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Enhancing farmed fish with specialty lipids

Shrimp farming in wasteland in South Gujarat provides employment to 10,000 tribal workers!

Mangroves: umbilical cord of marine life in Karnataka

Sustainability key to marine ornamental fish trade in India

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AQUA POST

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Need to improve fisheries insurance

India has a long 8000 km coastline that supports the livelihood of almost three crore people associated with fish farming. The community, however, is passing through difficult times. The very coastline has become a bane for them, thanks to unusual extreme weather events in recent times.

No amount of support from the respective state governments could wipe away the tears from their eyes. In recent years, Cyclone Amphan in West Bengal, Tauktae in Gujarat, and Yaas in Odisha had created havocs and almost ruined the fisheries and aquaculture sector in the coastal states. Government aid followed but the fishing businesses both in the east and west coast of India are yet to get back on their feet.

The financial incentives offered are more like a one-time compensation scheme that remains focused on the particular nature of the tragedy. State governments, while supporting the farmers post-tragedy, work to bring immediate relief to the affected familie. But the question which goes unanswered is long-term sustenance and a mechanism to protect them from recurring tragedies. The comprehensive insurance should cover fish insurance, boat insurance, fishery requisites insurance covering nets and gears, hut/ house insurance etc. If we cover inland fish and shrimp farmers, the comprehensive cover should include the ponds and the pond fish insurance.

What would have come tothe relief to the fish farmers in this houris comprehensive and broad-based insurance coverage. Sadly, with no protection available, rebuilding lives have become an endless struggle. Only accidental insurance cover of Rs.5 lakh is not enough as it covers only death/ permanent and partial disability. The sample size is much less. There should be exclusive live cover in the pattern of Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) for the fishers/fish farmers.

The National Marine Fisheries Census of 2016 estimated that over 65 per cent of the fishing families in coastal areas live below the poverty line. They remain the most vulnerable of all the people in the farming industry and yet uninsured. There is a need to frame polices to socially secure the poor fishers besides livelihood issues during ban period.

If a ray of hope had come in the form of the Pradhan Mantri Suraksha Bima Yojana (PMSBY) for fishers, it has been a non-starter from the very beginning, sabotaged by Centre-State wrangling and bureaucratic hurdles. The FISHCOPFED, the implementing agency for last 38 years, has been discontinued. The Centre has assigned the responsibility to NFDB.

In 2020, the Pradhan Mantri Matsya Sampada Yojana (PMMSY) was launched providing coverage of up toRs 5 lakh for accidental injuries or deaths of fishers. But where the scheme lacks focus is that it does not provide coverage for weather-related incidents.

Therefore, the purpose of the scheme remains defeated, unless there is broad-based insurance that offers complete coverage. Further the stakeholders must be associated with the planning process. Awareness training programs for the target group should be taken up in a big way.

Against the backdrop of these challenges, it's prudent for the government to consider a standalone insurance plan for the fishers and fish farmer community. The plan can take into account the rapidly evolving changes in the fishing industry and the impact of climate change. The premium component can be subsidised by the government to reduce the burden on the fish farmers and special mechanisms are ensured for early settlement of claims. This will help the sustainable growth of the sector in the long run.

Bharath Pradhan

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Genetically modified scampi gains an average weight of 30-35 grams in three months

A revolution is unfolding in prawn farming in the Haldia block of West Bengal. For, a genetically improved prawn developed in the labs at CIFA Bhubaneswar has gained an average weight of 30-35 grams in flat three months. It holds the potential of a bumper harvest and redefine the prawn market in days to come.

The genetically improved scampi is indigenous andproving to befast-growing and disease resistant.

Dr Bindu Raman Pillai, Principal Scientist and Head, Aquaculture Production and Environment Division, ICAR-CIFA and her team have developed the GI-scampi at Bhubaneswar through genetic selection in collaboration with World Fish, Malaysia.

"We are conducting monthly sampling in the farmers' field and the result indicated that GI-scampi has gained an average weight of 30-35 g in just 03 months along with carps in polyculture system. The growth of GI-scampi is satisfactory and we are hopeful that the outcome after this culture period will encourage other farmers to adopt", said Dr Farhana Hoque. He is a scientist at Regional Research Station-Rahara, ICAR-CIFA.

The first on-field demonstration of genetically improved scampi (GI-scampi) in carp-scampi polyculture model was started in West Bengal at Haldia Block from August 2021 by ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA) under Pradhan MantriMatsyoSampadaYojana (PMMSY) funded project.

A team led by DrHoque and Suman Kumar Sahu, Fishery Extension Officer, Haldia visited the four adopted farmers' field at Haldia on Friday.

East Midnapore is known for its giant freshwater prawn culture. Farmers in the region prefer to culture non-indigenous white leg shrimp Litopenaeusvannamei for higher profits. Incidences of disease, however, are causing a significant production loss. At such as time, the genetically improved scampihas proved a boon for them.

To assess the performance of this newly developed, fast-growing scampi in the farmer's field, an on-field demonstration programme was initiated in different states of India.

In West Bengal, four farmers: SuvenduBallav of Barabarivillage, KrishnaprasadSamanta of Dighasipur village, SubhrajyotiSahu of Bamunchak village and Pabitra Mukherjee of SobharampurDebhog village of Haldia block were adopted for the demonstration.

The farmers received inputs of all kinds like manure, lime, fish feed, fertilizer, and Indian major carps for the demonstration.

The seeds of GI-scampi were supplied from ICAR-CIFA Bhubaneswar in August in the presence ofSanjay Das, BDO, Haldia Block, Dr Debabrata Panda, Scientist CIFA, Suman Kumar Sahu, FEO Haldia, Mr Gakul Maji, Karmadhakshya Haldia Panchayat Samity.

"We are extremely happy. We are getting all types of support and guidance from Dr Hoque and FEO sir for scientific polyculture of GI-scampi along with carpsfrom July onwards. We are getting good growth of this scampi and this will help us in making profit. Their constant support even encouraging us to culture other improved varieties of fish", said Pabitra Mukherjee, one of the adopted farmers.

