It was in early 2000 when we carried out successful trials and in the next four years, we demonstrated the farmers that it was a workable model that would add to the level of income," he said.

Mr. Seth decided to retire from corporate life after spending 33 years in the industry. At the time of departure realised that PepsiCo did not have any interest in persisting with the seaweed initiative as it was not part of its core portfolio. So he decided to create Aquagri to continue the work and Pepsi Co. graciously facilitated the business transfer.

Aquagri continued with commercial cultivation of Kappaphycus having achieved 20,000MT wet seawed production as the highest ever in 2013. Since then due to climate change and abnormal sea water temperature conditions, the seaweed cultivation faced a set back and is still struggling to recover from it in absence of high growth planting material availability andhaving no defined process for bringing fresh planting material and cultivars from the international sources.

Tamil Nadu State model of private sector participation in seaweed collection directly from collectors can be rolled out at other promising locations. Such a model has had no adverse impact as seaweeds are self-generating resources and go waste if not exploited seasonally.

The fact that seaweed cultivation has remained in the mind of the country's leadership and on the top of government's agenda despite stiff opposition from the Ministry of Environment and Forest.'There was a time when I was challenged with the prospect of the business folding up. I had to then dig into my saving to keep the venture alive. During those days, no banks were also willing to invest in this business,' recalls Mr Seth.

The major turnaround for Seth's company came in 2017 when the world's biggest farmers' cooperative, Indian Farmers Fertilizer Cooperative Limited (IFFCO), one of the largest manufacturer and marketer of chemical fertiliser globally having revenues of 3.90 billion USD on the fertilizer, took 50% equity stake through its wholly owned subsidiary IFFCO Bazar Ltd. in Aquagri.

IFFCO in line with the stated government strategy of reducing chemical fertilizer usage, diversified its offering by expanding its portfolio to include organic products, amongst which the most successful has been "Sagarika" Marine Algae based bio-stimulant. Since IFFCO partnership, Aquagri business has grown exponentially and starting out from being an exporter of seaweeds from India the company now has to rely on imports to sustain its commitments to its customers in the Indian market.

In the last year or so, seaweed sectors potential has duly been recognised by the government and the decision to make it a part of Ministry of Fisheries mandate, could now lead to a turn around. The Ministry has come out with encouraging policies both from the Centre and the Tamil Nadu State Government

"Mr Seth observes the following factors have slowed the pace of development of the seaweed sector.

1. **Currently own species, which the farmers are cultivating since 2005, is Kappaphycus. Even after, over 30 years of its introduction to Indian waters, Ministry of Environment and Forests terms it as exotic and invasive and prohibits the cultivation in the gulf areas. Need to open up the gulf areas for cultivation of Kappaphycus**
2. **Our planting material has lost vigor and we need to get fresh cultivars of Kappaphycus and other successful species being cultivated in Indonesia and Philippines if we want to catch up with them.**
3. **We need to set up commercial micro-propagation and tissue culture based nurseries and seed banks in PPP model to ensure uninterrupted supply of the planting material to the farmers.**
4. **Infrastructure and training should be imparted to the farmers only after validating the cultivation site and ensuring adequate planting material supply."**

Some issues, however, need attention for giving a boost to the sector. They include addressing the shortage of planting materials and working out with the Ministry of Environment and Forest which has put restrictions on cultivation of Kappphycus in the gulf areas, he suggested. Besides, Mr Seth called for clear demarcation of the areas of cultivation.

Challenges

The greatest challenge is to align the Ministry of Environment and Forest and to educate them to understand that seaweed cultivation and harvesting is being done globally to combat climate change and to protect eco sensitive coral regions.

In India seaweed is a sunrise industry with scope for production and fulfilment of commercial requirements of food, feed, chemicals, pharmaceuticals, cosmetics, biofuels, biofertilisers, biostimulants etc for various industries. It provides additional income to cultivators and fishermen families.

Seaweed cultivation not only acts as a carbon sink but also helps in scavenging the fertiliser run offs from land agriculture to the sea by absorbing phosphates and nitrites from the near shore areas.

It must be recognised that India's successes in agriculture have been triggered by adopting the exotic species in a controlled manner, the introduction of rice varieties from Philippines and Wheat from Mexico. Similarly, India became the largest exporter of prawns after introduction of Vannamei shrimp. There denial and opposition for adopting Kappaphycus for cultivation in gulf areas just on the grounds that it is exotic and may be invasive is without any scientific basis. No invasion is reported from Indonesia or Philippines, the largest growing centres or from Palk Bay area where it has been cultivated for the last 20 years.

The greatest opportunity seaweed cultivation offers is of providing sustainable livelihood to the coastal communities. These communities do not have thriving agriculture due to soil salinity and lack of fresh water availability, further their traditional livelihood occupation of fishing is under strain due to depletion in fish catch.

The other big opportunity is in the space of marine algae based bio-stimulants which are globally being used for providing relief against abiotic stress and boost crop production, while reducing chemical fertiliser usage by 25-30%. This fact itself has huge implication both for the farmers and for relieving the government subsidy burden on chemical fertilisers.

The role seaweed additives as part of animal feed can play in reducing methane emission from cattle and improving health of animals is a matter of global focus, where India has the potential to emerge as a major supplier.

Preventing Whitewash

Dr Manoj Sharma, MD, Mayank Aqua, Surat

Shrimp farming has been facing the devastating effects of the White Spot Syndrome Virus (WSSV) since 1995 till date. WSSV affects the production of the shrimps to more than 50 % and causes loss of millions of dollars every year. Apart from the low temperatures in the winters, the monsoon provides a very conducive environment for the WSSV disease. Farmers have learned to cope up with WSSV by crop management practices, sustainable practices, diversifying species and proper planning.

Since 2017, the shrimp farmers are repeatedly facing issues and losses in the shrimp farming due to various reasons such as scarcity of rain, increase in the atmospheric temperature, weak prices and prevailing diseases such as white gut, white faeces, white spot disease, EHP, Running mortality syndrome primarily and others.

Shrimp'nomics

Indian shrimp production has dropped to over 30% due to the production issues and industry dynamics and farmers are reluctant to do shrimp farming due to the fear of loss of livelihood. Considering the WSSV disease, farmers started taking the pre-monsoon crop approach which is between February to Mid-August as a standard practice. But now this approach has also been dreaded due to the diseases such as white gut and white faecal disease that forces farmers to carry out premature harvest.

This "WHITEWASH" in the shrimp farming which is white gut and white faecal disease in the summer and WSSV in the monsoon and winter has caused severe damage to the shrimp farming fraternity all over India. All these issues can be attributed to high stockings, high temperatures, high salinities and high organic loads which makes them a perfect recipe for the WHITEWASH havoc in shrimp farming.

