English Monthly from Hyderabad, India

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March 2022

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Inside...

Spiral Stopper

Bevel Gear Box

2 HP Motor

Spiral

Worm Shaft & Wormwheel

Spiral [Helical] Gear Box

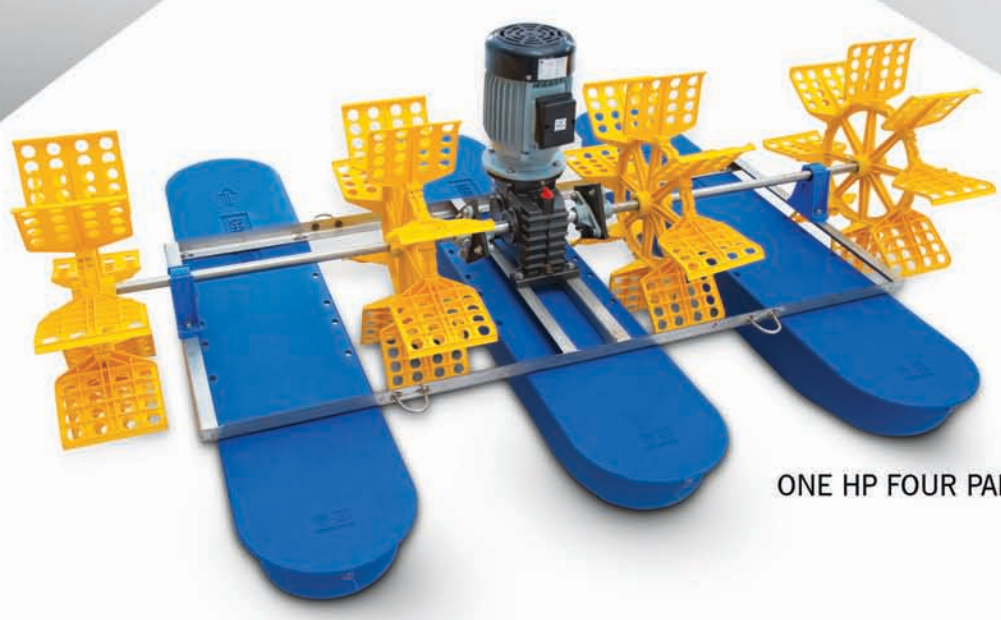
1 HP Gear Box

Paddle Wheel

Long Arm Gland

2 HP Gear Box

2 HP Out Put Shaft



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Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 29 Number 11 March 2022

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M. A. Nazeer

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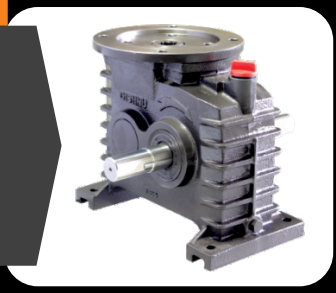

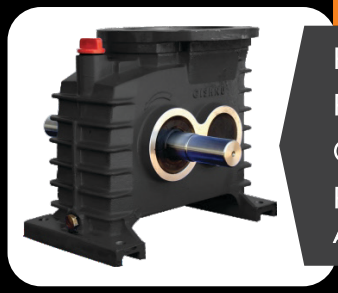

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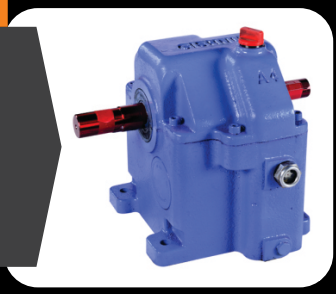

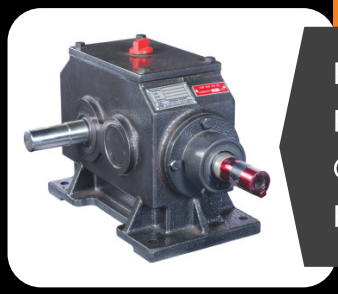

Type : GBH

Range : 3 hp & 5 hp
Pedals : 8+8 & 20+20
O/p RPM : 105 & 120
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School without Walls, where farmers learn through observation and experimentation

Dear Readers,

The March 2022 issue of ***Aqua International*** is in your hands. In the news section you may find news about ...

Mr K. Kanna Babu, Commissioner, Department of Fisheries, Govt. of AP, said that there is no truth in the 'misinformation campaign' being carried out by certain sections against the GO Rt. No 217. At a press conference recently, Mr Kanna Babu explained in detail about the benefits the fishermen community would accrue through implementation of the said GO. He said the Minister for Animal Husbandry and Fisheries S. Appalaraju and Rajya Sabha member Mopidevi Venkata Ramana had explicitly spoken about the contents of the GO 217 on many occasions and had clarified the doubts of the representatives of the fishermen associations.

The Commissioner said that of the 27,363 tanks in the State, 3,325 minor irrigation tanks and 118 reservoirs were in purview of the Fisheries Department besides 23,920 tanks in purview of the Panchayat Raj Department. He said recognising the fact that the fishery wealth in the minor irrigation tanks was being captured by the middlemen, the fishermen cooperative societies were unable to reap their benefits, the GO was issued to ensure that the fruits of the government initiatives reached the rightful beneficiaries.

India's fisheries sector has emerged as a key beneficiary of the customs duty rejig to boost local production even as much of the attention has been focused on the manufacturing industry.

The Union budget announced a sharp reduction of basic customs duty from 30 % to 10 % on live black tiger shrimp, which farmers use for breeding, and from 30 % to 15 % on both frozen krill, a feed for fish, and on algal oil derived from certain marine algae for making aquatic feed.

These inputs used in shrimp culture were given relief on basic customs duty as India is a major exporter of shrimps and there are several farms in coastal Andhra Pradesh and Tamil Nadu, Central Board of Indirect Taxes and Customs (CBIC) chairman Vivek Johri said in an interview recently. To support the food processing sector, the duty on frozen squids and mussels, a shell fish, too was halved to 15 %. Increasing farmers income is a policy priority for the government, including for those in the fisheries sector.

Industry representatives said the move was beneficial but more could be done. "The finance ministry has reduced import duty only on black tiger shrimp from 30 % to 10 % which is really commendable and helpful for aquaculture industry. But right now, more than 95 % shrimp import consists of L. Vannamei shrimp. Hence, it would be highly beneficial if the import duty is reduced on that as well," said Prathipati Veerabhadra Kumar, managing partner of Srinidhi Biotechnologies, a hatchery based in Andhra Pradesh.

Kumar said the hatchery industry is heavily dependent on feed necessary for shrimp from other countries, and it would be helpful if the import duty is reduced on that as well since there are relatively less number of indigenous shrimp feed manufacturers. It was also said hatcheries need incentives given that they take the initial high risks of importing live shrimps and have a limited window period for selling to farmers without compromising quality and safety.

The government is also running a five-year scheme -- Pradhan Mantri Matsya Sampada Yojana -- up to FY25, aimed at addressing the gaps in the fisheries value chain from fish production to post-harvest infrastructure and marketing. Under this scheme, India has set a fisheries export target of Rs 1 trillion, additional seven million tonnes of fish production, and generation of 5.5 million jobs over the years. The policy priority is to help achieve a 'blue revolution' through sustainable and responsible development of the fisheries sector.

Skretting, the Aquaculture division of Nutreco, a world ingrained company in animal nutrition has renamed its Skretting Aquaculture Research Centre into Skretting Aquaculture Innovation, and restructured it into a complete and multi-functional unit incorporating the global marketing, sustainability and digital teams into its midst. The new unit is called and integrates all aspects of innovation from basic to applied research, to product development to digital innovation and sustainability. Mr Alex Obach,

Contd on next page

NRS GROUP

Aqua International

Our Mission

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

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

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

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

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

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Skretting Innovation Director says that what they have created is a completely dynamic approach towards innovation, where they don't focus only on one aspect of innovation, for example ingredients, health, digital or only sustainability. They have put all of this together into an integrated and agile value centre with their clients' current and future needs at the core. The new unit remains headquartered in Stavanger, Norway.

Mr Alex Obach says that Skretting believe that the biggest challenges facing aquaculture today are ingredients (availability, sustainability and logistics) health challenges and circularity. We have a clear roadmap to address these challenges, and a dynamic and dedicated team making it happen. We have a dual role to support the business with the challenges of today and our longer-term responsibility to bring innovative solutions for tomorrow to drive aquaculture into the future. These are exciting times for aquaculture innovation at Skretting.

Ernakulam native couple Ramitha Dinu and Dinu Thankan started fish farming, not as an additional source of income but to withstand the financial imbalance that happened due to the pandemic. Even though Dinu ran a small business and Ramitha worked as a part-time French tutor, they found it difficult to gain a stable income. Ramitha said that during the lockdown in 2020, they were introduced to Biofloc technology in fish farming through a family friend, The former deputy director of the Central Fisheries Research centre, Shaji knew all about this method. Under his expert guidance, the couple built a tank in their backyard and put in 1,500 Tilapia fish babies. Within six months, each fish grew to an average size of 350 to 400 grams weight. The first yield was sold within the blink of an eye and we were able to sell them for Rs 300 per kg.

People in the neighbourhood Whatsapp group were their first customers. They even delivered clean fish to their doorstep at an additional charge of Rs 50. It's almost time for the second harvest and both of them are busy with its preparation.

Kerala State Coastal Area Development Corporation and Central Institute of Fisheries Technology have jointly launched an initiative named 'Parivarthanam' to introduce LPG in fishing boats as an eco-friendly measure. Minister for fisheries, harbour engineering and culture Mr Saji Cheriyan reviewed the trial use of LPG in fishing boats at Vizhinjam recently. The trials showed that fuel cost could be saved by 50 to 55 % by using LPG as an alternative fuel in fishing boats. The trial was conducted in association with Hindustan Petroleum Corporation Limited (HPCL), which has developed a specially-designed cylinder customised for use in fishing boats.

Minister for Fisheries, Ports and Inland water transport S Angara has directed fisheries department officials and the College of Fisheries to focus on the revival of murell culture in Dakshina Kannada. Dr Shivakumar Magada, Dean, College of Fisheries, Mangaluru, said the breeding of 'Channa marulius' popular as 'madanji' in Tulu and 'kuchu', 'korava', 'kandu' in Kannada and 'Channa striatus' known as 'malenji' in Tulu, have been planned. Murrels or snake-head fish are freshwater fish that are tasty and high in nutrients. Most farmers have farm ponds well suited for murrel culture, and can also be an additional source of income.

The Mandapam Regional Centre of Central Marine Fisheries Research Institute has kick-started a sea ranching project under the 'Pradhan Mantri Matsya Sampada Yojana' by releasing a total of 1.38 million green tiger shrimp (*Penaeus semisulcatus)* seeds in the Gulf of Mannar, Tamil Nadu. The shrimp seeds were sea ranched at Vedalai in the sea grass beds of the Gulf of Mannar on February 17.

Aquaculture Field School is a school without walls for improving decision making capacity of farming community in aquaculture. It is a participatory extension approach whereby fish farmers are given opportunity to make choice in the methods of aquaculture production through discovery based approach. AFS is composed of a group of farmers who regularly meet. Typical group strength is 20 to 25. The basic tenets of AFS are: fish farmers are experts; the fish farm is a learning place; fishery extension worker as facilitator not teacher; scientists / SMS (subject matter specialist) work with rather than lecture them; learning materials are learner centered. The principle of AFS is similar to that of Farmers Field School (FFS) implemented in agriculture. It is best described as a 'school without walls', where farmers learn through observation and experimentation in their own fields. This allows them to improve their management skills and become knowledge experts on their own farms. Farmers interact with researchers and extension workers on a demand driven basis, only asking for help where they are unable to solve a problem themselves.

In promises to provide extension and advisory services and therby reducing the pressure on existing extension machinery. Through the operator farmers, who had excelled in aquaculture venture by using CIFA's technologies, the outreach and dissemination will see manifold increase.

The Pulicat lake, which is 481-square kilometer lake, India's second largest brackish-water ecosystem after Chilka in Odisha, is home to around 110 different terrestrial and aquatic birds, small mammals, and reptiles as well as 160 different fish species of both marine and brackish water traits. The Central Govt is in the process of mapping and geo tagging the wetlands. The mapping is aimed for inventory and monitoring existing resources. A demarcated area within a 500 meter radius, will include the villages of Elavur, Injur, Selliabedu, Uppanavoyal, Periaveppathur, Kolur, Poovami, Tirupalaivanam, Pralayambalam, Andarmadam and Thangai Perumkulam.