Suman Kumar Sahu, Fishery Extension Officer Haldia Block said that the Fisheries Department has always supported fish farmers in the development of fish farming and is working to expand eco-friendly scientific fish farming.

Fishermen in Kerala harvesting 10 tonnes black clam per day

Kochi: Fishermen in the Vembanad Lake, Kerala have started harvesting about 10 tonnes of black clam per day, a new feat, with the efforts of the CMFRI.

Aimed at boosting the clam fishery and enhancing livelihood options for the clam fishers in the region, the Molluscan Fisheries Division of CMFRI re-laid (stocked) baby clams after identifying suitable areas on the northern side of the Thanneermukkom Barrage.

CMFRI's initiative of relaying baby clams in various sites in the Vembanad facilitated increasing the clam production which in turn helped the fishermen to harvest around 10 tonnes of clam per day from two areas of the lake, said a media statement.

According to the CMFRI scientists, the initiative is expected to yield nearly 1500 tonnes from these sites which are more than 7-fold of the re-laid baby clams.

The long undisturbed period of nearly two years facilitated at least two spawnings followed by spat settlement leading to the establishment of a new black clam bed in the Lake and thus enhancing the clam resource, said Dr P Laxmilatha, Head of Molluscan Fisheries Division (MFD) of CMFRI.

Relaying of baby clams led to the establishment of the resource in these areas spreading around 20 hectares and helping fishers harvest adult clams with a good growth rate, she said.

"The production of black clams declined from a peak of 75,592 tonnes in 2006 to 42036 tonnes in 2019 in Vembanad Lake. Low production owing to multiple reasons and the pandemic have had a cascading effect on clam fishers along Vembanad Lake", Dr Laxmilatha added.

Reaping the benefits out of this, fishermen under the Keecheri Ulnadan Matsya Thozhilali Sahakarana Sangham now collect the clams using canoes from re-laid locations and sell the clam meat for Rs 150 per kg in the nearest market. Each canoe collects 450 kg of clams per day.

Dr Vidya R, Scientist of the MFD, CMFRI who led the project said that apart from increasing the production of clams in the area, the relaying helped clam fishers to sustain their livelihood during the tough pandemic period.

"Nearly 5000 fishermen are involved in black clam fishery in the Vembanad Lake", she said adding that the clam rejuvenation programme greatly helped increase the production in the backwaters that provided a lifeline to the fishers depending on clam resources in the area.

CMFRI Kochi extends support to fish farmers become entrepreneurs

In a major attempt to transform the lives of scheduled caste families in Cheranellur, Ernakulam, the Central Marine Fisheries Research Institute (CMFRI) extended support to the SC community to help them become self-reliance entrepreneurs through innovative biofloc fish farming on 26.11.2021.

The CMFRI provided to members of five SC families in the area with all the necessary support to launch a biofloc fish farming unit under the scheme of Scheduled Caste Sub Plan (SCSP). The self-help group named 'Sreelakshmi' with these families as members began the aquaculture practice by stocking 1800 Genetically Improved Farm Tilapia (GIFT)

seeds into a 5 diameter biofloc tank set up adjacent to their households. CMFRI's assistance includes basement work, setting up of the tank with a volume of 23,500 litres of water and related facilities like aeration system, fish seeds, feeds and scientific and technical guidance. The self-help group will be able to earn an income of at least Rs. 1.35 lakh from 8-month-long farming period, within which the fish will attain weight of 300 to 500g. Biofloc technology is a scientific method for high-density fish farming in a controlled environment in which fish wastages are converted into useful nutrients. The system is also integrated with horticulture crops to utilize the fish waste as fertilizers.

Under the SCSP scheme of the CMFRI, the cage fish farming is being undertaken by members of the SC community across the country, and biofloc farming is aimed to extend the benefits of this scheme to those who do not have access to open coastal waters and brackish water bodies for cage fish farming. This innovative biofloc fish farming is underway in Palakkad, Thrissur, Idukki, Kottayam and Kollam districts under SCSP&TSP scheme with CMFRI's guidance and harvest were also carried out successfully during the period of covid pandemic.

Cheranellur Panchayat Vice President Smt. Arifa Muhammed, Shri. A N Radhakrishnan, and ward member Ansar V B and officials from CMFRI also attended the function. During the occasion, seed, feed, water testing kits, nets and other accessories were handed over to the beneficiaries. The GIFT seeds were procured from MPEDA's hatchery in Vellarpadam. CMFRI will monitor and provided guidance at different phases of biofloc fish farming at farmers field on day today

ICAR-CIBA signs MoU with Shree Rudra Animal for tech transfer of eco-friendly biofloc based shrimp farming

ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) signed Memorandum of Understanding (MoU) with M/s Shree Rudra animal health Pvt. Ltd., East Godavari District, Andhra Pradesh for eco-friendly biofloc based multi-phased nursery/grow-out shrimp farming technology transfer on 27th November, 2021.

During the occasion Dr. K.P. Jithendran, Director, ICAR-CIBA highlighted the importance eco-friendly and sustainable farming practices to the Indian shrimp industry and potential of such technologies in ensuring intensification and high-density farming. He described the scientific strength of the institute in biofloc technology and assured of providing all required support for the successful implementation of this programme.

Mr. S. Srikanth Sudheer Reddy, Managing Director, M/s Shree Rudra animal health Pvt. Ltd., East Godavari District, Andhra Pradesh, expressed their commitment in the program and working towards an eco-friendly aquaculture.

Dr. A. Panigrahi, Principal Scientist and Team leader briefly explained about the significance of this MoU. He articulated that by manipulating the carbon to nitrogen (C: N) ratio in the culture system which facilitates the production of beneficial microbial biomass that absorbs the nitrogenous wastes in the pond water for its multiplication and biofloc development which itself is an in situ feed source for the growing shrimp. Biofloc facilitates in keeping the water quality clean and reduces the external application of feed thereby reducing the cost of production. Dr. Kumaraguru Vasagam, Principal Scientist, Officer-in-Charge of PME and team members of ITMU of CIBA coordinated the programme. Dr. T.N. Vinay, Scientist, Crustacean Culture Division proposed the vote of thanks.