Ten Practical Tips

- Before stocking, do check the shrimp seed health status and make sure the seed is free of WSSV.
- Manage organic loads in your pond. Remove during pond preparation and putextra effort in soil conditioning. Use multiple settlement ponds and multiplereservoirs to clarify intake water.
- Practical biosecurity like bird and crab fencing, foot and hand wash should bemandatory. Avoid repeated sampling and animal handling during initial 60days.
- Adequate disinfection and sanitisation of the working labours, machinery and equipment, nets and tanks used for harvesting is must. Do not allow the direct entry of the shrimp buyers or there crates at the farm site as they might be contaminated and can bring pathogens at the farm site.
- Practice optimal stocking density, best is at around 30 pcs /m2 . Work with apositive carrying capacity of your pond.
- Keep separate area for depositing sludge. Never release sludge from your pond into your own water source. It is harmful in the long run.
- Good feed management is a major factor in farming success. Multiple feeding(5-6) times per day is ideal. Use of Auto-feeders is the best option.
- Use of good quality probiotics and gut conditioners are very helpful.
- Maintenance of DO levels at above 5 ppm is a blessing to the growing shrimp. Use combination of paddle wheels and air diffusers for better efficiency.

Biofloc technology in North East region: A study

Mr. Debtanu Barman

What is Biofloc Technology (BFT)?

Biofloc technology (BFT) is an ecologically bio-friendly aquaculture technique based on in situ microorganism production. Fish and shrimp are grown in an intensive way (minimum of 300 g of biomass per square meter) with zero or minimum water exchange. In addition, continuously oxygen supply and water movement in the entirely water column is required to induce the macro-aggregate (biofloc) formation. Nutrients in water (in accordance with a known carbon to nitrogen ratio of 12–20:1) will contribute naturally to a heterotrophic microbial community formation and stabilization.

These microorganisms play three major roles:

(i) Maintenance of water quality, by the uptake of nitrogen compounds generating in situ microbial protein.

(ii) Nutrition increasing culture feasibility by reducing feed conversion ratio (FCR) and a decrease of feed cost.

(iii) Competition with pathogens.

Need of Biofloc Technology

Biofloc system was developed to improve the environmental control over the aquatic animal production. In aquaculture the strongest influential factor is feed cost (60% of total cost) and most limiting factor is the water and land availability. High stocking density and rearing of aquatic animal requires a wastewater aquaculture.

The principle of this technique is the generation of nitrogen cycle by maintaining higher C/N ratio through stimulating heterotrophic microbial growth which assimilates nitrogenous waste that can be exploited by cultured species as feed. Higher C/N ratio is maintained by the

addition of carbohydrate source (molasses) and the water quality is improved through production of high-quality single cell protein. Immobilization of toxic nitrogen species occurs more rapidly in BFT as the growth rate and microbial production per unit substrate of heterotrophs are 10 times greater than autotrophic bacteria. Due to its bottom dwelling habit and resistance to environmental changes, the technology was implemented in shrimp farming. An improved growth rate and larval growth has been reported in BFT as compared to normal cultivation.

How does it work?

The principle behind the working of biofloc is C:N ratio. In biofloc tank, we put both fishes and probiotics i.e., heterotrophic

Few problems faced by fish farmers of NE region

- Non-availabity of Fish Round the Year.
- The shortfall in seasonal rain.
- Low water retention capacity of soil.
- Acidic nature of soil and water.
- Low level of individual land holdings.
- Poor management of the culture ponds.
- Less diversified aquaculture system and species.
- Financial crunch to start an aqua-partnership business.
- Prolonged winter season (reduced growth)

bacteria in high density.

Both Fishes and Bacteria need feed. When we put fish feed and molasses inside tank, some of the feed is consumed by fish and some feed is wasted. From the amount of food consumed, 75% is released by fish in the form of nitrogenous waste. Bacteria also need food i.e Carbon. The C:N ratio of bacteria is 10:1, That means - For every 10 parts of carbohydrates or carbon, bacteria need 1 part of nitrogen.

The carbon requirement of bacteria is fulfilled by the waste feed and molasses. When it feeds on Carbon, the nitrogen thus required is fulfilled from the excretory product (75% N Waste) of fish. In this way - Bacteria or Probiotics consume both waste feed and N - Waste which otherwise can cause severe problem inside the pond ecosystem if left there.

After consuming 10-part carbon and 1-part nitrogen, Bacteria reproduce and produce many new bacteria which are called “Protein Cells” in bio floc farming. These protein cell i.e., bacteria are again consumed by fish as feed.

This is the working principle of biofloc fish farming. This chain reduces feed cost by 70%. The nitrogenous waste thus produce can cause death of fish if it goes above toxic level. Heterotrophic Bacteria also consume this toxic nitrogen i.e., Waste of the tank. Thus - We can say this is amazing way of eco-friendly fish culture method.

Why is Biofloc important in North Eastern States?

Biofloc technology (BFT) is recognized as a sustainable and eco-friendly method of aquaculture that maintains water quality, along with the generation

How to start Biofloc technology-based fish farm

It’s important to understand that biofloc technology and their underlying principles are relatively new and complicated aquaculture concepts. There are still many unknowns and much remains to be discovered. Whether you’re planning to start a small scale biofloc fish farming or gigantic commercial biofloc fish farming, follow these steps to get started:

- Get a good location for your farm
- Get a good transportation facility& Electricity
- Get a good source of water
- Get a good source of electric supply
- Get a good source of local and trained manpower
- Layout of designing and Construction of farm as well as culture tank
- Biofloc generation
- Addition of Carbone source
- Decide the right species and stocking density of fish for culture
- Get healthy fingerling or juveniles
- Control of Carbon and Nitrogen ratio
- Understand the fish feeds and feeding of fish
- Maintain higher aeration system
- Control of biofloc volume
- Removal of sludge
- Control of disease occurs
- Start marketing your fish before they grow-up
- Harvest healthy crop
- Be business minded
- Get good and practical farming training

Technical Specifications of biofloc technology –10000 (10m3) Liter Unit

SL. NO.	COMPONENT	DETAILS
01.	Area for 1 tank	225 Square Feet
02.	Biofloc tank size	4-meterdia&1.2-meter height
03.	Water holding capacity of each tank	10,000 L
04.	Water quality parameters	Temperature: 22-32^{0}C Dissolve oxygen: 5-8 mg/L Ammonia:<0.5 mg/L pH: 7.2-8 TDS: 400-1200 mg/L Floc density: 25-40 mg/L Nitrite:<0.3 mg/L Nitrate: 150 mg/L Alkalinity: 120-280 mg/L
05.	Tanks made-up of	Tarpaulin/Fiber/HDPE
06.	Stocking density	250-450/1000 L
07.	Species cultured	Vietnam Koi/GIFT Tilapia/Singhi/Maguretc
08.	Survival (%)	80
09.	Type of feed to be used	Floating pellet feed
10.	% of feed	2-4% (ABW)
11.	Feeding frequency	4-time early stage & later 2 time per day
12.	FCR	1:1.2
13.	Duration of culture (DOC)	120-180 days
14.	Size/weight of the species (gm)	90-300 gm
15.	No. of crops per year	2
16.	Production	250-300 kg/tank/crop

of microbial proteinaceous feed for aquatic organisms such as fish& shrimp. The biofloc system is an innovative system where fish can be produced in artificial tanks with high densities. It requires much lesser space than the traditional form of fish farming.