The human population is increasing day by day throughout the world and the world's per capita fish consumption has reached 20.5 kg, while the per capita consumption for India is 6.56 kg. Therefore, 13.94 kgs of per capita fish consumption demand-supply gap exists in India to reach global level. Live stock food producing sectors are hardly working to sort out food scarcity. Aquaculture is farming of aquatic species and provides the significant amount of food protein to meet out the demand of food supply. Aquaculture is classified into two groups such as "unfed" and "fed" aquaculture.

The total annual production of fish meal and fish oil was estimated approximately 4.5 and 0.9 million tons in 2016. However, the production of fish meal and fish oil from source of wild caught has been decreasing over the past 20 years. The total production of aqua feed is predicted to increase by 75% from 49.7 million tonnes in 2015 to 87.1 million tons in 2025. In consequence, aqua feed industries are in a position to find best alternatives to fish meal and fish oil.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under "Readers Column". Time to time, we shall try to update you on various aspects of Aquaculture sector. Keep reading the magazine Aqua International regularly and update yourself. Wish you all fruitful results in your efforts.

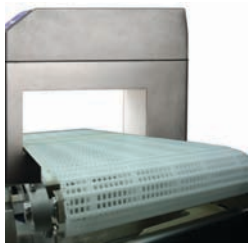
M.A.Nazeer
Editor & Publisher
Aqua International

Integrated Solutions For Increased Productivity

The comprehensive range of ASN 9000 systems provide a flexible, fully integrated choice of metal detection solutions for small to medium sized frozen seafood pouch inspection applications.

Condition Monitoring
Condition Monitoring technology constantly analyses the performance of major detector components. Adverse trends are identified and highlighted as an early warning of a potential problem in advance of actual failure to reduce downtime and increase efficiency.

Hygiene Design
The combination of a fully welded "open design" conveyor frame with a search head free of dirt traps supports HACCP compliance. All contact parts are made from food grade materials ensuring there is no potential for product contamination.



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Driving the future of innovation – Skretting introducing Aquaculture Innovation

- *Fully operational multi-functional unit in Stavanger, Norway, directly addresses customer needs now and in the future bringing breakthrough innovation to aquaculture*
- *€20M annual investment in innovation*
- *Skretting Aquaculture Research Centre (ARC) integrated into Skretting Aquaculture Innovation (AI)*

Skretting ARC has been renamed and restructured into a complete and multi-functional unit incorporating the global marketing, sustainability and digital teams into its midst. The new unit is called Skretting Aquaculture Innovation (AI) and integrates all aspects of innovation from basic to applied research, to product development to digital innovation and sustainability.

At the cutting edge of innovation

"What we have created is a completely dynamic approach towards innovation, where we don't focus only on one aspect of innovation, for example ingredients, health, digital or only sustainability," says Alex Obach, Skretting Innovation Director. "We have put all of this together into an integrated and agile value centre, with our clients' current and future needs at the core."

"We operate in a specific area of the aquaculture value chain, with great diversity in our clients, the species farmed and the ingredients available. However, there are innovation areas that add value across the board, including sustainability, life

start, health, ingredients and more," continues Obach.

The new unit remains headquartered in Stavanger, Norway, and comprises more than 150 experts across the functional areas, closely collaborating with colleagues around the world. With novel technologies in the Skretting Bubble combined with future solutions from Nutreco Exploration (NutEx) set to deliver exclusive ingredients through phytotechnology, biotechnologies and physical chemistry, combined with increasing opportunities through Nutreco's breakthrough investment arm NuFrontiers, Skretting AI is at the forefront of cutting-edge innovation.

Sustainable seafood, conscious consumers

The innovation areas of Skretting AI are tightly matched with the global rise in seafood consumption, combined with the rise in conscious consumers. The pandemic has highlighted the need for sustainable, healthy and local food, and there is an expectation that companies will operate in a conscious, transparent and ethical way.

"A Skretting-fed fish or shrimp matches these requirements," says Obach. "We contribute to more than 21 million seafood meals every day – a big responsibility. We innovate to incorporate the needs of both our clients and the wider society.

"We believe that the biggest challenges facing aquaculture today are ingredients (availability, sustainability and logistics) health challenges and circularity. We have a clear roadmap to address these challenges, and a dynamic and dedicated team making it happen. We have a dual role to support the business with the challenges of today and our longer-term responsibility to bring innovative solutions for tomorrow to drive aquaculture into the future. These are exciting times for aquaculture innovation at Skretting!" concludes Obach.

About Skretting

Skretting is the global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry. Skretting has production facilities in 19 countries on five continents, and manufactures and delivers high quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 2 million tonnes. The head office is located in Stavanger, Norway. Skretting is the aquaculture division of Nutreco, a world leader in animal nutrition. Our purpose is Feeding the Future.

"Skretting that the biggest challenges facing aquaculture today are ingredients (availability, sustainability and logistics) health challenges and circularity. We have a clear roadmap to address these challenges, and a dynamic and dedicated team making it happen. We have a dual role to support the business with the challenges of today and our longer-term responsibility to bring innovative solutions for tomorrow to drive aquaculture into the future. These are exciting times for aquaculture innovation at Skretting!"

– Alex Obach, Skretting Innovation Director

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Using Biofloc Tech for Fish Farming, Couple Earns Rs 1 Lakh from Single Harvest

Ramitha Dinu and Dinu Thankan employed biofloc technology in farming Tilapia fish and have sold more than 600 kg within six months.

Ernakulam native couple Ramitha Dinu and Dinu Thankan started fish farming, not as an additional source of income but to withstand the financial imbalance that happened due to the pandemic. Even though Dinu ran a small business and Ramitha worked as a part-time French tutor, they found it difficult to gain a stable income.

During the lockdown in 2020, they were introduced to Biofloc technology in fish farming through a family friend, The former deputy director of the Central Fisheries Research centre, Shaji knew all about this method. Under his expert guidance, the couple built a tank in their backyard and put in 1,500 Tilapia fish babies.

"Within six months, each fish grew to an average size of 350-400 gm. The first yield was sold within the blink of an eye and we were able to sell them for Rs 300 per kg," says Ramitha.

People in the neighbourhood WhatsApp group were their first customers. They even delivered clean fish to their doorstep at an additional charge of Rs 50. It's almost time for the second harvest and both of them are busy with its preparation.

Farm Fresh Fish

The couple spent around Rs 1.6 lakh to set up the tank and purchase fish and other requirements. They received a subsidy followed by a licence for farming. Fish babies were supplied by the fisheries department and carefully moved to the tank built according to the instruction.

Up to 2,000 fish babies can be added to an 8-metre in diameter tank, which is 1.5 feet high. The whole process regarding this farming is to be done carefully because it employs an artificial setup. Constant checking of pH and ammonia levels is vital for a healthy yield.

"Biofloc technology may sound complicated but it is rather simple. If performed with interest and care, profit is certain," opines Dinu. "Crystal raw salt is mixed in the tested water before adding the babies. We need to ensure a 24/7 electricity supply to provide artificial oxygen. Thus, an inverter with an extra battery is a must. The pH value and ammonia of the water should be checked daily and if there is any variation, there are simple ways to make it normal like mixing jaggery."

Uni-President

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

3. DECREASE AMMONIA CONTENT

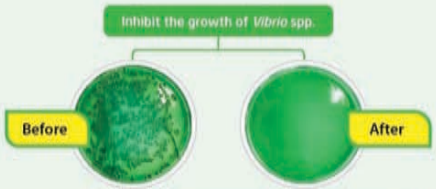
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

4. IMPROVE WATER COLOR

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

5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

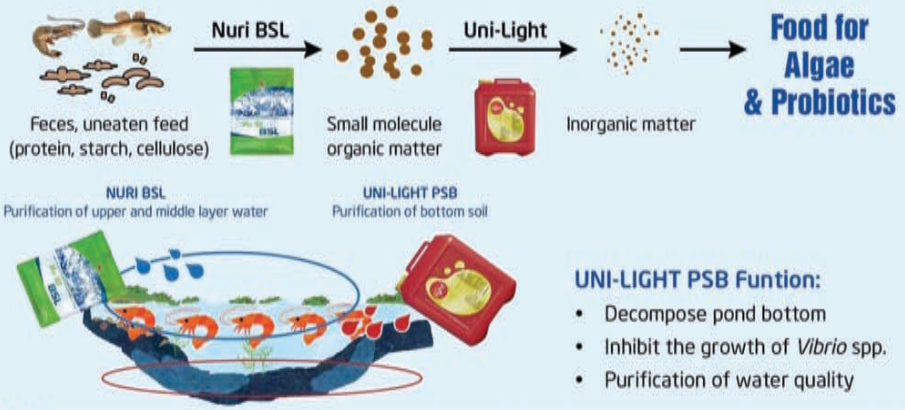
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

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

* DIRECTION OF USE:

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



UNI-LIGHT PSB Funtion:

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

BSL Dosage:

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

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

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Kerala MPs meet Piyush Goyal on MPEDA headquarters issue

There are unofficial reports that the headquarters may be shifted from Kochi to Andhra Pradesh

MPs from Kerala Hibi Eden and T.N. Parathapan met Commerce and Industry Minister Piyush Goyal in New Delhi to impress upon him the requirement for maintaining the headquarters of the Marine Products Export Development Authority (MPEDA) in Kochi in the wake of reports that the government was planning to shift it to Andhra Pradesh.

The MPs said Kerala was blessed with a long coastline and fishing constituted one of its largest employment opportunities across nine of the 14 districts, providing daily maintenance to about a million people. The presence of the MPEDA headquarters was instrumental in developing a fish export culture, worth about ₹5,000 crore annually.

The fisheries export business, including that of ornamental fisheries, accounts for a substantial part of the State's economy and the move to relocate the MPEDA headquarters would be a big setback to the sector, the MPs said in their submission before the Union Minister. "We strongly oppose any such move to relocate MPEDA headquarters, which is against the interest of our fisheries sector. We humbly request you to reconsider the decision," they said.

There are unconfirmed reports that the MPEDA headquarters will be shifted to Andhra Pradesh, which accounts for the bulk of shrimp export from the country.

Frozen shrimp accounted for ₹35,520 crore worth of exports on a total volume of 5,90,275 tonnes during 2020-21. Frozen shrimp forms about half of the total volume of 11,49,510 tonnes of seafood exported from the country and accounts for more than half of the total export realisation of around ₹43,700 crore. The bulk of the shrimp exported from the country is cultured whiteleg shrimp L. Vannamei from Andhra Pradesh. A large portion of the shrimp processed in Kerala too is brought from Andhra Pradesh farms.

The MPEDA was established as a statutory body in 1972 under the Union Ministry of Commerce and Industry for the promotion of marine fisheries products exports. Marine food is exported to over a hundred countries across the globe and it is expected that seafood exports will touch the ₹1 lakh crore mark by 2025. The MPEDA is learnt to have submitted a roadmap to achieve the target, listing out the interventions needed.

Minister reviews trial run of LPG in fishing boats

Thiruvananthapuram: Kerala State Coastal Area Development Corporation (KSCADC) and Central Institute of Fisheries Technology (CIFT) have jointly launched an initiative named 'Parivarthanam' to introduce LPG in fishing boats as an eco-friendly measure. Minister for fisheries, harbour engineering and culture Saji Cheriyan reviewed the trial use of LPG in fishing boats at Vizhinjam here on Friday.

The trials showed that fuel cost could be saved by 50 to 55% by using LPG as an alternative fuel in fishing boats. The trial was conducted in association with Hindustan Petroleum Corporation Limited (HPCL), which has developed a specially-designed cylinder customised for use in fishing boats.

Emphasising the need to introduce cost-effective and sustainable practices in the fisheries sector, Saji Cheriyan said that the trial run of LPG-fuelled boats in traditional fishing boats would help fisher folk to save the fuel cost considerably.

"Fishermen face a host of issues like high fuel cost and lack of adequate catch due to depletion of marine resources. The shift from fuels like kerosene and petrol to LPG in traditional fishing boats will bring down the steadily increasing operational cost borne by fishermen," the minister said.

After reviewing the trial, Saji Cheriyan suggested to the HPCL officials that the speed of boats could be improved and more fishermen could be included in the next round of trials.

The research and development centre of HPCL, in collaboration with Pune-based Vanaz Engineers Limited, has developed the customised LPG kit exclusively for LPG-powered outboard engines. According to Roy Nagendran, CEO, Parivarthanam, who supervised the trial, apart from financial benefit, the use of LPG in boats will substantially reduce environmental pollution.

Nagendran said that a boat powered by a 10 HP engine normally requires six to 10 litres of kerosene for one-hour operation. The wastage of a fuel like kerosene is also high as around 20 % of it flows out into the sea. A 2.5 kg LPG kit is enough for one-hour operation of a boat. When compared to the cost of fossil fuels, fishermen will benefit substantially from the shift.