CMFRI introduces biofloc fish farming to SC families of Ernakulum for self-reliance

The Central Marine Fisheries Research Institute (CMFRI) has launched an initiative to make the fishermen families belonging to the Scheduled Caste community in Cheranellur, Ernakulam self-reliant in biofloc fish farming practices and become entrepreneurs.

The programme has been launched on November 26 in association with self-help group Sreelakshmi.

Biofloc technology is a scientific method for high-density fish farming in a controlled environment in which fish wastages are converted into useful nutrients. The system is also integrated with horticulture crops to utilize the fish waste as fertilizers.

CMFRI is providingthe members of five SC families in the area with all thenecessary support to launch a biofloc fish farming unit under the scheme of Scheduled Caste Sub Plan (SCSP).

The families have begun the aquaculture practice by stocking 1800 Genetically Improved Farm Tilapia (GIFT) seeds into a 5 diameter biofloc tank set up adjacent to their households. The assistance from CMFRI includes basement work, setting up of the tank with a volume of 23,500 litres of water and related facilities like aeration system, fish seeds, feeds and scientific and technical guidance.

CMFRI will monitor and guide different phases of biofloc fish farming at the farmers'fields.

The self-help group will be able to earn Rs 1.35 lakh from the 8-month-long farming period, within which the fish will attain a weight of 300 to 500g, said a CMFRI statement.

Under the SCSP scheme of the CMFRI, cage fish farming is being undertaken by members of the SC community across the country, and biofloc farming is aimed to extend the benefits of this scheme to those who do not have access to open coastal water and brackish water bodies for cage fish farming, the statement said.

Similar biofloc fish farming practice is underway in Palakkad, Thrissur, Idukki, Kottayam and Kollam districts under the SCSP&TSP scheme with CMFRI's guidance. The harvest was also carried out successfully during the covid pandemic.

Cheranellur Panchayat Vice President Arifa Muhammed, A N Radhakrishnan, ward member Ansar V B and officials from CMFRI also attended the launch function.

Seed, feed, water testing kits, nets and other accessories were handed over to the beneficiaries on the occasion. The GIFT seeds were procured from MPEDA's hatchery in Vellarpadam.

Fisheries Min encourage researchers to develop cost-effective tech for fish farming during ICAR-CIFA, Bhubaneswar visit

Bhubaneswar: Union Minister of Fisheries, Animal Husbandry and Dairying Parshottam Rupala has stressed the development of cost-effective technologies that can give more benefits to the fish farmers in the country.

During an interaction with researchers at ICAR-Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar on World Fisheries Day, he motivated them to develop such cost-effective solutions and reviewed freshwater aquaculture research activities being carried out by the institute.

During his visit to the CIFA farm facilities, he was apprised about 23 different food fish varieties like genetically improved rohu 'jayanti', catla, scampi, minor carps, catfishes, murrel, anabas, pearl mussel etc. and different aquaculture systems such as pond culture, bio-floc and aquaponics. Different gadgets,

feed formulations, therapeutics developed by the institute were also displayed, said a statement.

An exhaustive display of different publications was arranged to showcase the knowledge products of the institute available for the farmers.

Dr J.K. Jena, Deputy Director-General, Fisheries Science, ICAR and Dr Saroj Kumar Swain, Director, ICAR-CIFA briefed the minister about the different technological options available for the farmers.

Going through the display of ornamental fishes, Rupala expressed interest in the different varieties of ornamental fishes and suggested scaling-up ornamental fish farming in the country, the statement said.

He visited the Krishi Vigyan Kendra - Khordha inside the ICAR-CIFA campus during his visit where ten successful women self-help group members displayed their products in an exhibition including honey, handicrafts, value-added products, vermi-compost, incense stick, mushroom, applique work etc.

The Minister interacted with the SHG women, noted their issued and expressed happiness that KVK is promoting such income-generating activities among women for strengthening their livelihood. He interacted with the successful farmers and entrepreneurs facilitated by the KVK-Khordha.

He also felicitated ICAR-CIFAs farmer Padmashri Batakrushna Sahoo on the premises of KVK-Khordha. Sahoo, a pioneer fish farmer from Odisha, received the Padmashri award on November 8 this year. He is an innovative aquafarmer who adopts and experiments with new aquaculture methods. Many of the technologies developed in ICAR-CIFA were tested and refined on his farm. The minister applauded his contributions and urged him to motivate the youngsters to take up fish farming.

The Minister also felicitated the IARI awardee farmer Surendra Bhola for his exemplary contribution to fisheries. Earlier, Dr S K Swain, Director, ICAR-CIFA welcomed the Minister and other dignitaries. The minister was in the city to grace the World Fisheries Day celebrations.

Balasore bags best marine dist award; AP best marine state

Balasore in Odisha was awarded the Best Marine District in the country on the occasion of the World Fisheries Day celebration on November 21.

Andhra Pradesh was awarded the Best Marine State while Best Inland State Award was given to Telangana. The awards were presented in Bhubaneswar by Union Minister for Fisheries, Animal Husbandry and the Dairying ParshottamRupala.

Balaghat in Madhya Pradesh received the Best Inland District award; and the Best Hilly and Northeastern State and District awards were bestowed on Tripura and Bongaigaon, Assam respectively.

The fisheries sector has highgrowth potential and the government is providing necessary support to achieve the one lakh crore export target from the sector by 2024-25, the Minister said.

Rupala called for greater awareness on Kisan Credit Card (KCC) and said the government has extended KCC support to the fishermen and women. The government will soon start a massive campaign to raise greater awareness of KCC.

Minister of State for Fisheries, Animal Husbandry and Dairying Dr L. Murugan said Prime Minister Narendra Modi envisaged a separate ministry for the fisheries sector and since then in a short period, the potential of the sector has been realized and the country now has set the ambitious target of achieving one lakh crore income from the sector.