According to experts an area of 150 to 200 meter square along with sufficient water supply is enough to grow 2000 kg of fish in four small tanks. Biofloc systems are also most suitable for species that can tolerate poor water quality. A variety of freshwater

Survey & Economic analysis.

Table: Cost Estimates of Biofloc Unit with 10,000liters (Statistic from Field Survey Conducted)

10000L Biofloc Tank (Field Report) – NE States (1unit/6month Crop Cycle)

Fixed Cost

Sl. No.	Items	Qty.	Price (Rs.)	Total (Rs.)
01.	Setup of Tarpaulin tank (10000L capacity)	1	17,000.00	17,000.00
02.	Shed Material	LS	5,000.00	5,000.00
03.	Net & Accessories	LS	2,000.00	2,000.00
04.	Air Pump, Air Stone & Accessories	LS	10,000.00	10,000.00
05.	Weight machine	1	500.00	500.00
06.	Miscellaneous	LS	2,500.00	2,500.00
Total				37,000.00

*Input cost may vary depending on stocking density

10000L Biofloc Tank (Field Report) –NE States

Recurring Cost

Sl. No.	Items	Qty.	Price (Rs.)	Total (Rs.)
01.	Fish Seed (pieces)	3500	2.00	7,000.00
02.	Fish Feed (kg)	180	55.00	9,900.00
03.	Probiotics, Molasses, Salt, Lime etc.	LS	2,000.00	2,000.00
04.	Medicine & Feed Supplement	LS	1,500.00	1,500.00
05.	Water testing kits (set)	1	1,800.00	1,800.00
06.	Miscellaneous	LS	2,000.00	2,000.00
Total				24,000.00

Economics viability of BFT farming

Production of Marketable Fish (Average)	250 kg
Price of Marketable Fish	Rs. 320/- (per kg)
Total Sale Amount	(250 kg × 320) = Rs. 80,000.00
Total Investment (Fixed Cost + Recurring Cost)	(37,000.00 + 24,000.00) = Rs. 61,000.00
(Total Sale Amount – Total Investment Amount)	**(80,000.00 – 61,000.00) = 19,000.00 (Net Profited)**

fish species like Anabas, Tilapia, Carp, Magur, Singi, Tengra, Pangasius and some species of shrimp can be reared easily. With so many advantages over traditional aquaculture practice, it has also certain constraint and improvisation is still needed to get more sophistication in this method. Nevertheless, there is a huge potentiality of this technique as it is an alternative for intensification.

North East India is blessed with aquatic recourses due to its unique climatic condition but it has not been able to utilize its resources rationally and efficiently for the generation of employment and revenue. Unexplored aquatic resources along with the current demand for aqua products have made this region suitable for entrepreneurship development, generation of employment and revenue in this sector. There are several options available for the improvement of fisheries and the aquaculture sector of North East India and it's up to the people to develop an entrepreneurial spirit to boost its economy through the sustainable utilization of the aquatic resources. Conglomeration of new technology, management practice and creative endeavor in fisheries and aquaculture can help Northeast India to climb the economic ladder.

(*Disclaimer: The author is the CEO & Director -in-Charge, Aqua Doctor Solutions & Aqua One Centre, Kolkata, West Bengal, India. The author and his team have made the socio-economic feasibility study of biofloc technology in North East states. AQUA POST deos not take any resposnibility. It is sole discretion of the readers/users to verify the technology and economic feasibility.*)

Water Management in shrimp and fish culture with probiotics

Mr. Abhijeet Naohate, Ms. Shweta Tiwari & Mr. Joao Sendao

The immense potential of probiotics lies on their multiple mechanisms in conferring not just benefits to the host, shrimp and fish, but also helping to eliminate organic wastes and pollutants from the water and bottom of the ponds.

Introduction

Aquaculture is not just an important economic activity but also a sustainable option to provide protein rich food to the ever-growing global population. To meet the global demand, aquaculture production practices have been intensified to a greater extent both in technological and practical measures. Fish and shrimps are dependent on the water they live in for all their needs, including breathing, eating, reproducing and growing. Inadequate water quality causes more losses than any other problem and to a great extent water quality determines the success or failure of any farming operation.

The aquatic environment is composed of many aquatic variables. Farmers must know the variables that are potential sources

of stress for the fish since these variables may also explain the causes of fish culture problems. Water quality parameters, which are of prime importance, are mainly temperature, salinity, turbidity, oxygen, CO2, nitrogen, ammonia, pH, alkalinity, hardness, minerals etc. Proper management consists also of monitoring the ponds regularly, keeping good records and planning ahead for the operation of your farm. Most likely, a pond with good water quality will produce more and healthier animals than a pond with poor quality.

Finally, the success any culture system is no longer a question of a single approach. The success will only by achieved when all the aspects regarding water management are tightly linked to a feed and farm management and strong biosecurity practices.

Probiotics

Due to intensification in aquaculture practices, the emergence of a wide array of

pathogens resulted in infectious diseases that are the major limiting factor in most aquaculture operations. The use of probiotics is one of the most important developments for sustainable aquaculture due to the fact they are safe, effective and eco-friendly alternative to antibiotics by stimulating animal growth and general health status.

The literal meaning of probiotic is pro=for and biotic= life i.e. for life. Verschuere and colleagues proposed an aquaculture-based definition of probiotics, which states A probiotic is defined as a live microbial adjunct which has a beneficial effect on the host by modifying the host associated or ambient microbial community, by ensuring improved use of the feed or enhancing its nutritional value, by enhancing the host response towards disease, or by improving the quality of its ambient environment.

The immense potential of probiotics lies on their multiple mechanisms in conferring not just benefits to the host, shrimp and fish, but also helping to eliminate organic wastes and pollutants from the water and bottom of the ponds. So, based on the mode of action, probiotics can be divided into two broad categories: (a) gut probiotics: which are administrated orally along with food to improve the gut associated beneficial microbial flora and, (b) water probiotics: these types of agents that will be administrated directly to the water and it will promote an improvement in water quality and bottom pond health status – Bioremediation.