Eight fishermen held by Sri Lankan Navy near Katchatheevu

Their mechanised boat was seized; fishermen's associations condemn the arrests

Eight fishermen from Thangachimadam near Rameswaram were arrested by the Sri Lankan Navy near Katchatheevu island in the early hours of Sunday, on charges of poaching in international waters. Their mechanised boat was seized by the authorities.

On Saturday, around 540 fishermen from Rameswaram ventured into the sea. As they were about to return on Sunday evening, eight of them were detained by the Sri Lankan Navy for crossing the International Maritime Boundary Line (IMBL).

The arrested persons were Ramesh, 40, Rodick, 19, Ajit, 19, Columbus, 52, Iman, 22, Linson, 23, Pavoothi, 19, and Israel, 20. The boat was said be owned by Ramesh.

Fishermen's associations in the coastal district strongly condemned the incident and demanded the immediate release of the arrested fishermen. In the last 26 days, 81 fishermen from Tamil Nadu and Karaikal have been arrested for poaching. "This is unacceptable and an anti-fishermen act by the Sri Lankan Navy," said Sesu Raja, a fishermen leader in Rameswaram.

The seized boats have not been released by the Sri Lankan government. Bose, another fishermen leader, said Sri Lanka had no right to auction them. He urged the Centre and the State government to take tangible steps to ensure the safety of fishermen.

At a time when fishermen were unable to make ends meet due to the COVID-19 pandemic and the price of diesel was high, such frequent arrests by the Sri Lankan authorities may force them to stop fishing. "The fishermen are neglected by those in power on our own soil. When the government here has claimed that Sri Lanka is a friendly nation, such arrests and humiliation are baffling to us," Mr. Bose said.

According to a Fisheries Department official, the eight arrested fishermen were being taken to a special camp in Sri Lanka, and were likely to be produced before a court.

Meanwhile, the Sri Lankan Navy said its patrol teams apprehended an Indian trawler and fishermen engaged in the illegal practice of "bottom trawling'" on the Sri Lankan side of the IMBL in the Palk Strait.

The fisheries conflict affecting the fishermen of Tamil Nadu and the war-affected Tamil fishermen of northern Sri Lanka is back in focus, in the wake of a spate of arrests by the Sri Lankan Navy and the deaths of two Jaffna-based fishermen, reportedly in mid-sea clashes with their Tamil Nadu counterparts. Tamil Nadu Chief Minister M.K. Stalin has sought New Delhi's swift intervention to ensure the arrested fishermen's release.

High-level visit likely

External Affairs Minister S. Jaishankar is likely to visit Sri Lanka in mid-March, possibly with a senior representative from the Tamil Nadu government, to discuss the escalating tensions between the fishermen of India and Sri Lanka in the Palk Strait, among other bilateral matters, diplomatic sources told *The Hindu*, according to a report in the newspaper.

However, the dates are yet to be fixed, with the Russia-Ukraine crisis dominating world affairs. If the visit materialises, the possible inclusion of a senior Tamil Nadu Minister in the Indian delegation would be significant, signalling Tamil Nadu's willingness to work with the Centre on the long-festering fisheries issue.

Though it was bilaterally agreed during Sri Lankan Foreign Minister G.L. Peiris's visit earlier this month, that the next Joint Working Group meeting on fisheries would be convened before Mr. Jaishankar's scheduled visit, no date had been proposed yet, official sources in New Delhi said.

Fishermen's associations from both sides are open to resuming talks, but northern Sri Lankan fishermen have emphatically stated that unless their Tamil Nadu counterparts immediately stop the practice of bottom trawling, widely deemed destructive to marine resources, they would have little faith in talks.

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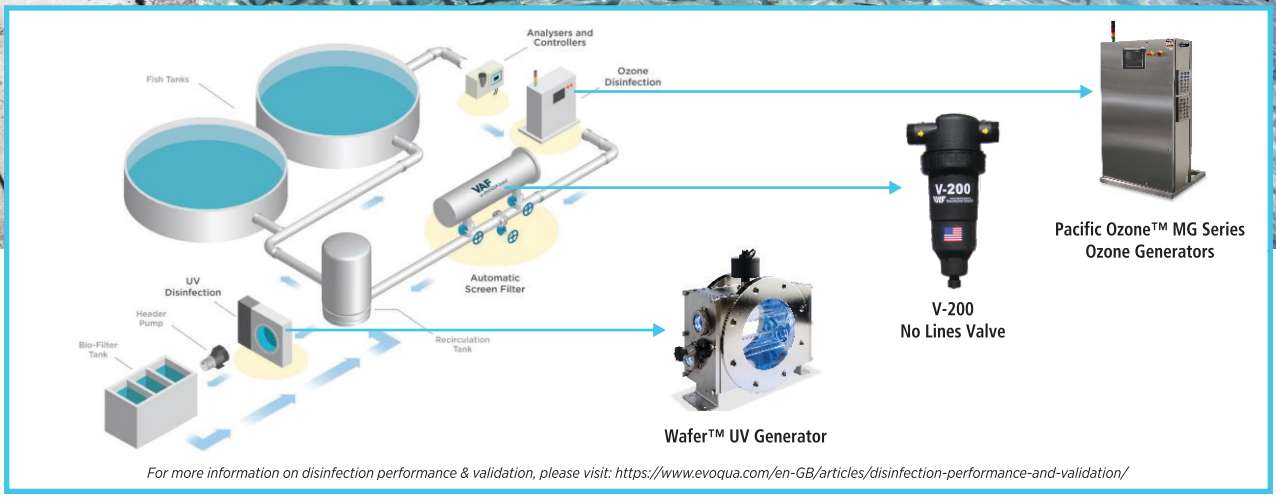

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Assam increasing production of indigenous and exotic ornamental fish

The Integrated Ornamental Fish Farming Unit at the Ornamental Fish Department of Zoology at Gauhati University is making good strides in terms of production of indigenous and exotic ornamental fish.

Set up with support from the National Fisheries Development Board, Hyderabad and Aquaculture and Biodiversity Centre and the State Fisheries Department, the Integrated Ornamental Fish Farming Unit is making headway in the production of indigenous ornamental fish of different species.

Managing Director, FISHFED, Dr. Dhrubajyoti Sharma, who has been associated with the project since its very inception, said that it has been a story of success insofar as production of indigenous fish of different species is concerned.

A total of 70 species of ornamental value have been procured from different locations of Assam and other states of North East Region and reared in natural habitat in nine ponds covering an area of 16 acres under the National Development Fisheries Board's Rs.1.36 crore funded project.

The brooder's bank for ornamental fish houses 70 aquariums, 10 cisterns, carp hatchery, air breathing fish hatchery unit and a laboratory. Six units of

The brooder's bank for ornamental fish houses 70 aquariums, 10 cisterns, carp hatchery, air breathing fish hatchery unit and a laboratory.

modified ornamental fish hatcheries have been installed with facilities like ozone generator, oxygen concentrators with an overhead tank to ensure infection free water for the brooders.

"The Fish brooder bank helps to produce quality and improved fish seed in substantial quantity to fish farmers as well as hatchery owners," said Fisheri ..

Development Officer attached to Minister Fisheries, Pratul Deka.

A pilot project on ornamental fishes under NDFB is also underway. Three clusters have been formed comprising women fish farmers. Matsyagandha Ornamental Society at Dhing under Nagaon district, Jagaran Ornamental Fishery Development Society at Krishnai under Goalpara district and Amranga Ornamental Fishery Development Society at Mirza under Kamrup district have come up. Three government research institutes such as the College of Fisheries, Raha under the Assam Agricultural University, KVK Zoology Department of Gauhati University and Ornamental Fisheries Research Unit under Department of Fisheries have been linked to these clusters.

Dr.Sharma said that Assam with its vast water resources in the form of rivers, water bodies and ponds have immense potential for production and trading of indigenous ornamental fish to different parts of the world.

Annual trade for exotic ornamental fish for the state is estimated to be Rs.5 crore. About 90 per cent exotic fish species are coming from Kolkata. Under the pilot project, five selected native ornamental fish and 10 exotic ornamental fish having good market demand have been taken up for breeding and rearing and in which breeding technologies have been already standardised.

India stands at the number two position, behind China, in the world in fish production. However, the contribution of ornamental fish to a whopping Rs.47,000 crore revenue is a mere Rs.6 crore. Of the approximately 4,500 species identified, the global trade in ornamental fish is dominated by 2,500 odd species.
"The advantage Assam possesses with abundant water resources will surely open a sea of opportunities for us to diversify our farming to include ornamental fish. It is more than a viable option, even for small scale and landless farmers, women, self-help groups and cooperatives," said Dr.Sharma, said,adding that farming ornamental fish is equally remunerative for small as also big units.

The global trade in ornamental fish, including the ancillaries such as aquaria etc. is estimated between US$ 15 to 20 billion, fish alone being around US$ 8 to 15 billion. A study estimates the domestic demand for aquarium fish to go up to Rs. 12,000 crore by the year 2025, meaning that the country needs to register an annual growth of nearly 40%.

"Efforts are on to support our farmers through a scientific breeding programme that enhances the physical attributes of the fish, the very attributes which make it worthy of participation in a beauty

pageant, the returns of which could be more than one multiple of 5,000," said Deka.

It may be noted that sale of Platinum Arowana has been recorded at US$ 4,00,000 which translates into a whopping Rs 3,20,00,000.

The Pradhan Mantri Matsya Sampada Yojna (PMMSY) has a strong component of support to ornamental fish farming. "A welcome aspect of the scheme is that it strategises budgetary support to attract private investment, and also to provide backend support to the farmers by way of establishment of brood banks and hatcheries," he quipped.

The National Cooperative Development Corporation (NCDC) too has developed schemes to encourage and finance cooperatives and Farmer Producer Organisations (FPOs) for farming ornamental fish. "The vocation gets further integrated with a host of other activities such as farming and/or harvesting aquatic plants, expanding aquarium manufacturing industry, feed units, and lo and behold even fish beauty industry," Deka added.

Mandapam Regional Centre of ICAR-CMFRI kick-starts sea ranching project under PMMSY

The Mandapam Regional Centre of ICAR- Central Marine Fisheries Research Institute (CMFRI) has kick-started a sea ranching project under the 'Pradhan Mantri Matsya Sampada Yojana' by releasing a total of 1.38 million green tiger shrimp (Penaeus semisulcatus) seeds in the Gulf of Mannar, Tamil Nadu. The shrimp seeds were sea ranched at Vedalai in the sea grass beds of the Gulf of Mannar on 17th February 2022.

The project entitled 'Sea ranching of Green tiger shrimp (Penaeus semisulcatus) Post Larvae (PL) in Palk Bay and Gulf of Mannar, Tamil Nadu' was sanctioned by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India to the ICAR-CMFRI under Central Sector Scheme component of the PMMSY with a total budget of Rs. 168.948 lakhs. The project aims to release a total of 200 million green tiger shrimp post larvae in a period of four years in the Palk Bay and the Gulf of Mannar region of Tamil Nadu.

The Mandapam Regional Centre of ICAR-CMFRI is carrying out the sea ranching of hatchery produced green tiger shrimp seeds in the region to replenish the natural stock and to enhance the shrimp productivity. This was helpful to promote the livelihood of the fishermen in the region and also for the conservation and in maintaining a sustainable shrimp stock in the wild. During the period from 2017 to 2021, a total of 17.245 million seeds were released in this region.The shrimp seeds were released by Dr. G. Tamilmani, Head-in-Charge & Principal Investigator of the project, Scientists and Staff of Mandapam Regional Centre of ICAR-CMFRI and local fishermen.

Commercial Launch of ICAR-CIBA Technology Products for Mitigation of Nitrite Metabolite in shrimp ponds and control of External Parasite in fish in Agri Business Meet

ICAR-CIBA conducted the Agri Business meet on 14th February 2022. During the meet technology products for mitigation of nitrite metabolite in shrimp ponds and control of external parasite in fish, developed by the institute and commercialized to M/s Alpha Biologicals, Nellore, Andhra Pradesh were launched. The products NOVACIDE-ALF, Anti-Lice Formulation and NOVATAN-AMS Autotrophic Microbial Solution to mitigate nitrite were released by Dr.K.P.Jithendran, Director, ICAR-CIBA in the presence of farmer representatives, industry professionals and scientists. The NOVACIDE-ALF is an efficient oral preparation for control of crustacean parasites like *Argulus spp., Caligus spp., Lernanthropsis spp.* and *Lernaea spp.* in different fish species in different culture systems such as aquarium, pond, cage, concrete tank, FRP tank, and lake with wide range of salinities 0-30 ppt. The NOVATAN-AMS uses formulation containing enrichments of nitrite oxidising bacteria that are efficient in oxidising toxic metabolite nitrite to non-toxic nitrate.