He said thatParadip is among the five major ports being developed as Major Fishing Harbours.

Fisheries business incubation centre inaugurated at Gurugram

Union Minister of Fisheries, Animal Husbandry and Dairying Parshottam Rupalaon November 16 inaugurated a dedicated business incubator 'LINAC-NCDC Fisheries Business Incubation Centre (LIFIC)' in Haryana's Gurugram.

The first-of-its-kind centre has been set up at an investment of Rs3.23 crore to nurture fisheries start-ups under real market-led conditions.

Rupala said that the incubation unit will provide handholding such as training, converting entrepreneurial ideas into business models and providing seed money to the new as well as existing business entrepreneurs keen to make big in the segment.

The Centre, he said, will serve as a 'milestone' in future for the fisheries sector that is being given a big push under the central flagship Pradhan Mantri MatsyaSampada Yojana (PMMSY).

The National Cooperative Development Corporation (NCDC), an implementing agency for the LIFIC, has identified the first batch of ten incubators from four states—Bihar, Himachal Pradesh, Gujarat and Maharashtra. Out of them, 6 are from newly-created Fish Farmers Producer Organizations with the support of the financial grant under the PMMSY.

"Unlike in the dairy sector, cooperative societies are yet to make their presence felt in the fisheries segment. That is why a separate Ministry of Cooperation has been established so that cooperatives in various sectors including fisheries get a boost and help attain the Prime Minister's vision of achieving Atmanirbhata (self-reliance), the Minister said.

He said the government will soon start a drive to provide credit cards on the line of Kisan Credit Cards (KCCs) to the fishermen and those involved in the livestock business as well.

Minister of State for Fisheries, Animal Husbandry and Dairying Dr L Murugan said that the Centre would ensure that the fisheries sector helps push the income of the stakeholders.

"Fisheries is a sunrise industry in India, growing at 7 per cent rate annually. The Prime Minister has set a goal of 22 million tonnes of fish production and export to the tune of Rs one lakh crore by 2025. It is a very tall order to be achieved within the next four years given that presently, fish production is 130 lakh tones and export worth Rs 46,000 crore.Setting up this first business incubation centre for fisheries in India is a step in this direction to achieve the ambitious goal. We need to work on the promotion of lots of innovation for start-ups, incentives and encourage cooperatives in the fisheries sector to achieve the targets," said Jatindra Nath Swain, Union Fisheries Secretary.

Overall, there are around 30,000 cooperatives in the fisheries sector. "It's a purely business centre and not merely a technology centre or accelerator," NCDC MD Sundeep Nayak said, adding the initiative shall primarily focus on converting entrepreneurial ideas into business models and then support the launch of business operations.

LIFIC shall also handhold the enterprises while negotiating a myriad of market dynamics to result in sustainable revenue generation and business operations in the sector.One critical input, credit linkage, may be provided to the successful incubators.

Govt dismisses move to privatize fishing sector

The government has no proposal to privatize the fisheries sector, Union Minister of Fisheries, Animal Husbandry Dairying ParshottamRupala has said.

In a written reply in Lok Sabha during the ongoing Parliament session, he also that the Ministry of Earth Sciences (MoES) is steering the draft National

Policy for India's Blue Economy-2021 (NPIBE-2021) as the nodal Ministry and it is under consideration.

The Minister's reply on the privatization issue has put a lid on the speculations in some quarters about the moves to throw open the sector into the private sphere.

The Minister said that his department has been implementing policies and schemes for the sustainable development of the fisheries sector. Besides the National Policy for India's Blue Economy-2021, the government has approved the flagship Pradhan Mantri MatsyaSampada Yojana(PMMSY).

The National Policy on Marine Fisheries, 2017 has also been notified, providing guidance to explore and sustainably use oceanic fishery resources in the Exclusive Economic Zoneof India.

The government of Indiaalso advise the coastal states and union territories from time to time to issue necessary orders to prohibit destructive fishing methods including LED light fishing, pair/bull trawling, the Minister said.

In addition, a uniform fishing ban is implemented in the Indian EEZ for 61 days on the east coast and the west coast. However, the traditional non-motorized fishing vesselsare exempted, he added.

Fisheries Sector stresses transformation of waste land into wealth land

Union Fisheries Secretary Fisheries Jatindra Nath Swain stressed on converting 'waste land in wealth land' with technology infusion, training and capacity building of farmers.

Addressing a webinar on the 'Promotion of Inland Saline Water Aquaculture' on November 5, he also emphasised providing market linkages to farmers, availability of quality seed, feed and good aquaculture practice. He said this while highlighting the components such as these under Pradhan Mantri Matsya Sampada Yojana (PMMSY) for the promotion of agriculture.

This was the eighth webinar in the series and a part of the celebration of Azadi ka Amrit Mahotsav. It was organised by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying.

Sagar Mehra, Joint Secretary (Inland Fisheries) highlighted the present status and potential of aquaculture in saline waters of Haryana, Panjab, Rajasthan and Uttar Pradesh. He said that PMMSY has envisaged an investment target of Rs. 526 Crore during 2020-21 to 2024-25 for development of saline water aquaculture while generating 3 lakh employment opportunities.

He elaborated the importance of cluster development models in these states for providing one-stopsolutions with the development of facilities like testing laboratory networks, feed plants, cold chain and marketing infrastructure to reduce production cost accompanied by promoting the adoption of technologies like RAS, biofloc etc.

Dr J. Balaji, Joint Secretary (marine Fisheries referred to thechallenges at hand in the development of inland saline water aquaculture and underlined the importance of quality seed, entrepreneurship model, organic shrimp aquaculture and for sustainable development of saline aquaculture in these four northern States.

During the technical session, Jose Antony, Scientist, NGRC, Gujarat of ICAR-CIBA made a comprehensive presentation on 'Promotion on Inland Saline Water Aquaculture' and emphasized on status, issues and future of inland saline water aquaculture in the fisheries sector while discussing the current status of inland shrimp farming and issues such as site selection, lack of laboratory & technology support etc.