The mechanisms of action of probiotics in aquaculture are not yet fully known. Their presumed modes of action are based on the number of studies done in various species. Firstly, the enhancement of feed utilisation and weight gain in aquatic animals. Probiotic microorganisms have beneficial effects on the GIT (gastrointestinal tract)/ gut of aquatic animals in the digestion of dietary nutrients as well as in production of energy. Diets supplemented with probiotics are digested and absorbed more efficiently due to the ability of probiotics to produce digestive enzymes (amylases, proteases, and lipases, etc.) and provide nutrients (vitamins, fatty acids and amino acids). Thesecan contribute to the better assimilation of diet components resulting in improved general health condition and growth performance of aquatic animals. Additionally, a few recent studies have shown that probiotics may also stimulate the nutrient absorption by increasing the surface area of the host GIT, based on quantitative changes in histological measurements of the area of intestinal fold, enterochromaffin cells, and microvillus.

Secondly, they facilitate competition for binding sites. It is also known as "competitive exclusion", where the adherence of certain probiotics to the mucosal layer of the intestine results in the formation of a physical barrier, suggested to inhibit infection pathogens through the blocking of the common route used by the pathogenic bacteria.

Third, probiotic bacteria may release a variety of chemical substances that have a bactericidal or bacteriostatic effect against bacteria pathogens. These inhibitory substances belong to different origin such as proteinaceous substance (lysozyme and different kind of proteases), chemical (hydrogen peroxides), and iron-chelating compound like siderophores and bacteriocin. At the same time, probiotic bacteria, also can produce organic acids that lower the pH in the gastrointestinal tract. This prevents the growth of various pathogens but triggers the development of certain species of Lactobacillus, which are beneficial to the host.

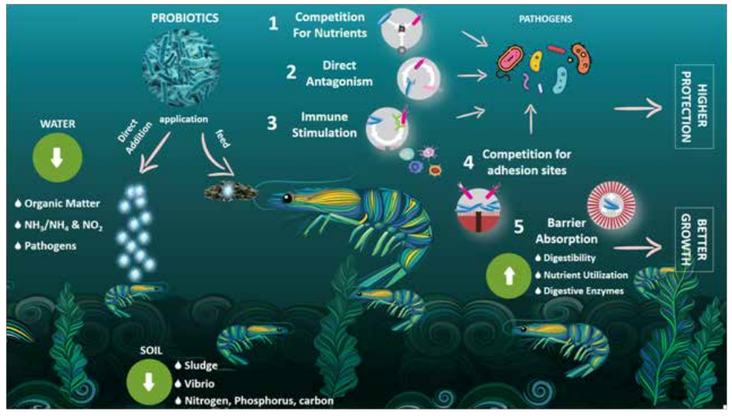
Fourth, they compete with the pathogens for utilization of nutrients. Probionts compete with the harmful pathogens for nutrition absorption; thus, reducing the amount of nutrients for the latter. The lack of nutrients for the pathogenic bacteria is a limiting factor for their maintenance.

Lastly, probiotics play a beneficial role as immunostimulatory to assist in the protection of aquatic

cultured species by reducing the impact of diseases and entrance of pathogens. They stimulate the various components of the immune system. Some probiotic bacteria are directly linked to the stimulation of the immune response, by increasing the production of antibodies, activation of macrophages, T-cell proliferation and production of interferon increasing the resistance of aquatic animals against stress caused by several environmental hazards during the aquaculture activity.

When applied directly in the water, probiotics will also play a crucial role as a primary tool in water quality and pond bottom quality management. Probiotic Bacteria will have a direct impact on ammonia and nitrates via assimilation and an indirect impact in the nitrites since by maintaining a low level of ammonia this will gives time to nitrites oxidize bacteria to develop. The probiotic bacteria can help as well to breakdown and consume the organic matter from the pond as well to exclude the pathogenic bacteria from the specific medium (Figure 1).

In order to be consider a good candidate and selected as probiotic bacteria for use in the



aquaculture industry, bacteria must possess certain properties, such as (i) not be harmful to the host; (ii) be accepted by the host; (iii) reach the location where the effect is required to take place; (iv) work in vivo as opposed to in vitro findings; and (v) not contain virulence resistance genes; (vi) evaluation of the ability of potential probiotics to out-compete pathogenic strains; (vii) evaluation of pathogenicity and survival test; (viii) economic cost/ benefit analysis.

Among all the species of probiotics discovered, Bacillus species, a Gram-positive endospore-forming bacteria, are the most widely used as aquaculture probiotics. The choice of the right probiotic should rely in some factors such as: i) number of viable colonies forming units (cfu); ii) quality standards of the manufacturer; iii) screening strains with good remediation characteristics still remains a fundamental step towards developing commercial microbial agents.

The choice of the right probiotic should rely in some factors such as: i) number of viable colonies forming units (cfu); ii) quality standards of the manufacturer; iii) screening strains with good remediation characteristics still remains a fundamental step towards developing commercial microbial agents.

Quality matters for any health supplement, and that goes triple for probiotics. Many commercial brands lack the technology to identify specific strains and how much of that strain really each product contains. A research conducted in Thailand showed that although a lot of commercial probiotic products in the market claims to have a high concentration of bacteria in fact just a few (2 in 12) really meet the label specifications. Hence it is very important to choose the right probiotic for the shrimp/ fish culture.

(The article is co-authored by Skretting experts. The authors are Assistant Manager - Sales & Technical Services, Laboratory Technician&Product Development Manager- Aqua Health Care Products, Skretting Vietnam respectively. Views are their personal.)

Black Soldier Fly: An alternative fish feed

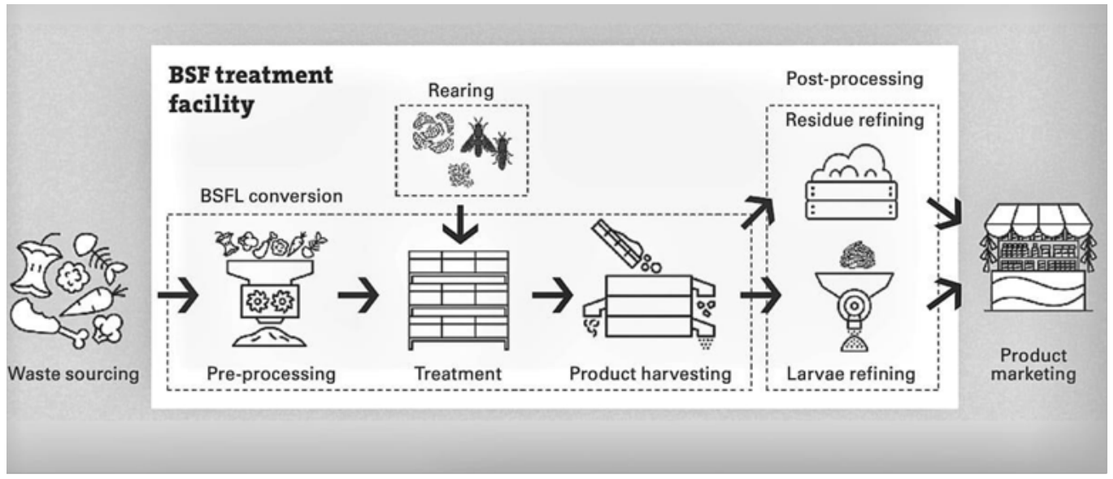
By Lokesh Pawar & Debtanu Barman

BSF Larvae- An alternative feed

The Black Soldier Fly (Hermetiaillucens) has obtained much attention in the past decade. The feeding activity of the BSF larvae drastically reduces the amount of waste while the harvested larvae can be used as valuable raw materials in the animal feed industry especially as an alternative fish feed.