Dr P.K. Patil, Principal Scientist, Officer in-Charge, ITMU, in his introductory speech detailed about the background of the technologies developed and their commercialisation. The Director, elaborated that the technology development and commercialisation should be based on the needs and benefit to the farmers. He stressed on development of efficient products that are safe to the environment. Dr R. Ananda Raja, Senior Scientist and Dr Satheesha Avunje, Scientist described scientific basis and principles of application, biosafety, environmental safety, withdrawal and efficacy of the products. Dr Amaraneni Ravi Kumar, Managing Partner, Alpha Biologicals emphasised the need for quality products to support aquaculture. He shared that the field trials conducted across the country shown that the products are working well. Mr. Punnaivanam, Novakem Biosciences described importance of the two products launched in managing the farming problems. The technologies for production of these two products were developed

at ICAR-CIBA and have been commercialized to M/s Alpha Biologicals, Nellore recently. The company has started commercial production of the products and planning to market them in major aquaculture states in the country.

AP Fisheries Commissioner rebuts 'propaganda' on GO 217

'Of the 27,363 tanks, GO is applicable to 582 tanks'

Commissioner, Department of Fisheries, K. Kanna Babu has said that there is no truth in the 'misinformation campaign' being carried out by certain sections against the GO Rt. No 217.

At a press conference on Tuesday, Mr. Kanna Babu explained in detail about the benefits the fishermen community would accrue through implementation of the said GO.

He said the Minister for Animal Husbandry and Fisheries S. Appalaraju and Rajya Sabha member Mopidevi Venkata Ramana had explicitly spoken about the contents of the GO 217 on many occasions and had clarified the doubts of the representatives of the fishermen associations.

Tanks

He said of the 27,363 tanks in the State, 3,325 minor irrigation tanks and 118 reservoirs were in purview of the Fisheries Department besides 23,920 tanks in purview of the Panchayat Raj Department.

He said recognising the fact that the fishery wealth in the minor irrigation tanks was being captured by the middlemen, the fishermen cooperative societies were unable to reap their benefits, the GO was issued

to ensure that the fruits of the government initiatives reached the rightful beneficiaries.

Mr. Kanna Babu said of the 27,363 tanks, the GO was applicable to 582 tanks spread across more than 100 hectares of land. Of them, only 337 tanks had been given on lease to 255 fishermen associations. A pilot project had been introduce in Nellore district and based on its success, a decision on its implementation in other districts would be taken, he said.

He said the fishermen need not worry about the propaganda being spread about the GO by certain vested interests. The YSR Congress Party government was committed to the cause of their development through the many initiatives being brought to ensure their all-round development, he added.

Fisheries department will revive murrel culture in Dakshina Kannada

Mangaluru: Minister for fisheries, ports and inland water transport S Angara has directed fisheries department officials and the College of Fisheries, to focus on the revival of murell culture in Dakshina Kannada.

Dr Shivakumar Magada, Dean, College of Fisheries, Mangaluru, said the breeding of 'Channa marulius' popular as 'madanji' in Tulu and 'kuchu', 'korava', 'kandu' in Kannada and 'Channa striatus' known as 'malenji' in Tulu, have been planned.

"Murrels or snake-head fish are freshwater fish that are tasty and high in nutrients. It is believed they have medicinal value. Available in abundance in the past, their population in the region has reduced due to pollution and other factors. Minister Angara insisted that the college take up the breeding programme and promote its culture in all small waterbodies. Most farmers have farm ponds well suited for murrel culture, and can also be an additional source of income," he said.

"Murrel is one of the indigenous air-breathing fish. It can even survive in lower dissolved oxygen levels. While it is the state fish of Telangana, people prefer murrel over any other fish in Andhra Pradesh, Tamil Nadu, Punjab, Haryana, Bihar and the North-Eastern region. Karnataka Veterinary, Animal and Fisheries Sciences University has already initiated its breeding programme at the Fisheries Research and Information Centre, Hesaraghatta, led by Dr Manjappa N. The centre has already collected sufficient brood stocks, and the first official breeding programme will be initiated by the end of May. The project worth Rs 1 crore is supported by the department of fisheries," Dr Magada said.

"We have also been directed to work on getting GI Tag for the Dakshina Kannada murrel. The cost of production is around Rs 250-Rs 280 per kilogram, while the market price is around Rs 450-600 per kilogram, as against the market price of about Rs 150-Rs 200 for other freshwater fish varieties. There is a data deficiency in terms of estimated production in India," he said.

A team of Indian scientists, including Dr Magada, had visited Vietnam to study murrel farming and its technology in 2018. Also, a proposal for the breeding of karimeen led by Dr Rajanna, has been submitted to the fisheries department, after Angara insisted on taking up the breeding and promotion of karimeen, a fish popular in Kerala.

Customs duty revamp gives fisheries sector a boost

The Union budget announced a sharp reduction of basic customs duty from 30% to 10% on live black tiger shrimp, which farmers use for breeding

India's marine product exports have been growing robustly, and a big part of it is due to shrimp exports.

India's fisheries sector has emerged as a key beneficiary of the customs duty rejig to boost local production, even as much of the attention has been focused on the manufacturing industry.

The Union budget announced a sharp reduction of basic customs duty from 30% to 10% on live black tiger shrimp, which farmers use for breeding, and from 30% to 15% on both frozen krill, a feed for fish, and on algal oil derived from certain marine algae for making aquatic feed.

These inputs used in shrimp culture were given relief on basic customs duty as India is a major exporter of shrimps and there are several farms in coastal Andhra Pradesh and Tamil Nadu, Central Bord of Indirect Taxes and Customs (CBIC) chairman Vivek Johri said in an interview.

To support the food processing sector, the duty on frozen squids and mussels, a shell fish, too was halved to 15%. Increasing farmers' income is a policy priority for the government, including for those in the fisheries sector, Johri said.

Industry representatives said the move was beneficial but more could be done. "The finance ministry has reduced import duty only on black tiger shrimp from 30% to 10% which is really commendable and helpful for the aquaculture industry. But right now, more than 95% shrimp import consists of L. Vannamei shrimp. So, it would be highly beneficial if the import duty is reduced on that as well," said Prathipati Veerabhadra Kumar, managing partner of Srinidhi Biotechnologies, a hatchery based in Andhra Pradesh.

Kumar said the hatchery industry is heavily dependent on feed necessary for shrimp from other countries, and it would be helpful if the import duty is reduced on that as well since there are relatively less number of indigenous shrimp feed manufacturers. Kumar also said hatcheries need incentives given that they take the initial high risks of importing live shrimps and have a limited window period for selling to farmers without compromising quality and safety.

The government is also running a five-year scheme -- Pradhan Mantri Matsya Sampada Yojana -- up to FY25, aimed at addressing the gaps in the fisheries value chain from fish production to post-harvest infrastructure and marketing. Under this scheme, India has set a fisheries export target of Rs. 1 trillion, additional seven million tonnes of fish production, and generation of 5.5 million jobs over the years. The policy priority is to help achieve a 'blue revolution' through sustainable and responsible development of the fisheries sector.

India's marine product exports have been growing robustly, and a big part of it is due to shrimp exports. Frozen shrimp makes up 74% of India's marine product exports in dollar terms, followed by frozen fish and frozen squids.

As per provisional estimates from the commerce ministry, export of marine products grew 35% to $6.1 billion during the April-December period of 2021 compared to $4.5 billion in the same period the previous year. In the April-December period of 2019, India had exported $5.5 billion of marine products. In December 2021, marine product exports touched $720.5 million, showing a 28% growth over the year-ago period. The government expects exports to touch an all-time high, exceeding the $7 billion seen in FY18, despite the impact of the pandemic.

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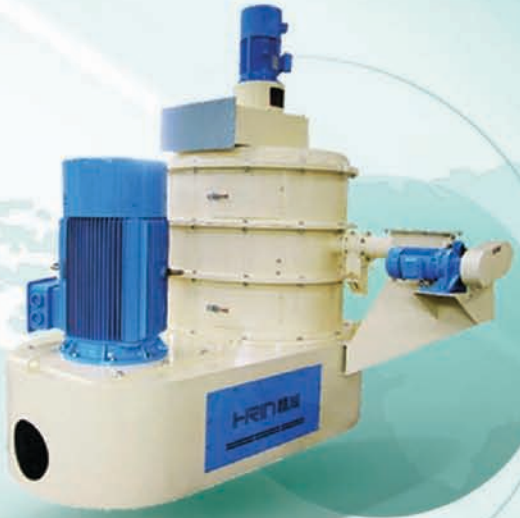

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HORSESHOE CRAB – An overview

Email: monicasomannak@gmail.com

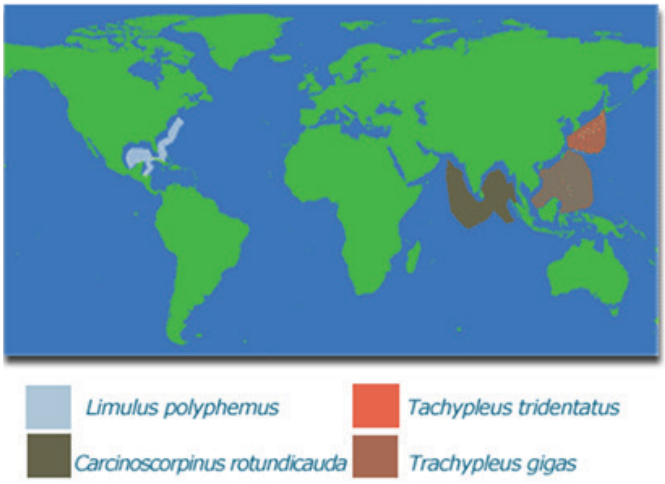
Monica K.S
Department of Aquaculture, College of Fisheries, Mangaluru

Highlight Points

- Horseshoe crabs are without a doubt one of evolution's success stories, but their 450 million-year-old lineage demands our attention and care if they are to live and thrive in the Anthropocene. Horseshoe crabs are extremely important ecologically and economically, and their blood is used to develop a bacterial contamination test that protects human health and saves millions of lives each year. Overfishing and the loss of critical spawning and juvenile nursery habitats are threatening them, owing to the increased human population along the global coastlines.

Introduction

Horseshoe crab is an important component of macro-benthos communities in the fine sand or mud substrate in coastal waters, both in the tropical and temperate region. Horseshoe crabshave survived for a long period of time without showing any significant morphological changes, hence horseshoe crabs are often called as living fossil. Horseshoe crabs have changed very little over 500 million years and have survived from two mass extinctions. They are even older than dinosaurs. The horseshoe crab is not really a crab. They look like prehistoric crabs. It is more closely related to scorpions, spiders, and mites than to true crabs, lobsters, and shrimp.



Global distribution of horseshoe crab

There are only four species of horseshoe crab found around the world. Horseshoe crab populations are distributed only in North America, Central America, and South East Asia.

Sl. No.	Species	Common name	Distribution	Habitat
1.	*Limulus polyphemus*	Atlantic horse shoe crab	Atlantic coast of North America, Gulf of Mexico	Found in sand or mud flats, estuaries, and mangrove swamps.
2.	*Tachypleus tridentatus*	Tri spine horse shoe crab	Asia, along the coast of Japan, the Philippines, China, Java, Sumatra and India. (North East coast of Orissa, Sunderbans– West Bengal)	Live in sandy to muddy habitats
3.	*Tachypleus gigas*	Coastal horse shoe crab		
4.	*Carcinoscorpius rotundicauda*	Mangrove horse shoe crab		Inhabits muddy areas, commonly in brackish waters


Tachypleus gigas


Tachypleus tridentatus


Limulus polyphemus


Carcinoscorpius rotundicauda

Life cycle

Horseshoe crab eggs stay buried in the sand for two to four weeks. They then hatch into larvae. The newly hatched larva looks like a trilobite. (Trilobite is a fossil group of extinct marine arthropods). Horseshoe crab larvae closely resemble adult horseshoe crabs but they are much smaller and they do not have tails. These larvae will swim in the open water for about six days before they settle onto the ocean floor.

Once they are around 20 days old, the horseshoe crab larvae molts. The juvenile stage is where the horseshoe crab grows its telson. Horseshoe crabs remains in the juvenile stage for about two years. During this time, they stay in shallow,

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

COMPOSITION:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
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protected water. After the larvae and young juveniles leave the beach environment, they do not return to the beach until they are sexually active adults. Both larvae and juveniles are more active at night than during the day.They burrow into the sand remaining inactive during day.