The webinar began with the welcome address by Shri I. A. Siddiqui, Fisheries Development Commissioner, DoF.

Enhancing farmed fish with specialty lipids

By Ng Chee Kiat & Jacky T H Ku
J F NUTRITECH SDN BHD

Introduction:

The role of feeds in driving the growth of animal production is well acknowledged and as such the choice of materials in designing diets need to be both effective and sustainable. With the increasing diversity of farming conditions and increasing threats towards sustainability of farmed stocks, there is a growing need to design feeds to cater for the specific needs of the farmed species.

Feed standards increasingly discourage the use of fish oil and its replacement with vegetable oils. This is also well documented. World vegetable oil production is currently about 190 million metric tonnes (mmt) for which palm derived oils account for about 30 per cent (65 mmt). The potential benefits of palm oil as a lipid source for animal feed diets have been promoted widely.

Recent developments in the processing technology of palm oil have enhanced its status as a prime ingredient for meeting the fatty acid requirements of farmed fish and also to act as both growth promoters and quality enhancers. The article talks about different solutions with the potential for enhanced production.

Nutritional Benefits of Palm Oil

Palm oil is a well recognized sustainable source of lipidsthat has a good balance of saturated and unsaturated fatty acids which makes it a healthy source of dietary lipids. It also contains key

Vitamin E (600-1000 ppm)	• Anti-cancer effects • Anti-angiogenesis • Antioxidant • Anti-arterosclerosis • Anti-ageing • Inhibition of cholesterol synthesis • Cardio-protection effects • Aid diabetes
Carotenoids (500-700 ppm)	• Pro-vitamin A activity • Cardio-protection effects • Anti-cancer
Phytosterols (300-620 ppm)	• Cholesterol lowering properties
Squalene (250-540 ppm)	• Cardio-protective effects • Inhibition of cholesterol synthesis • Anti-cancer
Phospholipids (20-100 ppm)	• Brain development • Energy endurance • Eases digestion and nutrition absorption
Co-enzyme Q10 (10-80 ppm)	• Enhance production of cellular energy • Antioxidative defence mechanism • Cardio-protective effects • Anti-cancer
Polyphenolics (40-70 ppm)	• Cholesterol inhibition • Aids various circulation problems • Anti-cancer

Key nutrients known to be available in palm oil include Vitamin E, carotenoids, phytosterols, squalene, phospholipids, co-enzyme Q10 and also polyphenolics.

Many of these phytonutrients has beneficial effects on aquatic animals like improving growth and survival under farmed conditions.

Phytonutrients with health benefits in palm oil

Source: Malaysian Palm Oil Board

phytonutrientsembedded within its matrix of fatty acids which provides a host of health benefits.

Balanced Fatty Acid Profile

Palm oil has a well balanced fatty acid profile with equal amounts of saturated and unsaturated fatty acids which makes it the most common vegetable oil used for human consumption today. It has equally beneficial effects on blood cholesterol as olive oil, and a fatty acid profile similar to sunflower oil.

Vitamin E &Beta Carotene

The high level of Vitamin E provides feeds with a good source of natural antioxidants. The use of carotenoids as a feed additive is already widely practised, which also suggests the increasing trend of using naturally produced carotenoids versus those from synthetic sources. The inclusion of carotenoids in fish diets has traditionally been aimed towards improvement in pigmentation but reports show that beta carotene also enhances the growth and survival of fishes in farmed conditions.

Medium Chain Triglycerides (MCT)

The use of organic acids in animal feeds as a growth promoter is well tested and gaining popularity towards developing functional antibiotic-free diets. Medium-chain fatty acids (MCT) like lauric acid (C12:0) are widely reported for their anti-bacterial activity as is linoleic acid (C 18:2). While lauric acid is abundant in palm kernel oil, linoleic acid is available in significant portions of palm oil.

Phytonutrients

Palm oil is also rich in phytonutrients including phytosterols, squalene and co-enzyme Q10. Phytosterols which is necessary for cholesterol synthesis for shrimp growthis present at concentrations of 500 ppm or more. Squalene which is found in an equally high amount aids in oxygen transfer to tissues which promotes metabolism and

Specially designed machinery (right) allows for low-temperature separation of palm olein to retain the phytonutrients.

growth. Co-enzyme Q10 is well documented as crucial for the normal growth and development in animals.

Specially designed machinery (right) allows for low-temperature separation of palm olein to retain the phytonutrients.

Low-Temperature Processing of Palm Oil

Conventional processing of crude palm oil usually involves high temperatures and requires more than 24 hours to complete. Phytonutrients are however heat sensitive and as such many of these nutrients are lost when crude palm oil undergoes the conventional refinery process.

Using refined processing techniques at low temperatures, the natural goodness of palm nutrients is not only retained but also enhanced, improve and used as a superior feed ingredient. This results in the production of nutrient-enriched fractions of both Olein and Stearin which is very rich in beta carotene and tocotrienols.

Nutrient enhanced Olein and Stearin derivatives from JF Nutritech patented process

Nutrient enhanced Olein and Stearin derivatives from JF Nutritech patented process

Perfat Ruby

The nutrient- enriched fractionated olein products marketed as Perfat Rubyis used to targeting the animal feed sector, where its application can improve growth, survival, feed efficiency, pigmentation and also improvement in tissue quality. The products are differentiated according to the levels of Vitamin E and Beta Carotene to suit the different matrix of farmed animals.

Perfat Ruby 1500 and 2500 allows feed manufacturers to be more competitive and sustainable in driving the growth of aquaculture because of the high concentration of natural phytonutrients and

Product Name	Description	Beta Carotene (min)	Vitamin E (min)
Perfat Ruby 500	Premium Red Oil	500 ppm	400 ppm
Perfat Ruby 1000	Premium Red Oil	1000 ppm	800 ppm
Perfat Ruby 1500	Premium Red Oil	1500 ppm	1200 ppm
Perfat Ruby 2500	Premium Red Oil	2500 ppm	2000 ppm

antimicrobials, which will further improve the efficiency and functionality of the aquaculture feed. The efficacy of Perfat Ruby is best achieved by injection of the lipids by post pelletizing.