Culturing of Black Soldier Flyhas received attention in recent years due to the business opportunities it offers. It also addresses several challenges like hygiene issues arising from the lack of waste management, unemployment in rural areas, and an increased demand for sustainable feed for the ever-growing aquaculture and aviculture sector.

Rearing of insects is a promising and innovative alternative as several insects' species can feed of various types of organic waste streams. In addition, insects are precious reservoirs of proteins, fatty acids, micronutrients and contain high amounts of energy. The latter show a good profile of amino acids in general, and of the most-limiting essential ones like lysine, threonine and methionine, often lacking in plant-based protein sources for non-ruminants.



Its popularity links to the promising opportunities of using the harvested BSF larvae as a source of protein for FISH FEED. This could bring revolutionary change in aquaculture if small scale farmers adopt this technology. Feed trials have confirmed it as a suitable alternative to fish meal.

We can turn Bio-waste into wealth as it's having multi-dimensional benefits as following:

A) Great Source Of Protein for fish meal or could be directly given as feed to the fishes.

B) No Extra Expenditure on Feedingthem because they feed on waste produced by humans (Bio waste)e.g., Kitchen waste.

C) Produce Compost as a byproduct which is valuable too.

How to Culture

The five main processing units that are key to a BSF processing facility are as follow:

1. Waste receiving and pre-processing unit.
2. BSF waste treatment unit.
3. BSF rearing unit.
4. Product harvesting unit
5. Post-treatment unit (larvae refining and residue processing)

Waste Collection and Pre-Processing

It is critical that the waste received at the facility is suitable for feeding to the larvae. A first step involves a control of the waste to ensure it contains no hazardous materials and no inorganic substances. Further steps then involve a reduction of the waste particle size, a dewatering of the waste if it has too high moisture and/or a blending of different organic waste types to create a suitable balanced diet and moisture (70-80%) for the larvae.

Rearing Unit

This ensures that a reliable and consistent number of small larvae (called 5-DOL) is always available to inoculate the daily amount of biowaste that is received for processing at the treatment facility. A certain number of larvae hatchlings are, however, kept in the rearing unit to ensure a stable breeding population.

Black soldier fly larvae (BSFL) will eat nearly any kind of organic waste ranging from animal waste to food scraps. As the BSFL mature, they grow into ½- inch-long grubs, at which point they climb out of their food source and turn into pupae. The pupae can immediately be fed to fishes and are a good source of protein. They can also be dried and processed into feed for use at a later time. Small composting operations also allow them to turn into flies and breed, propagating the population.

Optimal Condition for BSFL Production

Temperature

The optimal temperature at which BSFL consume their food is around 35 °C. The minimum and maximum temperature allowing survival is 0°C to 45 °C. The best range of temperature for the larvae to pupate and mating is from 25 to 30 °F.

Diet of BSFL

Diet BSFL can have a widely varied diet. The BSFL feed on many kinds of organic waste such as table scraps, composting feed, and animal manure. A diet combining kitchen scraps and coffee grounds may help to boost their metabolism. The BSFL have a limited ability to process any animal products such as meat and fat.

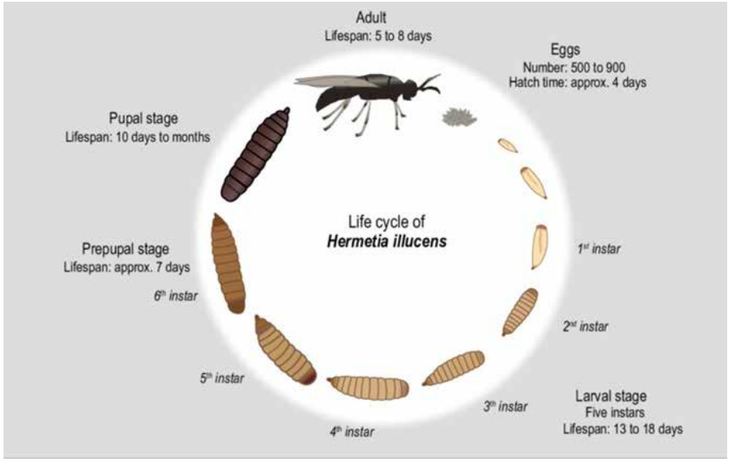
Humidity

Black soldier fly larvae develop most rapidly at 70 percent humidity. The rate of weight loss for the BSFL increases with decreasing humidity. The optimal humidity for black soldier fly mating is around 30 to 90 percent. It is found that it is especially important to keep the grubs' feeding medium at a proper moisture level—not so dry that it cements the grubs into the feed, and not so wet that they cannot breathe through the pores in their exoskeleton.

Additional environmental conditions

BSFL do not survive well in direct light or in extreme dry or wet conditions. They prefer to be 8- 9 inches deep in their food source. If they are too far below the

Understanding Life Cycle



(Source: St-Hilaire et al., 2007)

LarvaeLarvae+ Compost. Pupae

surface, they will perform little bioconversion. Female flies avoid any sites that are anaerobic when trying to lay eggs.

BSFL as a fish feed for many species

Protein replacement in fish diets has been investigated using the meals obtained from both larvae and prepupae of BSF for the following fish species: Channel catfish (Ictalurus punctatus), blue tilapia (Oreochromis aureus), hybrid tilapia, rainbow trout Atlantic salmon (Salmo salar), turbot (Psetta maxima), and yellow catfish (Tachysurus fulvidraco). Most of these studies showed that only low inclusion levels of BSF larvae have shown a similar performance to that of fish fed traditional feedstuff, which may be explained by high larval protein content. BSF larvae could be the best, sustainable and cost-effective alternative to conventional feed.

Business Model

There are several variations on the business model in farming BSF larvae off wastes which could be explored in building a sustainable business model less dependent upon investing large amounts of capital in scaling up and operating a single centralized industrial plant facility. Since BSF larvae can be grown relatively inexpensively on a modular scale in portable "Propagation Bioreactors" (PBRs) fabricated from commercially available totes and agricultural bins (BR2s) (see Propagating BSF Using "Box in a Box" Propagation Bioreactors), rather than investing capital in building one very large plant facility and carrying the full burden of operating a large scale plant facility, a company or farmer farming BSF could focus

on building and designing simple layout plans for the assembly of smaller decentralized production plants capable of producing larvae on a scale in the range of 5 to 10 metric tons of dry larvae per year per unit farm and this production is also not defined one can produce according to their capacity because insect protein demand is high in the market so small production will also make good profit.