Food and feeding

Larvae feed on a variety of small polychaetes and nematodes. Juvenile horseshoe crabs feed mainly on molluscs. Adult horseshoe crab prey on a wide variety of benthic organisms including arthropods, annelids, polychaete worms, sand worm, soft – shell clam.

Significance of horse shoe crab in medical field

Of all marine species, horseshoe crabs have contributed the most to medical and physiological research. Horseshoe crab blood plays a vital role in human medicine. The straw-colored, copper-based blood turns blue when exposed to high concentrations of oxygen. Horseshoe crab blood contains primitive large blood cells called amoebocytes. A clotting agent called Limulus Amoebocyte Lysate (LAL) is derived from the amoebocytes of the horseshoe crab.

LAL reacts with bacterial endotoxin lipopolysaccharide (LPS), which is a membrane component of gram-negative bacteria. This reaction is the basis of the LAL test, which is widely used for the detection and quantification of bacterial endotoxins. When the LAL comes in contact with bacterial toxins, a clotting reaction occurs. Pharmaceutical companies test the sterility of vaccines, drugs, prosthetics and other medical devices using LAL. There is no synthetic substitute for the LAL test.

Blood collection

The animals used for blood collecting are initially disinfected with 1% iodine tincture and 70% alcohol. As a hypodermic needle is inserted into its artery, the blue blood is made to flow into a clean container filled with an anticoagulant such as caffeine or theophylline. The pH value of the blood is buffered to 7.2 with tris-HCl solution. About 80–100 ml of blood can be collected every time from one mature crab. Blood extraction from one specimen can be done 4–8 times a year.

Threat faced by horse shoe crabs leading them to endangerment:

The indiscriminate exploitation of horseshoe crabs for various commercial purposes has resulted in the significant global decline of this creature in the past decades. Environmental degradation and destruction of breeding grounds are also reasons behind their diminishing population. Unregulated fishing activities along the coast and unawareness among local fishermen about the crab's economic importance are leading to their declining population in India. Every year, horseshoe crabs die in large numbers after getting entangled in fishing nets. The fishermen leave their thick and deep-sea fishing nets under the boat or just along the water line on the estuary after fishing. As the tide rises, so does the water level, thus letting the net spread in the water. So, when the shore-bound horseshoe crabs approach the estuary for spawning—the process of laying eggs—they get caught in the net.

Horseshoe crabs have been taken in substantial numbers to provide bait for American eel and conch fishery. They are caught in large quantities for its blood collection.

According to the International Union for Conservation of Nature, all four extant species of horseshoe crabs are harmed, because of:

1. Overfishing for use as food and bait
2. Production of biomedical products derived from their blood
3. Habitat loss or alteration due to shoreline development
4. In order to protect the horse shoe crabs from extinction, they are listed under Schedule IV of India's Wildlife Protection Act, 1972.

DECADAL TRENDS OF LOBSTER FISHERY IN INDIA

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Highlight Points

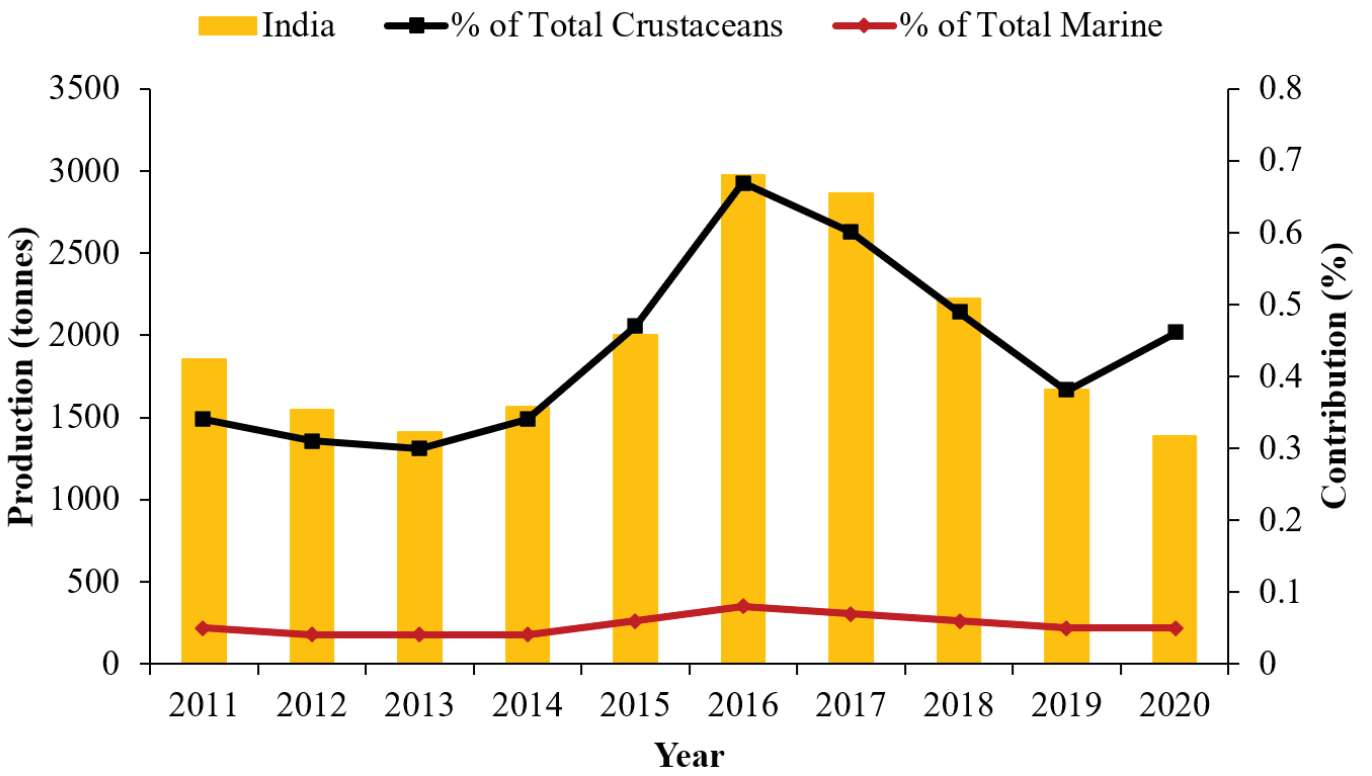
- In the last decade (2011-2020), the average annual lobster production in India was 1950 tonnes.
- Highest lobster production was reported during 2016 (2976 tonnes).
- Lobster production contributes 0.05% to the total marine fish landings and 0.46% to the total crustacean landings.
- Gujarat and Tamil Nadu share a major portion in lobster production.

Status

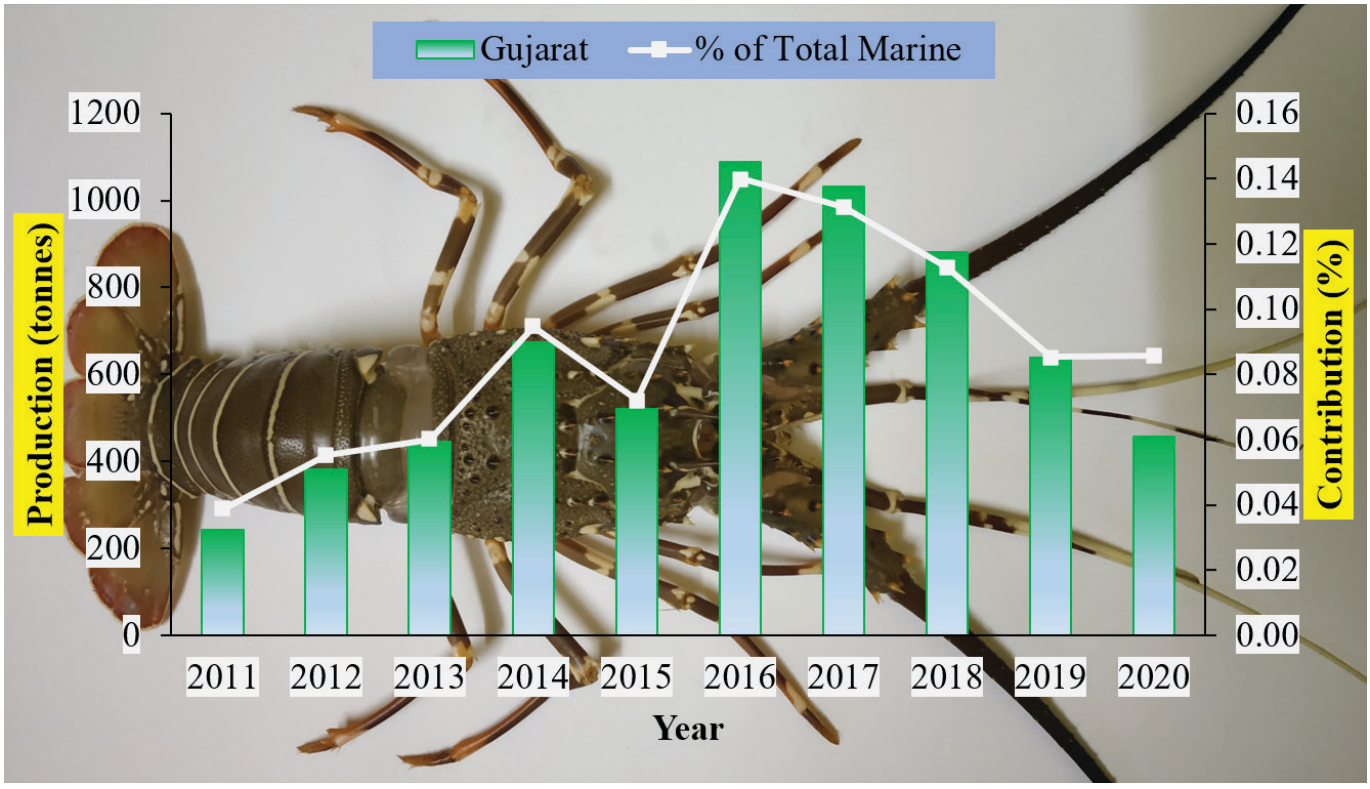
In India, lobsters are one of the high valued crustaceans having very good demand in the national and international markets. They are cosmopolitan in distribution, but in India major landings were reported from NW (northwest), SE (southeast) and SW (southwest) coasts. The decadal lobster fishery of India (2011-2020) ranged from 1410 to 2976 tonnes (t) with an average of 1950 t. The fishery improved from 1852 t (2011) to 2003 t (2015) and reached the highest of 2976 t during 2016 showing a growth rate of 76.83% (compared to 2011), but after that, it shows a steady decline in catch and has reached to 1389 t (approx.) in 2020 (Fig. 1) (CMFRI, 2022).. Compared to last year the lobster landings showed a decline of 16.88%. Gujarat and Tamil Nadu were the major contributors to the fishery among the different maritime states. In Gujarat, lobster landings fluctuated between 243.70 t in 2011 (0.04% of total landings) to 1089 t in 2016 (0.14%) to 457.36 t in 2020 (0.09%) (Fig. 2) with an average of 636.37 t (0.09%) (CMFRI, 2021). In India, lobsters are mostly harvested from the shallow waters and the fishery is of small scale contributing 0.04 – 0.08 % to total marine fish landings and 0.30 – 0.67 % to the crustaceans landings of the country (Fig. 1). Lobsters are harvested by multiple crafts and gears with major catch contributed by multiday trawlers followed by out-board gillnetters, single day trawlers, dolnetters and non-motorized gear such as traps. Three categories of lobsters are found in India viz. spiny or rocky lobsters, sand lobsters and deep-sea lobsters. Among them, spiny lobsters belonging to the Palinuridae family (*Panulirus polyphagus, P. homarus, P. ornatus, P. penicillatus and P. versicolor*) are found in large quantities and are highly luxurious seafood followed by sand or slipper lobsters belonging to Scyllaridae family (*Thenus orientalis and Thenus unimaculatus*) and deep-sea lobster (*Puerulus sewelli and Palinustus waguensis*). Lobsters are either sold in the domestic market or exported in the international market. Lobsters are having high demand in the international market in live conditions. The total live items exported from India during 2020-21 was 4379 tonnes (value: 32.72 US $) (MPEDA, 2021). The price of the live lobsters in the international markets ranges from US $ 16.8 – 38.57 per kg depending on the size and demand.