Advantages of Perfat Ruby in Aquaculture

Perfat Ruby(PR) oils have been shown to improve both the feed performance and the farm productivity in shrimp farms based on data from trials carried out in commercial farms over the last 12 months. The benefits of using Perfat Ruby can be summarized as follows.

Improved shell quality and pigmentation

The shell quality of Black Tiger shrimp (Penaeus monodon) has an improvement in the smoothness; firmness and pigmentation in just 14 days after shrimp have been fed with PR 2500 at inclusion levels of 6 per cent in commercial shrimp feed.

Quality improvement observed in farmed Black Tiger shrimp after feeding with Perfat Ruby coated feed for 14 days (middle) and 33 days (top) as compared to normal uncoated feed (bottom)

Improvement in growth and survival

There has been improvement in the shrimp hepatopancreas based on a study of 30 days based on harvest data and also analyses of shrimp juveniles in commercial ponds. Shrimp fed with PR 2500 showed little incidence of inflammation in tissue samples and there was no presence of the green colonies of Vibrios in the shrimp samples that were fed PR 2500 coated feed.

Uncoated Shrimp Feed

PErfat Ruby 2500 Feed

Improvement in protein availability and feed efficiency

The higher levels of fat inclusion resulted in the continued growth of shrimp, suggesting there is a protein-sparing effect which leads to better utilization of the protein available in shrimp feed for growth.

Better feed pellet stability

Shrimp feed pellets were also more stable in water as a result of the PR 2500 coating which created a protective layer that improved the physical integrity of the pellet when in water. The special properties of PR 2500 allowed the nutrients in the feed to be available to shrimp for longer periods while not reducing its attractiveness or palatability to shrimp.

Water clarity after soaking pellets in water for 30 minutes show PR 2500 gives better pellet stability

Lowering of Feed Conversion Ratio (FCR)

With improvements in feed efficiency and better water stability, there will be a reduction in the FCR (Feed Conversion Ratio) values for ponds fed with PR coated feeds. Farm trials show that FCR values as low as 1.15 can be achieved even at productivity levels

Pond harvest summary in shrimp (Penaeus vannamei) ponds fed with PR 2500

Farm Details

Name:	Sikap Intan
Location:	Bagan Datok, Perak
Type of pond:	Concrete, circular tank
Date stocked:	18th November 2020
Source of PL:	CP
Feed type:	CP
PR Type:	Perfat Ruby 2500

Production Summary

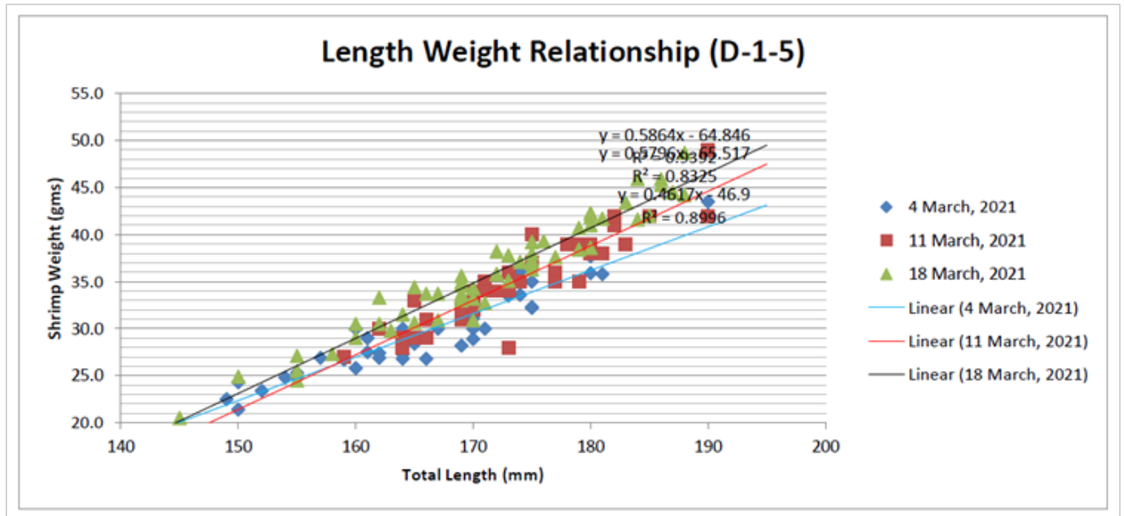
Pond No : A 6		
Date of stocking	18-Nov-20	
Pond Size	800	sq m
Stocking number	200,000	
Stocking weight		kgs
Shrimp weight		gm
Harvest weight	4,073.00	kgs
Harvest Survival	85.98%	
Total Feed	4,569.00	kgs
FCR	1.12	
Density	5.09	kgs/sq m
Date of harvest	22-Jan-21	
Culture days	65	
Date of PR feeding	1-Jan-21	
Average Daily Gain	0.45	
Weight at Final Harvest	29.07	
Days of Feeding on PR	21	

Farm Details

Name:	Sikap Intan
Location:	Bagan Datok, Perak
Type of pond:	Concrete, circular tank
Date stocked:	23rd October 2020
Source of PL:	CP
Feed type:	CP
PR Type:	Perfat Ruby 2500

Production Summary

Pond No : B 4		
Date of stocking	23-Oct-20	
Pond Size	1,600	sq m
Stocking number	300,000	
Harvest weight	7,416.70	kgs
Harvest Survival	91.49%	
Total Feed	8,591.00	kgs
FCR	1.16	
Density	4.64	kgs/sq m
Date of harvest	4-Jan-21	
Culture days	73	
Date of PR feeding	22-Dec-20	
Average Daily Gain	0.45	
Weight at Final Harvest	33.11	
Days of Feeding on PR	13	



Improvement in water quality

With better water stability, there is reduced leaching of water-soluble amino acids from the shrimp pellet which results in a reduction in nitrogen loading in the pond water. This is obvious from the reduced amount of foaming observed on the water surface. This results in better water quality which leads to faster shrimp growth and better survival.