One can also generate employment by providing guidance and creating awareness among local fish farmer to inspire them to produce BSF under this model the company would therefore specialize more on layout design, flexibility and simplicity in operating modular plant facilities that could be installed and operated on relative small farms and sites, and organize co-operative wholesale pooling, marketing and sales of harvested larvae by farmers operating the small plant facilities through licensing contracts. Farmers engaging in farming BSF off local agricultural wastes would be free to sell portions or all of the larvae they harvest to the co-op. managed by the company in a business relationship that works for all interested parties.

It requires minimal amount of investment to produce the BSF larvae at farm site for Example in area of 600 square feet could produce 2 tons of fresh BSF per month depending upon the biowaste supply.

Therefore, culturing BSF is economical sustainable and viable source of employment and revenue generation and this could bring revolutionary change if adopted on ground level.

Conclusion

The growing scarcity of resources for feed production and environmental concerns highlight the unsustainability of conventional feed sources. Insect farming is considered as an alternative feed due to its low land and water requirements, its low ecological footprint, and circular economy contribution by converting biowaste into high-quality feed ingredients. While there is growing research on the technical feasibility and nutritional performance of insect-based feed, its potential benefits are not quantified. Using experimental and secondary data provided by various organization, we can assess the potential socio-economic benefits of black soldier fly larvae meal (BSFLM). By replacing 5–50% of the conventional feed sources (fishmeal, maize, and soya bean meal) by BSFLM can generate a potential economic benefit to economical weaker section and also could resolve the problem of managing tones of biowaste.

(The authors are working at Aqua One Center (AOC), Kolkata, West Bengal. Views expressed are personal.)

ICAR-DCFR: The journey of cold-water fisheries in India

ICAR-Directorate of Coldwater Fisheries Research (DCFR) has an interesting history of origin and a vision to be a global knowledge center in coldwater fisheries research and innovation.

Origin &Growth

Coldwater fisheries in Indian sub-continent was initiated by British administrator turned naturalist by introducing two main types of trouts viz. brown trout (Salmo trutta fario) and rainbow trout (Oncorhynchus mykiss) around the beginning of the last century primarily to meet their needs for sport fishing or recreational angling. These introductions in India could be considered as the formal beginning of coldwater fisheries development in the country. For many decades, the mere intention remained to develop recreational fisheries to satisfy the needs of anglers for sports. Later on, these species introduced in culture system for food and therefore, hatcheries were setup for seed production.

The development of hill fisheries thus started in the selected locations particularly in the Kashmir valley and some parts of the peninsular India. The research on coldwater fisheries commenced with the establishment of Coldwater Fisheries Research Centre of CIFRI in the year 1963 at Harwan, Jammu & Kashmir as a scheme under 3rd Five year Plan. Initially the centre assisted in providing the research inputs related with departmental trout hatcheries and other trout related problems to the State of Himachal Pradesh and Jammu & Kashmir. The activities of the centre increased rapidly and it carried out significant amount of investigation on coldwater fishery resources of the country. Thus, it was realized that coldwater fisheries as an important sector have potential in generating rural income and providing food security to the economically underprivileged population residing in Indian uplands.

To utilize the available resources and opportunities in the coldwater fisheries, the involvement of Indian Council of Agricultural Research in this sector started during late sixties and subsequently culminated in the creation of National Research Center on Coldwater Fisheries (NRCCWF) as an independent Research Center on 24thSeptember 1987 during the 7thFive Year Plan. This is the only national facility in the country to take up the research investigation on capture and culture aspects on coldwater with a focus on exotic and indigenous fish species.

Since its inception, the NRCCWF in spite of constraints in terms of manpower and infrastructure has made significant contribution for proper appraisal of coldwater fishery resources and developed suitable technologies to propagate important coldwater fish species in hills. Thus, keeping in view the ever-expanding activities of NRCCWF, and the greater potential of coldwater fisheries in different Himalayan states, in a significant decision during the 11th Five Year plan it wasupgraded toDirectorate of Coldwater Fisheries Research (DCFR). The basic objectivewas to develop location, situation and system specific technologies by utilizing and augmenting resources in all the Himalayan states from Jammu and Kashmir to Arunachal Pradesh.

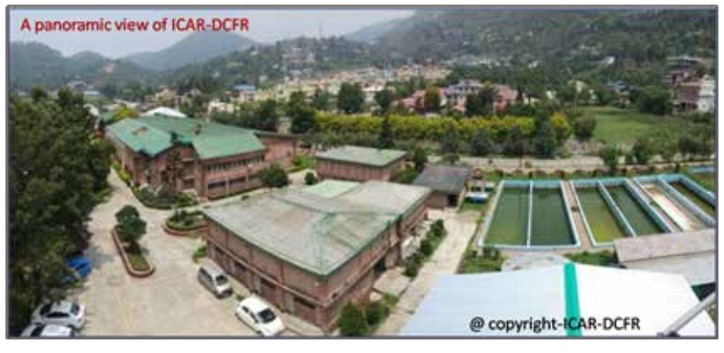
The directorate is a national facility to strengthen fishery research in coldwater sector encompassing the Himalayan and peninsular parts of the country. The research programmes undertaken by the Directorate designed with major thrust on conservation and management of open water fisheries and development of hill aquaculture. The directorate has well equipped state of art laboratory facilities for research in diverse areas such as aquatic resource management, aquaculture, fish health management & disease diagnosis, fish nutrition & feed development and molecular genetics & biotechnology.

Achievements

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, Governemnt 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, Mission& Linkages

The ICAR-DCFR is a constituent research organization under the aegis of Indian Council of Agricultural Research (ICAR) and fully devoted to the development of technologies for coldwater fisheries and aquaculture. During its journey of last three decades, it has tirelessly worked for the development of coldwater fisheries sector in the country. It has played pivotal role in the socioeconomic development and livelihood security of the hill farmers. It has well defined objectives, which are stated as (i) to conduct basic, strategic and applied research in coldwater fisheries and aquaculture (ii) to act as a repository of information on the hill fisheries resources and (iii) human resource development through training, education and extension. The directorate has a 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". For achieving greater success in extending and disseminating its ideas and technologies it has linkages with different stakeholders in government and non-government organization spread all over the country and thus works in close cohesion with them. It has direct reach to the farmers and remains committed to the mantara of "Lab to Land" and "Land to Lab". During the years, the directorate has addressed problems of farmers and other stakeholders through research and responded by giving feasible technologies benefitting not only farmers but also different line departments of the hill states. Through its work and committed manpower the ICAR-DCFR has been working to achieve the dreams of Atam Nirbhar Bharat to make the sector self-sufficient.