Conservation and Management

In recent years, soaring demand and charismatic prices for lobsters in the international market have resulted in the increased exploitation of the resources. In India, no management restrictions are in place to regulate lobster fishing. There are no restrictions on the minimum size, type of gear, or fishing seasons. Fishermen enticed by the high prices of lobsters in the market are indiscriminately exploiting the resource. Hence, the development and execution of regulatory measures are crucial. The biological, economic, and social aspects will have to be considered when framing and implementing management methods. Education and awareness programs are required on the negative impacts of catching the berried (egg-bearing) females and juveniles for sustaining the fishery. Installation of analogs of reefs (artificial reefs) is required to provide refuge for juveniles and berried females in order to increase lobster production. Thus, a holistic approach to lobster resource management is required, with the primary goal of sustainable utilization and resource protection for future generations.



Trends in production of lobsters along Indian coast (2011-2020)



Trends in production of lobsters along Gujarat coast (2011-2020)

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Restoration and Rehabilitation Strategies for the Conservation of Pulicat Lake Ecosystem

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Abstract / Highlight points of the Article:

This article gives an insight about the ecological and biodiversity status of the Pulicat lake and outlines the conservatory measures for protection. An array of research initiatives taken by the Institutes and Government are presented coherently to plan for the advanced conservative measures. Protection of livelihoods and the traditional practices of the fishermen with the ecologically sound management measures has also been discussed vividly. This paper would serve the purpose of envisioning the researchers, policy frame workers and administrators for drafting the practical possible bio mitigation measures for managing the renowned second largest brackishwater lake resources. This would emphasise the fact that the 'Pulicat lake Development Authority' can be formed on line with the Chilka Lake Development Authority by the Govt to protect this ecosystem from fast deterioration.

Highlight Points

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Pulicat Lake

The Pulicat lake, which is 481-square-kilometer lake, India's second-largest brackish-water ecosystem after Chilka in Odisha, is home to around 110 different terrestrial and aquatic birds, small mammals, and reptiles, as well as 160 different fish species of both marine and brackish water traits. The lake is well-known as a prominent fishing destination, particularly mullet, shrimp, mud crab and mollusc fishery with an annual fish production of 1152 tonnes. Around 60,000 migrant water birds, including flamingos, travel to the northern part of the lake throughout the winter.The lake's boundary limits range between 13.33° to 13.66° N and 80.23° to 80.25°E, with a dried part of the lagoon extending up to 14.0°N. It is situated 40 km north-east of Chennai. The drainage basin area is about 4,450 km2 and the rivers Arani and Kalangi supply fresh water to this lake, especially during the monsoon period. The depth of the water column varies from 1 to 6 m (Padma and Periakali, 1999). The lagoon is aligned parallel to the coast line with its western and eastern parts covered with sand ridges. Its length is about 60 km with width varying from 0.2 km to 17.5 km. It is connected with the Bay of Bengal through a deep opening of 0.8 km width situated 1.6 km North of the Pulicat light house. The lake has been designated as a biodiversity hotspot by the WWF India, and there are plans to include the Pulicat wet lands in the RAMSAR site (Sanjeevaraj,2006). The entire Pulicat lake water system, the Ennore creek, and the Buckingham canal are all included in CRZ-I, according to the Coastal Regulation Zone Notification (1991). In 1976, the entire area of the lake in Andhra Pradesh (58000 ha) was declared a sanctuary, and in 1980, the entire portion of the lake in Tamil Nadu (6000 ha) was declared a sanctuary (Anon,2001).

Pulicat Lake is a biodiversity hotspot in southern India. Approximately 40,000 people live in 34 villages on the Tamil Nadu side of the lake, while 25,000 people live in 15 habitations in Andhra Pradesh. According to the official records, there are 600 sqr km of wetlands marked along with the boundaries in the lake. However, pollution and climate change are jeopardising its diverse ecology, as well as the livelihoods of the people who reside in the Pulicat. Tamil Nadu owns 24 percent of the lagoon and 76 percent is coming under Andhra Pradesh. Closely ahabitants of 46 villages located in and around the lake is also striving hard to maintain the ecosystem

The lake's mouth narrows and shallows during the post-monsoon months (January to September), resulting in the formation of a sand-bar across the lake's mouth, which is a crucial determining factor for the lake's hydrology, biodiversity, and fish. In view of this, the Pulicat bird sanctuary in Tiruvallur district has been declared as an ecologically sensitive zone to ensure total protection. Primarily, it has been proposed to maintain a 2 km buffer zone in Pulicat Lake.To address the issue, the Ministry of Environment and Forests reduced the legal restriction distance from 10 km to 2 km.

The Pulicat Lake, which is located in the Tamil Nadu districts of Nellore and Tiruvallur, has fully dried up on its northern coast in Andhra Pradesh, displacing thousands of people. The Central Govt is in the process of mapping and geo tagging the wetlands. The mapping is aimed for inventory and monitoring existing resources. A demarcated area within a 500meter radius, will include the villages of Elavur, Injur, Selliabedu, Uppanavoyal, Periaveppathur, Kolur, Poovami, Tirupalaivanam, Pralayambalam, Andarmadam and ThangaiPerumkulam.

More stringent rules are required, as the wetlands provide place for migratory birds and hatching. The wetlands are significant for natural and sea activities. Because of brackishwater, a type of algae is formed which is a nutritional food for birds and it helps speedy reproductive activity. Central Government is keen in developing a buffer zone to protect the lake and the ecology. A buffer zone is the area of land within 100 feet of coastal banks, inland banks, freshwater wetlands, coastal wetlands, tidal flats, beaches, dunes, marshed and swamps. Any activity in a buffer zone could have an impact on the nearby wetlands. Wetlands are not bordering natural habitations,but human habitations.The effluents generated by shrimp aquaculture pose a threat to ecology in the area. There are certain norms from the National Board for Wildlife for formation or laying roadseither in the wetlands or buffer zone. The interests protected by the norms are flood control, prevention of storm damage, curbing pollution, protection of fisheries, shellfish groundwater, public or private water supply, and wildlife habitat.

Fishermen on the Tamil Nadu side make it a point to clear the sand bars for easy access to their hamlets that are located close to Pulicat Lake. The lake has been drying up annually due to the closure of the mouths of the sea on the northern (AP) side at Kondurupalem and Rayadoruvu in Vakadumandal of Nellore district several years ago.

Central Government including Andhra and Tamil Nadu state Government's plentiful assurances to take up dredging operations to open the mouths of the sea remain on paper. Studies indicate that the average depth of the lake came down to 1.5 m from 4 m in many places, with its area reduced to 350 sq km in a few decades, which will, in turn, lead to a huge reduction in the aquatic population. This is attributed to a rapid shrinking of the water spread area, mainly due to silting in the lake's northern side. In fact, the lake was full to its brim even on the northern side because of heavy rains in the previous years, but then it was dry by the end of every year. All the water emptied into the sea as the lake was on higher ground. An urgent need to take up a survey of the levels before opening the sea's mouth at Rayadoruvu and Kondurupalem. A cost estimate of Rs 15-20 crores to carry out dredging operations. Recalling that the lake was winter home for flamingoes and the favourite feeding ground for thousands of migratory birds, that any move to relax the restrictions will drive away the birds.

An integrated research programme in Pulicat should serve as the backbone of the conservation system. Below is a timeline of the Pulicat research endeavour. The Government of India created the Pulicat Lake Unit under the Central Inland Fisheries Research Institute (CIFRI) in Barrackpore in 1964 to investigate the fishery and hydrobiology of the lake. Between 1964 and 1972, the unit conducted a wide range of studies on the biology and fisheries of economically important fishes and fish populations in the lake, as well as extensive studies on the hydrobiology of the lagoon ecosystem. Following that, CIFRI's Pulicat Lake unit began researching aquaculture. Fish and shrimp species cultivation in pens and cages with extra feeds, mud crab culture in ponds, and edible oyster culture were all investigated.

The State Fisheries Department, Tamil Nadu established a Research Station at Pulicat in 1973 and conducted shrimp culture in six nursery ponds. The Institute for Ocean Management, Anna University, Madras Christian College, University of Madras and Sri Venkateswara University. The National Institute of Ocean Technology, Chennai initiated mud crab farming and fattening programmes in Pulicat lake. Besides this Central Institute of Brackishwater Aquaculture has also made a lot of efforts in restoring the livelihoods of the Pulicat fishermen community.

PULICAT CONSERVATION STRATEGIES

Hydraulic Intervention for Permanent Opening of the Lake Mouth

Hydraulic engineering management of fisheries, which entails managing seawater intrusion to increase aquatic productivity, is one of the non-regulatory approaches of recovering the ecology of lagoons. The lake mouth would be deepened and permanently opened by hydraulic techniques, allowing for simple water passage between the lake and the sea. This would make it easier for more fish to enter the lake, increasing fisheries and productivity. In this context, the Chilka Development Authority's effective ecological restoration of the Chilka Lake in Orissa is worth emphasising. The opening of an artificial mouth and desilting of the main river were the initial hydrological interventions in the restoration of Chilka Lake's ecology. This has not only revitalised the lagoon ecology, but has also resulted in the expected improvements in salinity, fisheries resources, and

species migration into the lake. Similarly, the restoration of the Thames Estuary in England from a severely degraded, nearly fish-free state to its original quality is another example of ecological restoration. Similar efforts to maintain the mouth of the Pulicat Lake permanently open will improve the lake's fishery, assure food security, and usher in a new period of peace and prosperity in the region.

Besides this few strategies are also discussed below:

- To conserve the Pulicat Lake ecosystem by reducing the fishing intensity in the lake to enhance biodiversity and biomass of fishes. In order to reduce the fishing intensity in the lake, fishing effort needs to be diverted to the open sea near the Pulicat Lake by generating fishing through deployment of artificial coral reef (live rock) and fish aggregating artificial reef in the sea.
- Construction of a groyne, a stone wall, a mound of stones, or a tidal inlet wall to keep the sea mouth open for at least 20 years, followed by sand removal to maintain a sustainable brackish water regime for the survival of migrating birds, aquatic animals, and fishermen.
- The earthen road bridge connecting Sullurpet and Sriharikota Island shall be replaced with a concrete bridge with ample space for free flow of water instead of cement pipes over a 9.5-kilometer length to prevent rapid drying in the shallow water regime's southern half.
- Instead of Casuarina, plant mangroves along the littoral areas of islands and sand bar margins to supply nutrition to aquatic wildlife. Mangrove leaves provide food for plankton, which in turn feeds fish and shrimp in the food chain. Fishing birds use mangroves as a temporary landing spot.
- Planting mangroves around *Prosopis juliflora* on islands in the lake's littoral zone would also help to balance the ecology
- During the monsoon and also during the post-monsoon period up to April, shallow water regimens around Rayadoruvu, Attakanithippa, Venadu needs to be maintained with optimum salinity of brackish water regimens.
- Water storage pits of 100x100 feet with a depth of 112 feet near Attakanithippa, on either side of a 9.5-kilometer road bridge, where a few fish survive throughout the post-monsoon season (January to April) and acts as a food for Painted storks and Pelicans.
- Prevent the discharge of aquaculture farm wastewater into the Buckingham Canal, which eventually reaches Pulicat Lake in the Nellore District.
- Stop depositing Sullurpet municipal solid garbage near the Kalangi river's shore near the Sullurpet town road bridge.
- At the Forest Department Museum/Laboratory in Sullurpet, close to Pulicat Lake, a water quality monitoring laboratory and infrastructure shall be established.
- Tracking bird chronobiology in relation to weather should be also carried out
- Moderate fishing and shrimp catches by fishermen who rely on Pulicat Lake for their livelihood from October to February.
- Ecotourism promotion at Attakanithippa during the migratory bird season can also be encouraged

Emerging issues with over-exploitation of Pulicat Lake

- **Rampant destruction** (and fragmentation) of the mangrove ecosystem, and conversion of wetland for commercial cultivation of shrimps
- **Over-exploitation** of hydro-biological resources
- **Inappropriate extraction activities** (with impacts on fauna)
- **Deforestation and conversion** of neighbouring forests
- **Pollution by waste water and pesticides** from adjacent **agricultural lands.**
- A wide area of Pulicat has been destroyed, and now there are several development projects planned that will have an impact on the lake: expansion of the **Dugarajapatnam port** and a **proposed Adani port,** among other projects.
- Further, emerging issues such as global warming, climate change and their impacts on **coastal zone ecosystems** further accelerate the destruction of **fragile ecosystems.**

Key suggestions for rejuvenation of Pulicat Lake

Establishment of a Development Authority: Similar to the Chilika Development Authority in Odisha, state governments must form a development authority for the lake. The authority should be responsible for ensuring the following:

- A community-based planning and management scheme (eg. active participation of stakeholders and resource users)
- A holistic approach (that involves the entire ecosystem and not only the protected area)
- A land-use planning zoning programme, clear conservation objectives, identification and mitigation of significant impacts, and, lastly, a strong technical foundation for project execution and monitoring.