Foaming in pond fed with normal feed (foreground) as compared with PR coated feed (background)

Better meat quality and muscle formation

Shrimp fed with PR coated feed also shows better meat quality and muscle formation. In farm trials, the length-weight relationship of shrimp showed gradual improvement as shrimp were fed with PR coated feeds.

Improvements in Length – Weight ratio for shrimp fed with PR coated feeds

Studies on shrimp tissue after feeding with PR 2500 also showed a significant increase in both the beta carotene and also tocotrienol content when compared to that for shrimp fed normal feed. This suggests that Perfat Ruby can help to improve the healthiness of shrimp in the consumer diet.

alphaLAB Alpha Testing Labs (SA0175373P) Certificate of Analysis

Sample	Test Parameter	Test Method	Unit	Result
Control				
1	Beta Carotene	HPLC	ppm	0.41
2	Vitamin E (tocopherol)	HPLC	ppm	6.5
3	Vitamin E (tocotrienol)	HPLC	ppm	3.3
Treated with Perfat Ruby 2500				
1	Beta Carotene	HPLC	ppm	0.64
2	Vitamin E (tocopherol)	HPLC	ppm	6.9
3	Vitamin E (tocotrienol)	HPLC	ppm	6.2

alphaLAB Alpha Testing Labs (SA0175373P) Certificate of Analysis

Sample	Test Parameter	Test Method	Unit	Result
Control				
1	Beta Carotene	HPLC	ppm	0.15
2	Vitamin E (tocotrienol)	HPLC	ppm	2.5
Treated with Perfat Ruby 2500				
1	Beta Carotene	HPLC	ppm	0.59
2	Vitamin E (tocotrienol)	HPLC	ppm	3.8

Beta carotene and tocotrienol levels in both Pacific White (left) and Black Tiger (right)shrimp after feeding on PR coated feeds for 30 days compared to shrimp fed normal feed.

Prevention of rancidity in feeds

Both beta carotene and Vitamin E are very strong anti-oxidants and apart from the beneficial role they provide towards shrimp growth and survival, they also act to prevent rancidity in shrimp feed.

Coating of Shrimp Feed

One important aspect when considering the inclusion of Perfat Ruby in shrimp feed is the heat sensitivity of the nutrients, particularly beta carotene. For this reason, we have found that the best way to enhance shrimp feeds is to add Perfat Ruby after the pelletizing process by injection at room temperatures.

JF Nutritech currently has the technology to effectively inject Perfat Ruby in shrimp feeds which will allow the shrimp to have access to the necessary nutrients required for better growth, survival and resulting in better profitability for shrimp farmers.

Conclusion:

Along with palm oil that has a treasure of rich properties of diatary lipids and promotes enhanced aqua production, nutrient-enriched fractionated olein products such as Perfat Ruby that can significantly improve growth, feed efficiency, pigmentation and tissue quality. Shrimp fed with PR coated feed also shows better meat quality and muscle formation. All in all, the efficacy of Perfat Ruby is best achieved by injection of the lipids by post pelletizing.

(The author can be contacted atck@ jfnutritech.com)

Shrimp farming in wasteland in South Gujarat provides employment to 10,000 tribal workers!

Once a wasteland with high salt content, south Gujarat has seemingly emerged as a key shrimp production hub over the years. The journey has been quite eventful over the years and behind the growth, lay the vision of a farmer who could see gold in salt.

Dr Manoj Sharma has earned his name in the aquaculture industry, not only as an aquaculture expert and placing the state in the aqua map of the country, but also generating employment opportunities for lakhs, thousands of whom have migrated from far away Odisha.

The story began in 1994 when he developed four shrimp ponds in Olpad, an initiative that, later on,laid the foundation of the shrimp industry in Gujarat. The place became a pivot for shrimp cultivation, the creation of farmers groups and the eventual establishment of the Gujarat Aquaculture Association, an umbrella unit off all coastal fishermen.

As shrimp farming began to grow in the region, labourers from a north Odisha district called Sundargarh came in droves to work on his farm.

"It so happened that Dr Sharma engaged a tribal from a village in the district to carry out the task of feeding in shrimp ponds. After the success of the shrimp ponds, he

went back to his village and spread words about the development of shrimp cultivation in Gujarat and how it can bring employment to thousands of people; shrimp farming being a labour-intensive job. As the next crop commenced, the labourer brought five more workers with him. These five labourers then attracted another 500, a number which in course of time went up to 10,000," people associated with the growth of the industry there said.

Today, the shrimp industry in south Gujarat has transformed the livelihood of two lakh coastal fishermen and rural people. It has also generated hope in distant places such as Odisha, a state whose contribution to the industrialization of Gujarat cannot be overstated.

In 2019, the total shrimp cultivation in Gujarat stood at 45,000 tonnes, the bulk of which comes from south Gujarat. It has become the third-largest shrimp producing region in western India and also the third-largest shrimp production hub after Andhra Pradesh and West Bengal. As per reports, the region's annual turnover stood at Rs 2000 crore.

Dr Sharma, who is a progressive shrimp farmer and expert, had said at a conclave earlier this year that there is a huge scope to expand shrimp farming in south Gujarat as only 2 per cent of the 3.75 lakh brackishwater land, at present, is under cultivation. Moreover, he said the farmers who are directly involved in shrimp farming provide employment to 25000 people and indirect employment to 30,000 people.

For the workers, shrimp farms are much more than a place for employment. DrSharma has ensured that the labourers lead a comfortable life in these places. With this in mind, all the firms are equipped with dormitory facilities, kitchen and toilets. On the nutritional front, the labourers are provided healthy protein-rich food on daily basis.