Infrastructure & Research facilities

The ICAR-DCFR is located at Bhimtal in the district Nainital of the state of Uttarakhand at an altitude of 1470m asl. The Uttarakhandis located at the foothills of the Himalayan mountain ranges, rich in natural resources especially water, and forests with many glaciers, rivers, dense forests and snow-clad mountain peaks. The state is proud to have Char-dhams, the four most sacred and revered Hindu temples of Badrinath,Kedarnath, Gangotri and Yamunotri are nestled in the mighty mountains. It's truly God's Land (Dev Bhoomi). The directorate is surrounded by beautiful and famous serene Himalayan lakes like Nainital, Bhimtal, Sattal, Naukuchiyatal and Shymlatal. The headquarter of the ICAR-DCFR is at Bhimtal and the present establishment occupies an area of 1.3 ha comprising essential infrastructure facilities which includes well equipped research laboratories, library, auditorium, feed mill, wet lab facility, aquarium, coldwater fish museum, fish hatchery and seed rearing units. In recent years, the directorate has established country's first re-circulatory aquaculture system (RAS) for intensive farming of table size rainbow trout. The directorate has a field center and Experimental Fish Farm (Cheerapani) at Champawat district (Uttarakhand) to carry out farm activities. The farm has trout hatchery, raceways for nursery and brood stock rearing of rainbow trout and tanks for conducting field trials on various culture aspects of indigenous and exotic fish species.

Glimpse of coldwater fisheries resources of India

India's coldwater region extends from north western to north-eastern Himalayan region and some parts of Western Ghats, encompassing about ten states. Coldwater natural resources includes around 8,243 km long streams and rivers, 20,500 ha natural lakes, 50,000 ha of reservoirs both natural and manmade and 2,500 ha brackish water lakes at high altitude. The Himalayan region is drained by 19 major rivers. The main river systems draining the Himalayan region are the Indus, the Ganges, and the Brahmaputra. The Indus and the Brahmaputra are the longest, each having a mountain catchment of about 160,000 km2. There are numbers of lakes situated in the mid and high altitudes of Himalayan regions. These lakes have diverse origin such as retreat of glaciers, landslides and tectonic movements. The sizes of these lakes also vary as some are of large area while others have small.

The water bodies of the Himalayan region inhabit diverse kind of fish fauna. Out of total fish fauna available in India 17% fishes were documented from the mountain ecosystem establishing the status of the area as a center of origin and evolution of biotic forms. Around 218 fish species have been listed to be found in the Himalayas while 36 species of freshwater fishes (out of 1,300) are endemic to the Himalayan region. Among important ichthyofauna, snow trout (Schizothorax sp.), mahseer (Tor sp.), minor carps, barils, minnows, catfishes, loaches and exotic trout are important. The Himalayan region is ecologically fragile, and further due to different developmental activities made it vulnerable for aquatic flora and fauna. Consequently a number of species have become endangered or threatened and therefore need immediate attention for their conservation. However, after the introduction of exotic trout, commercial aquaculture in Himalayan states has significantly contributed towards high value fish production. The three-pronged fish farming, that covers high and mid altitudinal regions as well as foothills have been a successful model for aquaculture production based on exotic trout and indigenous fish species. It has provided an opportunity for sustainable utilization of aquatic resources for enhancement of production, livelihood security as well as conservation of fish species.

Role of ICAR-DCFR in coldwater fisheries development

ICAR-DCFR is a nodal agency for the development of coldwater fisheries sector of the country and played pivotal role in the development of the sector through it research and developmental activities. In last three decades, the directorate has developed models and technologies for both open water fisheries as well as aquaculture development. Aquatic resource assessment is the basic requirement for conservation and sustainable utilization of fishery resources. The directorate has developed GIS based maps of aquatic of aquatic resources of Himalayan states for aquaculture suitability and fishery development. The habitat and health assessment of rivers are being carried out to develop ecological models to formulate strategies for sustainable utilization as well as conservation. There is considerable scope for the development of aquaculture in the hill areas.

The directorate has successfully demonstrated and popularized polytank based multi-tier integrated fish farming model in mid-hill regions. The new farming model has significant improvement in fish productivity per unit area (from 0.3 kg/m3 to 0.5 kg/m3) in mid altitudinal regions. Species diversification in coldwater aquaculture remained a challenging task. In recent past, the directorate has developed breeding and seed production protocols for six new species having food and ornamental values. Golden mahseer (Tor putitora) is the most important and popular freshwater game fish of the Indian subcontinent and called as 'Pride of Himalaya'. However, due to its overexploitation, its natural population has significantly declined leading to the status of 'endangered' species in the IUCN red list. The directorate has put historic efforts not only in conservation but also in the breeding and propagation of this species. The scientists at ICAR-DCFR has successfully developed captive breeding of golden mahseer for seed production through temperature and photoperiod manipulation.

Rainbow trout (Oncorhynchus mykiss) is the main commercial high value species for coldwater aquaculture and most of its production is contributed by northwestern regions (Jammu &

Kashmir and Himachal Pradesh). However, recently production from northeastern Himalayan region (e.g. Sikkim) has shown considerable increase, due to addition of new ventures of trout farming. The total rainbow trout production in India has increased from a mere 147.0 tonnes (2004-05) to 1200 tonnes (2019-20). The directorate has developed efficient and cost-effective protein based starter feeds for initial feeding of rainbow trout fry providing higher survival and better FCR values (0.9-1.1 vis-a-vis 1.4-1.5). The developed feed is commercially available and now contributing in reduction in mortality at early stage thus making available more stocking materials for grow-out culture. The predominant trout production system in the country is flow-through system consisting of concrete raceways, which are designed in series or parallel arrangements and utilize gravity to move snow or spring-fed stream water through production system. The stocking density is low (15-20 kg/m3) and thus these traditional system has trout production from 800-100kg/raceway (area around 45 m3), depending upon stocking density and management measures applied during cultivation. The directorate has designed and established an indigenous re-circulatory aquaculture system (RAS) for intensive farming of table size rainbow trout where the stocking density can be increased up to 50 kg/m3. Moreover, RAS can reduce water requirement to less than 1m3 per kg of trout produced and culture duration to 5-6 months compared to flow through system where it requires 200 m3 of water per kg fish of produced and growth period is nearly 14-16 months. The RAS has been installed at Bhimtal and many of the entrepreneurs and state departments have shown their interest in replication of the model for commercial trout production.

Apart from this, the directorate is intensively involved in the areas of disease diagnosis and health management of the coldwater fish species. Active disease surveillance is one of the core programme of the directorate which helped in early disease diagnosis and remedial measures for the containment of the fish diseases. It has developed different probes for the identification of the pathogens as well as working on the drugs development for the major diseases of the coldwater cultivable species. Advanced molecular tools are quite essential for the genetic characterization as well as species development. The directorate is continuously doing molecular marker based species and population characterization of important coldwater species which provides essential information for conservation, prioritization as well as selection of population for broodstock development. Global climate change poses many threats to biodiversity and altering the physical, chemical, and biological characteristics of freshwater habitats, with concomitant effects on freshwater fishes particularly in coldwater regions. The directorate has initiated research programmes to address these challenges through formulating strategies.