1. **Proper Resource Allocation:** It has been recognised that the human and financial resources currently allocated are not sufficient
2. Successful conservation of lakes depends on the proper management of their watersheds, but there are conflicting interests in the use of their resources
3. Local governments should prohibit local residents from mining lime shells in Pulicat Lake, which devastates mudflat environments.
4. Local governments should establish a strategy to safeguard these areas, such as designating tidal flats as migratory bird critical habitat.
5. The government should go ahead and place the lake on the Ramsar List.
6. In addition to the Pulicat Lake biodiversity protection measures, ecotourism development, community participation, integrated watershed management, hydrological monitoring, and modelling activities must be carried out in conjunction with various national and international entities.
7. Chilika Lake's essential lessons into practise.

- Restoring the lake by funding research, educational, and conservation projects
- Establishing an interpretation centre, a GIS cell, and people's participatory, ecotourism, and development programmes

- Dredging interventions (in collaboration with the Central Institute of Brackishwater Aquaculture and the Central Marine Fisheries Research Institute)
- Managing fish resources
- Water chemistry and quality monitoring, as well as invasive species eradication
- A team of biologists to develop an adaptive ecological plan for the lake and conduct frequent lake ecosystem monitoring. The only way to manage resources sustainably is to use an ecological perspective.

CASE STUDY OF Chilika Lake

- The Chilika lagoon is an excellent example of how restoring a site's natural qualities benefits not only the lagoon environment but also the population that relies on it.
- Each family's average annual income grew by more over Rs.50,000 (about $660).
- The restoration of the Chilika lagoon is distinguished by the active participation of local populations, collaboration with a variety of national and international agencies, and extensive monitoring and evaluation systems.
- The designation of a site on the Montreux Record can be used to support steps to remedy changes in the natural character of a site and enhance the socio-economic situations of the population living in and around it, as the case of the Chilika lagoon exemplifies.

Way Forward

1. Participatory catchment management is required since the lake restoration strategy must be based on a river basin approach.
2. Community participation in the protection of bird habitats and species
3. Economic incentives for the local population to stop poaching birds
4. Efforts to enhance socioeconomic conditions, such as community-based ecotourism orientation training.
5. Installation of solar street lights in island communities
6. Establishment of a ferry service for remote island communities
7. Development of landing facilities for fishermen
8. Networking of NGOs and community-based organisations
9. Educating and raising awareness about environmental issues.

Conclusion

As a result, all stakeholders must be involved in the restoration, conservation, and management of lakes and coastal wetlands. In addition, there is a pressing need to strengthen regional ties, form strategic alliances, and adhere to best practises in lake and coastal wetlands protection and management. Establishing new or strengthening existing regional and international cooperation linkages and strategic partnerships between governments, international organisations, universities, research institutions, non-governmental organisations (NGOs), local communities, the private sector, and individuals is also critical. Pulicat Lake could be a key indicator of the future direction of wetland protection, and if successful, it could serve as an international model for development and protection.

Feed ingredients: The Future of Sustainable Aquaculture

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Highlight Points

- Fish meal and fish oil are primary sources of protein and lipid for aqua diets and the production of fish meal and fish oil decreased over the past 20 years.
- Feed ingredients, such as animal source of protein, single cell protein and food wastes are considered as non-conventional ingredients.
- Some non-conventional feed ingredients have mostly similar nutritional profile than fish meal and fish oil.
- Non-conventional feed ingredients could effectively fulfil the demand of fishmeal and fish oil in aqua diets.

Introduction

The human population is increasing day by day throughout the world and the worlds per capita fish consumption has reached 20.5 kg, while the per capita consumption for India is 6.56 kg. Therefore, 13.94 kg of per capita fish consumption demand-supply gap exists in India to reach global level. Livestock food producing sectors are hardly working to sort out food scarcity. Aquaculture is farming of aquatic species and provides the significant amount of food protein to meet out the demand of food supply. Aquaculture is classified into two groups such as "unfed" and "fed" aquaculture. Unfed aquaculture depends on their culture deco system itself (e.g., Filter feeders such as silver carp, grass carp and bivalves). Fed aquaculture is the most expanding food production sector and it has dependent on protein from feed (e.g., Seabass, Murrells, Shrimps). Traditionally, fish meal and fish oil are believed as primary sources of protein and lipid for most commercial cultivable finfish and shellfish diets. Fish meal hasrich in dietary source of protein, essential amino acid, mineral (Ca, P, Zn, Fe, Se, I) and Vitamin (A, B and D). Usage of fish oil in aquaculture is increased by approximately 14%, due to the result of adapting high production of marine finfish and shellfish. Fish oilcontains highlyomega -3 or n-3 long chain polyunsaturated fatty acids (LC-PUFA), Eicosa pentaenoic acid (EPA) and Docosahexaenoic acid (DHA).

The total annual production of fish meal and fish oil was estimated approximately 4.5 and 0.9 million tons in 2016. However, the production of fish meal and fish oil from source of wild caught has been decreasing over the past 20 years. The total production of aquafeed is predicted to increase by 75% from 49.7 million tonnes in 2015 to 87.1 million tons in 2025. In consequence, aqua feed industries are in a position to find best alternatives to fish meal and fish oil.

Aquaculture and Fishery by products

Fish and fishery by products are raw materials which are remains after the processing of fish or human consumption. Nearly, 50 – 70% of the by products are considered as inedible products and it has consisted of trimming waste such as viscera, heads, skin, bones and blood. This inedible by products are one of the best option of fish meal alternative in aquafeeds. At present, the global fish meal production is produced from 20%of fishery by products and 10% of aquaculture by products. The nutrient composition of these ingredient depends on type of raw materials and manufacturing process. Generally, high quality of fish meal consists of 65-75% of crude protein, 8-11% of crude lipid and less than 15 % of ash. However, fish meal produced from fish by products contains only 52-67% of crude protein, 7-14% of crude lipid and 12-23% of ash. The lower protein and higher ash might be due to present in various parts such as viscera,

bones, heads, skin, fins and blood in fish meal from fish and aquaculture by products. Even though, fish meal derived from fish by products has less protein and high ash, it has been successfully used in aqua diets. Fish meal derived from tuna by products can substitute 25-35% of the protein from the high-quality fish meal without any negative impact in various fish species such as Spotted rose snapper, Olive flounder and Korean rockfish. Since, the capture production of fish and aquaculture production are estimated to reach 91 and 109 million tons in 2030, therefore, the strong attention has been raised to increasing the inclusion rate of fish and aquaculture by products in aqua feeds.

Wastes from food

About 1.3 billion tons of food waste are being recorded around the world annually. The usage of food waste in animal feed is approved in many Asian countries but regulation has been existed in some countries (e.g., European Union). The food wastes can be raised from various sources and it has various nutritional composition. The major nutrient content of food wastes are proteins, carbohydrates and fats from fishmongers, greengrocers and butchers, respectively whereas, raised from restaurant and household wastes. Generally, the crude fat and carbohydrate content of food wastes can vary between 7-12% and 52-68% respectively. Meanwhile, crude protein content can vary from 3-38% depending on the source of waste. Food wastes are effectively used for feed for freshwater polyculture system in some countries (e.g., China). The growth performances of fish are highly depending on the type of species being cultured and type of food waste being used. On the other hand, food wastes are high in moisture level, probability of pathogens entered into aquaculture system. However, these problems can be rectified bysterilization of pathogens byenzymatic treatment or fermentation process.

Insect meals

Insects are short life cycle organisms and it can grow on wide range of substrates with high productivity and feed conversion. In addition, the production of insects as protein source of aqua feed does not compete with human food sources. Insects have relatively good nutritional composition; therefore, many countries (European Union) have approved insect meals as protein source in aquafeed. Many research have focused on black soldier fly (*Hermetiaillucens*), the common house fly (*Musca domestica*) and the yellow mealworm (*Tenebrio molitor*) as fish meal replacer in different commercially cultivable aquatic organisms. Non defatted insect meal contains 40-63% of crude protein and defatted insect meal contain up to 83% crude protein. The amino acids composition is dependent and vary with type of insect species (most of research has demonstrated that true flies contain similar amino acid profile compared to fish meal). The crude lipid content of insects are ranges from 8.5-36%, meanwhile, the fatty acid profiles are variable and dependent on developmental life stage and the substrates to be used in cultured media. Insects contain insignificant amount of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), lower levels of omega-3 and higher levels of omega-6 fatty acids compared with fish meal.

Table 1. Nutritional composition of some important insect meals (% in dry matter)

Insects	Black soldier fly larvae (*Hermetiaillucens*)	Housefly maggot meal	Housefly pupae meal	Mealworm (*Tenebrio molitor*)	Locust meal or grasshopper meal	Silkworm pupae meal
Crude protein	41–44	42–60	66 -76	47-60	29-66	52 -71
Ether extract	15–35	9–26	14-16	31-43	4-14	6-37
Crude fibre	7	2 – 9	16	7-15	2-14	2- 6
Ash	15 –28	6–17	5 - 10	3- 1	4-10	3-11
Gross energy (Mj/ Kg DM)	22.1	20.1–24.4	24.3	26.4-27.3	19.5-23.7	3.3-10.6
Mineral content of Insect meals (Ca, P, K, Na, Mg, Fe values were expressed as g/kg of Dry matter except Mn, Zn and Cu are expressed in mg/kg of Dry matter)						
Calcium (Ca)	50–86.3	3.1-8	-	0.3-6.2	-	0.7-8.4
Phosphorus (P)	6.4–15	9.7-24	-	4.4-14.2	-	1.9-8.5
Potassium (K)	6.9	1.0-12.7	-	8.5-9.3	-	-
Sodium (Na)	1.3	2.8-8.6	-	0.9	-	-
Magnesium (Mg)	3.9	0.7-11.5	-	2-2.8	-	1.9-6.5
Iron (Fe)	1.37	0.28-1.37	-	26-110	-	262-395
Manganese (Mn)	246	40-349	-	6-14	-	9-28
Zinc (Zn)	108	18-36	-	83-136	-	79-310
Copper (Cu)	6	43-325	-	15-18	-	2-25

Insect meal lipid quality can be enriched by feeding with fish wastes. Insect meal has relatively low level of carbohydrate (<20%), which are mostly in the form of chitin (N-acetyl D-glucosamine). Generally, chitin is considered as antinutritional factor, that are not able to easily digested by fish. On the other hand, many research have proven that low levels of chitin could act as an immunostimulant. Most of studies have recommended that partial replacement of fish meal with insect meal does not affect the growth performances in different aquatic species. However, the recent studies are reporting that 100% replacement of fish meal can be successful, even for carnivorous fish.

Microbial protein or Single cell protein

Microbial protein or single cell proteins (SCP) are promising alternative for animal or plant derived feed ingredients for aqua feeds. SCP is produced from various microorganisms such as bacteria, yeast and microalgae. Bacteria and yeast have a relatively high crude protein content (45 – 55% and 50 – 65%, respectively) and balanced amino acid profiles, which are similar to fish meal. Moreover, nutritional profile of yeast and bacteria can be enhanced by their modified culture media, growth conditions and post-harvest treatments. Even though, bacteria and yeast as an alternative sources of fish meal in aqua feed, their usage is still limited due to the cost of production. Microalgae are cultivated and used as feed ingredient or feed additive in aquaculture industries, especially fed for early-stage animals due to high level of crude protein and lipid (up to 71% and up to 40%, respectively) that are similar to most of terrestrial animal and plant sources. Many research studies have reported that, when diet is free from fish meal and fish oil, the usage of microalgae either as feed additive or feed ingredient has improved the growth performance and nutrient utilization in different cultured organisms.

Applications of important groups of microalgae, yeast/fungi and bacteria in aqua feeds

S.No	Group	Phylum	Class	Genus	Application
1.	Miroalgae	Chlorophyta	Trebouxiophyceae	Chlorella	Single cell protein
			chlorophyceae	Haematococcus	Bioactive compound
		Heterokonta	Labyrinthulomycetes	Schizochytrium	Single cell oil, Single cell protein
			Eustigmatophyceae	Nannochloropsis	Single cell protein
			Coscinodiscophyceae	Chaetoceros	Single cell oil
			Coscinodiscophyceae	Skeletonema	Single cell oil
			Bacillariophyceae	Navicula	Single cell oil
		Haptophyta	Pavlovophyceae	Pavlova	Single cell oil
			Prymnesiophyceae	Isochrysis	Single cell oil, Single cell protein
		Dinoflagellata	Dinophyceae	Crypthecodinium	Single cell oil
2.	Yeast/fungi	Ascomycota	Saccharomycetes	Saccharomyces	Single cell protein
			Saccharomycetes	Wikerhamomyces	Single cell protein
			Saccharomycetes	Candida	Single cell protein
			Saccharomycetes	Kluyveromyces	Single cell protein
		Mucoromycota	Mortierellales	Mortierella	Single cell oil
3.	Bacteria	Cyanobacteria	Cyanophyceae	Spirulina	Single cell protein
		Proteobacteria	Gammaproteobacteria	Methylococcus	Single cell protein
			Betaproteobacteria	Methylophilus	Single cell protein
			Alphaproteobacteria	Methylobacterium	Single cell protein

Macroalgae

Marine macroalgae also known as seaweeds, which are mostly cultivated across the globe. Around, 90% of seaweed production have been contributed from China and Indonesia. The main culture species of macroalgae are *Eucheuma sp*, *Laminaria japonica*(Japanese kelp), *Gracilariasp*, *Undaria pinnatifida*(Japanese wakame), *Kappaphycusalvarezii* and *Porphyrasp* (Japanese nori). Seaweed has significant amount of crude protein. Wild macroalgae crude protein is highly variable, ranging from less than 1 to 48% of the dry weight depends on the species and their environmental conditions. Generally, >10%inclusion rate of macroalgae shows negative impact on growth and nutrient utilization in aquatic species due to the presence of polysaccharides (up to 76% of dry weight), which is also known as dietary fibre. However, macroalgae is still suitable when incorporated as a functional feed ingredient at low levels and < 10% inclusion level of macroalgae has improved the growth performance of aquatic animals. Additionally, the bioactive compounds of macroalgae are act as health promoter, stress resistant, immune stimulant, feeding stimulant and flavour enhancer in aquatic diets.

Conclusion

The aquafeed industries are believed that fish meal and fish oil are the most promising primary sources of protein and lipid in commercially cultivable fish and shrimp diets. On the other hand, the fish meal and fish oil demand and supply are raising and declining, respectively. Therefore, optimizing the alternatives of protein and lipid for aquafeed is very essential to ensure an economically and environmentally sustainable future for aquafeed industries. Usage of these alternative ingredients for fish meal and fish oil is not only to reduce the production cost of aquafeeds but also reduce the scarcity of food demand in the future.

Can Aquaculture Field School (AFS) be an alternative to traditional approach of fisheries extension?

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What are Aquaculture Field Schools (AFS)?

Aquaculture Field School (AFS) is a school without walls for improving decision making capacity of farming community in aquaculture. It is a participatory extension approach whereby fish farmers are given opportunity to make choice in the methods of aquaculture production through discovery based approach. AFS is composed of a group of farmers who regularly meet. Typical group strength is 20-25. The basic tenets of AFS are: fish farmers are experts; the fish farm is a learning place; fishery extension worker as facilitator not teacher; scientists/SMS (subject matter specialist) work with rather than lecture them; learning materials are learner centered. The principle of AFS is similar to that of Farmers Field School (FFS) implemented in agriculture. It is best described as a 'school without walls', where farmers learn through observation and experimentation in their own fields. This allows them to improve their management skills and become knowledge experts on their own farms. Farmers interact with researchers and extension workers on a demand driven basis, only asking for help where they are unable to solve a problem themselves.

Why Aquaculture Field Schools?

Field school aims to increase the capacity of groups of farmers to test new technologies in their own fields and to assess the relevance of results to their particular circumstances. There is a need to integrate the curriculum of different steps in scientific method of aquaculture like where to rear, when to rear, how to rear, how to harvest,

how to market the product etc. These field schools cover a wide area where the progressive farmers are there and through them the technology of fish culture like culture and seed production of carp, catfish, and air breathing fish, ornamental fish etc. are disseminated.

In promises to provide extension and advisory services and therby reducing the pressure on existing extension machinery. Through the operator farmers, who had excelled in aquaculture venture by using CIFA's technologies, the outreach and dissemination will see manifold increase.

CIFA pilots Aquaculture Field School (AFS)

ICAR-Central Institute of Freshwater Aquaculture (CIFA) has established two field schools in the state of Orissa in the year 2009. One field school is established at Sarakana, Khurda district at the farm of Shri Batakrushna Sahoo and Shri Hrushikesh Panda. Shri B. Sahoo is an innovative farmer recognized at State as well as at National level, trained thousands of aquafarmers through The AFS. Shri Sahoo has been bestowed upon the prestigious 'Padma Shri' and the award is presented to him on 8 November 2021 by His Excellency the President of India at Rashtrapati Bhawan. The other field school is established at Maharatha's Aquavariant Estate, Bhatpadagarh, Banpur, Khurda district at the farm of Shri Manabendra Maharatha. These AFSs were studied in details and their contribution in extension and advisory services has been documented. There has been steady increase in number of AFSs since then and till September 2021 AFS has spread to 17 places in as many as five states- West Bengal, Odisha, Assam, Chattisgarh and Arunachal Pradesh.

List of AFSs established by ICAR-CIFA:

Sl No	State	District	Place	Name of the operator farmer
1.	West Bengal	S 24 Parganas	Sonarpur	Smt. Suniti Mondal
2.	West Bengal	Jalpaiguri	Malkanihat	Shri Bhagirathi Roy
3.	West Bengal	Coochbehar	Chat Elajan	Shri Sanjay Kirtania
4.	West Bengal	Uttar Dinajpur	Fatehpur	Sk. Safiqul Alam
5.	West Bengal	Dakshin Dinajpur	Dumutha Faridpur	Shri Biplab Chandra Roy
6.	West Bengal	24 S Paraganas	Goranbose	Smt. Mamoni Karmakar
7.	Odisha	Nabarangpur	Taragaon	Sk. Irfan Khan
8.	Odisha	Khordha	Sarakana	Sri Batakrushna Sahoo
9.	Odisha	Khordha	Bhatparagarh	Sri Manabendra Maharatha
10.	Odisha	Cuttack	Kochila Nuagaon	Sri Rajesh Ranjan Mahapatra
11.	Odisha	Puri	Astarang	Shri Ullas Kumar Nayak
12.	Odisha	Ganjam	Duba	Shri Susanta Kumar Pradhan
13.	Odisha	Mayurbhanj	Baisinga	Shri Akshaya Kumar Sahu
14.	Odisha	Puri	Subarnapur	Shri Kailash Ch. Sahoo
15.	Arunachal Pradesh	Papum pare	Sonajuli	Shri Tana Nikam Tara
16.	Assam	Kamrup	Bagibari	Sri Jyotish Talukdar
17.	Chattisgarh	Durg	Tirga	Sri Surendra Belchandan

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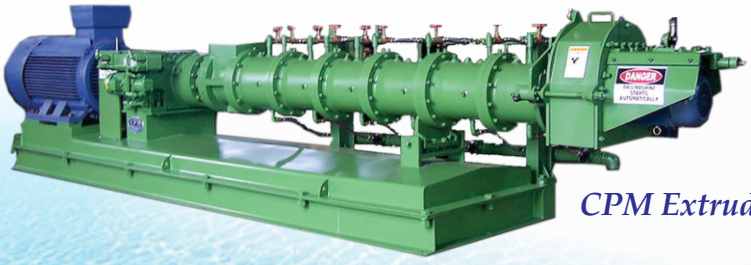

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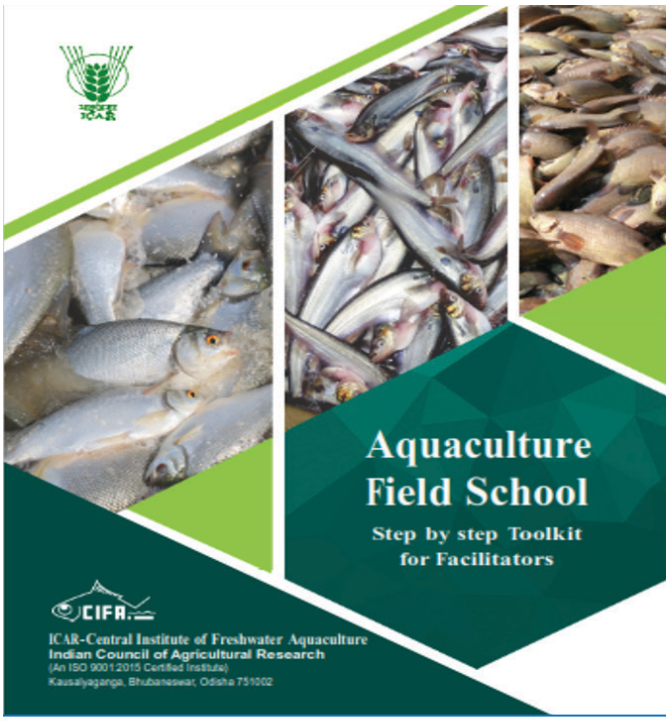
First Ornamental Fish Farmer Field School launched

An Ornamental Fish Farmer Field School was inaugurated on 7 February 2021 at the fish farm of Shri Bhagirathi Roy of Prabhupara village, Sadar block, Jalpaiguri, West Bengal. Shri Sagar Mehra, Joint Secretary (Inland Fisheries & Administration), Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India launched it. It is a unique Farmer Field School that had been established by ICAR-CIFA to promote farmer to farmer learning and dissemination of ornamental fish culture technique for the first time in the country. The school envisages empowering over 500 ornamental fish farmers in 20 nearby villages of North Bengal contributing greatly to the extension and advisory services delivery.

Impact of Field Schools

The AFSs piloted by ICAR-CIFA are the first of its kind in the field of aquaculture. There are FFS on IPM, rice and several other technologies which are promoted by National Food Security Mission and are implemented by State line departments as well as Krishi Vigyan Kendras. AFSs have brought large number of visitors from Orissa and other parts of the country. So much so that the Commissioner of Fisheries, Orissa and other senior officers visited the AFS and appreciated the efforts ICAR-CIFA and the facilitating farmer. Several field days and workshop on community based aquaculture are organized at AFS which is attended by farmers from neighbouring villages. Post - graduate students in fishery are also the regular visitors to these fields schools for gaining practical exposures. Several other researchers have documented the positive impact of field schools.



AFS Toolkit for facilitators

AFS approach relied heavily on non - monetary inputs with technical advice and interaction as primary intervention. Sharing of experiences with the lead farmer at the AFS has brought in confidence among them in scientific fish farming. This approach of 'farmer to farmer' extension with no physical input would certainly be sustainable in the long run. It is suggested that AFS be established in each district enabling the lead farmer to meet the information requirements of fellow fish farmers effectively.

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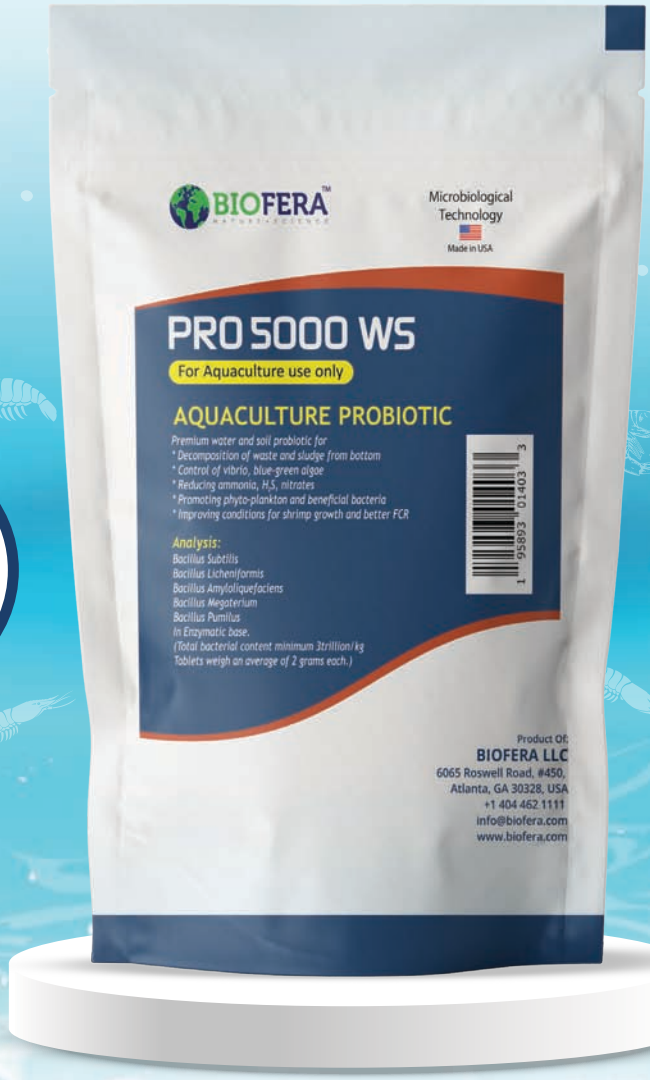

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