The ICAR-DCFR is ever growing with enthusiasm to realize its dreams of becoming a national leader in the area of coldwater fisheries research and development with an aim to be a global knowledge centre for innovative and simple solutions to the challenging and difficult problems.

Coldwater aquaculture- a sustainable livelihood option for hill people

In an interaction with AQUA POST, Dr. Pramod Kumar Pandey, Director ICAR-Directorate of Coldwater Fisheries Research shares the current status of cold-water fisheries in India and it impact on the livelihood and nutritional security of people living in the hilly terrain.

Q. What is the current status of coldwater aquaculture in India?

Ans: The country is bestowed with vast and varied hill fishery resources, which are spread over the Himalayan and peninsular regions as upland rivers, streams, high and low altitude natural lakes and reservoirs. There are around 8,243 km long streams and rivers, 20,500 ha natural lakes, 50,000 ha of reservoirs, both natural and manmade, and 2500 ha brackish water lakes in the high altitude. These water resources harbour 272 fish species, belonging to 21 families and 76 genera in the country, of which 203 are recorded from the Himalaya, while 91 from the Deccan Plateau. The large population of indigenous and exotic coldwater fish species in mountain water bodies has immense potential for aquaculture and capture fisheries as well. In the Indian Himalaya, the cultivation of fish contributes little to the overall freshwater fish production. At present, the total fish production (approx. 55000 tones) from upland areas constitute about 3% of inland fish production of the country. Commercial farming of high value rainbow trout (Oncorhynchusmykis) is in vogue in higher mountainous ranges whereas other exotic carp are being cultured in low and mid altitudinal areas. Presently, coldwater fishery sector in India is undergoing a transformation and has the potential to contribute for the livelihood development of large section of economically underprivileged population of the country. The emerging production technologies, higher economic growth, population explosion and shifts in dietary

pattern are leading to rapid growth in production as well as demand for food of animal origin.

Q. What are the short and long term goals of ICAR-DCFR?

Ans:Coldwater Fisheries Research started as a unit of Central Inland Fisheries Research Institute (CIFRI) in 1963 keeping in view the necessity to assess and utilize the fisheries resources available in the Himalayan region. In 1987, recognition of the hill aquatic resources paved the way for the establishment of the National Research Centre on Coldwater Fisheries (NRCCWF). In 2008, this institution was elevated as ICAR-Directorate of Coldwater Fisheries Research (DCFR). The dawn of ICAR-DCFR developed location, situation and system-specific technologies for facilitating the expansion of research and developmental activities in Himalayan states. The directorate is working in a mission mode with long term goals of the overall development of coldwater fisheries and aquaculture, in order to make the sector a sustainable livelihood option with a view to provide nutritional security to the people inhabiting the hilly terrain.

Q. What is the scope of entrepreneurship development in cold-water aquaculture?

Ans: There are immense scope for entrepreneurship development through trout farming to provide a source of employment and income to the resource poor hill people. Suitable sites are available in different parts of the hill states, which could be utilized for trout production through aquaculture. Being a low volume high value commodity, the rainbow trout has good potential for domestic consumptions as well as foreign export. In spite of having excellent positive traits, the development and expansion of trout farming is yet to be done on commercial scale. Trout farming has progressed steadily in last 20 years in India amid different constraints. The total trout production in the country was about 147 tones during 2004-05 which has increased about ten-fold in last fifteen years and has reached up to 1500 tones during 2020-21. Presently, the bulk of trout production is contributed by the Jammu & Kashmir and Himachal Pradesh, while the other hill states like Uttarakhand, Sikkim and Arunachal Pradesh also have potential for rainbow trout farming. Apart from that, there are ample scope for the development of ornamental fisheries.

Jobs, Admissions & Events

Jobs:

ICAR-CIFE has invited applications to fill up Chief Engineer Grade I vacancies in MFV Saraswati division.

Important Dates:
Notification date: 6th September 2021
Last date of submission: 21 September 2021 by 4:00 pm
Date of examination: 22nd September 2021 (11:30 am)

Eligibility:
The candidate must have secured at least
i. Matriculation or equivalent qualification
ii. Certificate of Competency as Fishing Vessel Engineer or Equivalent as per D.G Shipping / MMD Norms.
iii. Five years' experience onboard fishing vessel and not less than 25 GRT

How to apply:
Interested candidates can apply to the posts by sending the application through email to vmc@cife.edu.in before the 21-09-2021 (4:00pm).Candidates can log on to URL www.cife.edu.in for details or can click here(https://www.cife.edu.in/pdf/Careers/Chief%20Engineer%20Gr.I%20Notice%20&%20Service%20Details-7-9-2021%20.pdf) and read the notification carefully before applying.

Training:

ICAR-CIFA has invited to apply for itsBioinformatic Analysis of Next Generation Sequence Data (Physical Mode) (5 days)

Dates to remember:
Start Date: 11th January 2022
End Date: 15th January 2022
Last date to apply: 7th January 2022
Entrance Fee: 8000 INR
Coordinators: Dr P.Das, & Team
Maximum Intake: 30

Eligibility:
Researchers & Students

How to apply:
Candidates can apply online by clicking here (https://www.cifatraining.com/program-details.php?pid=16) .
For further information, the candidate may visit the official website:

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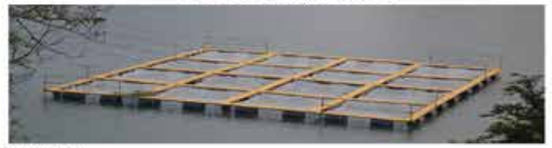
- Air-Breathing Fish Culture
- Reservoir Fisheries Management
- Fish for Human Health
- Cage & Pen Culture

CIFRI (GI) CAGE



Specification

Sl. No.	Particulars	Details
01	Name	CIFRI (GI) CAGE
02	Dimension	5m x 5m x 4m hapa 5m x 5m x 1.5m hapa 6m X4mX4m hapa and modification there of
03	Material	GI pipe, Drum as float (HDPE/FRP)
04	Capacity	87.5m³ (5X5X4 and 6X4X4) Table Fish up-to 4 tones (Pangasius) 25m³ (5X5X1.5) Production up to 2500-4000 numbers of fingerlings (100 mm

Price:
Price of one single cage is Rs. 73,500/- excluding the transportation/freight charges, the price of one battery of 16 cages is Rs. 11, 76,000/- excluding the transportation/freight charges.

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For Enquiry Contact:
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01	Name	**CIFRI HDPE MODEL PEN**
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Advantages

- Low dose of application
- Less toxic to fish
- Effective against the Argulus egg
- No effect on phytoplankton
- Environmentally safe

: For Further Contact :

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Web: www.cifri.res.in

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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