Mangroves: umbilical cord of marine life in Karnataka

By Rajesh, D.P., H.N. Anjanayappa and A.S. Kumar Naik

Mangroves not only support life but also maintain the fragile ecosystem and shield the population from natural events. This article seeks to discover the critical role played by mangroves in maintaining a healthy aquatic life and underlines the importance of conserving the mangrove ecosystem.

The coastal ecosystem provides a wide array of goods and services. They host the world's primary ports of commerce; they are the primary producers of fish, shellfish, and seaweed for both human and animal consumption. They are also a considerable source of fertilizer, pharmaceuticals, cosmetics, household products, and construction materials.

India has approximately 700,000 ha of the area covered by mangroves along the estuaries and major deltas. Mangroves are salt-tolerant plants of tropical and subtropical intertidal regions of the world.Besides ecological importance in trapping and accreting sediment material to reduce the erosion, mangrove ecosystem plays a significant role in aquaculture. The fishery potential of these areas is tremendous and provide a livelihood to the coastal population as well.

Mangroves are trees and shrubs that grow in the saltwater environment found mainly in hot climatic regions. The largest mangrove cover is found in Sunderbans, West Bengal that boasts a variety of living organisms from tiger to turtle. Mangrove is a specialized marine ecosystem consisting of a group of plants growing in muddy, loose and wet soils in tropical and sub-tropical areas, comprising of shallow, coastal waters, deltas and estuaries or lagoons. The specific regions where these plants occur are termed the 'mangrove ecosystem'. These are highly productive but extremely sensitive and fragile.

Mangrove distribution in Karnataka:

Karnataka has a coastline of over 320 kilometres. Fourteen rivers and several small rivulets, which originate in the Western Ghats cut across the coast to join the Arabian Sea. Towards the coast, the saltwater tides from the sea travel several kilometres interior through the river mouths providing congenial habitats for mangroves. Most mangroves are of the fringing type in linear formations along the river or estuarine banks. Where the estuaries are wider, especially in Swarna-Sita-Kodi, Gangoli, (towards the mouth of Haladi-Chakra-Kollur rivers), Aghanashini and Kali there are several remarkable locations for mangroves.

Mangrove species in Karnataka

Mangrove swamps develop only where coastal physiography and energy conditions are favourable. Mangroves develop best in the region, experiencing abundant rainfall, evenly distributed throughout the year and when the climate is very much regular. Coastal Karnataka is a region of high humidity. The rainfall here varies from 2500 mm to slightly over 3000 mm, most of it seasonal during June-September, the period of the South-West Monsoon. Karnataka coast soil is a mixture of laterite rock and clay.

Common mangrove species in the Florida Keys:

Red mangroves (Rhizophora mangle) are characterized by aerial

Table 1: True Mangroves of Karnataka:

Sl. No.	Family	Species
1	Acanthaceae	Acanthus ilicifolius
2	Combretaceae	Lumnitzeraracemosa
3	Euphorbiaceae	Excoecariaagallocha
4	Myrsinaceae	Aegicerascorniculatum
5	Poaceae	Porteresiacoarctata
6	Rhizophoraceae	Bruguiera cylindrical, Bruguieragymnorrhiza, Kandeliacandel, Rhizophora apiculata, **Rhizophora mucronata**
7	Sonneratiaceae	Sonneratia alba, Sonneratiacaseolaris
8	Verbenaceae	**Avicennia marina**, Avicennia officinalis

Table 2: Mangrove associates that have proximity to mangrove vegetation: Mangrove Associates

Barringtonia spp., Caesalpinia crista, Cerberamanghas, Clerodendruminerme, Cyperus malaccensis, Derris trifoliata, Erythrina variegata, Hibiscus tiliaceus, Morindacitrifolia, Pandanus sp. Salvadora persica, Thespesia populnea, Acacia auriculiformis Borassus flabellifer Ficus racemosa, Casuarina equisetifolia, Odinawodier, etc.

roots concealed props roots which provide support for soft mud and stabilize elements.

Black mangroves (Aviceniagerminans) occurs shoreward to the red mangrove and is characterized by the presence of small pencil-like vertical root shots call pneumatophores. These root shots stand in dense arrays near the high-tide line, enabling the mangrove to obtain oxygen directly from the air.

White mangroves (Laguncolariaracemosa) grow on elevated grounds above the high-tide mark and behind the red and black mangroves. The leaves are thick and succulent, rounded at both ends, and the same colour on both sides. The root system resembles that of most terrestrial trees and seldom show breathing roots.

What is the importance of mangroves?

Mangroves shed and drop about seven and a half tons of leaf litter per acre per year. The constantly-shed leaves are quickly broken down by bacteria and fungi and released into the water, providing food for sea life. Mangroves are the nesting grounds for mammals, amphibians, reptiles, countless unique plants, juvenile fish and invertebrates, sponges, barnacles, oysters, mussels, crabs, shrimps, oysters and many water birds such as the great white heron, reddish egrets, roseate spoonbills, etc. Mangroves also recharge underground water supplies by collecting rainwater and slowly releasing it.

The fishes lay their eggs in tangled roots of mangrove trees and later hatch and grow with the needed nutrients available. Thus mangroves act as natural nursery grounds. Mangroves offer shelter to the juveniles of a wide variety of marine organisms, notable among them being certain species of penaeid shrimps. A linear relationship exists between shrimp production and the size of the mangrove forest area. Mangroves give recreation to hunters, fishermen, bird-watchers, photographers and others who treasure natural areas.

- Mangrove plants protect the shore from wave action and erosion during rough seasons.
- Mangrove plants provide more nutrients to the adjoining coastal waters so that they serve as a breeding and feeding ground for a variety of marine organisms including fishes.
- Timber is obtained from mangrove trees are used in furniture and handicrafts.
- Mangrove area serves as an important fishing ground for the traditional fishermen who live side by side with mangrove environment.
- Mangrove plants serve as a source for new medicine development and formulation.
- Act as the nursery grounds for fish and other organisms.

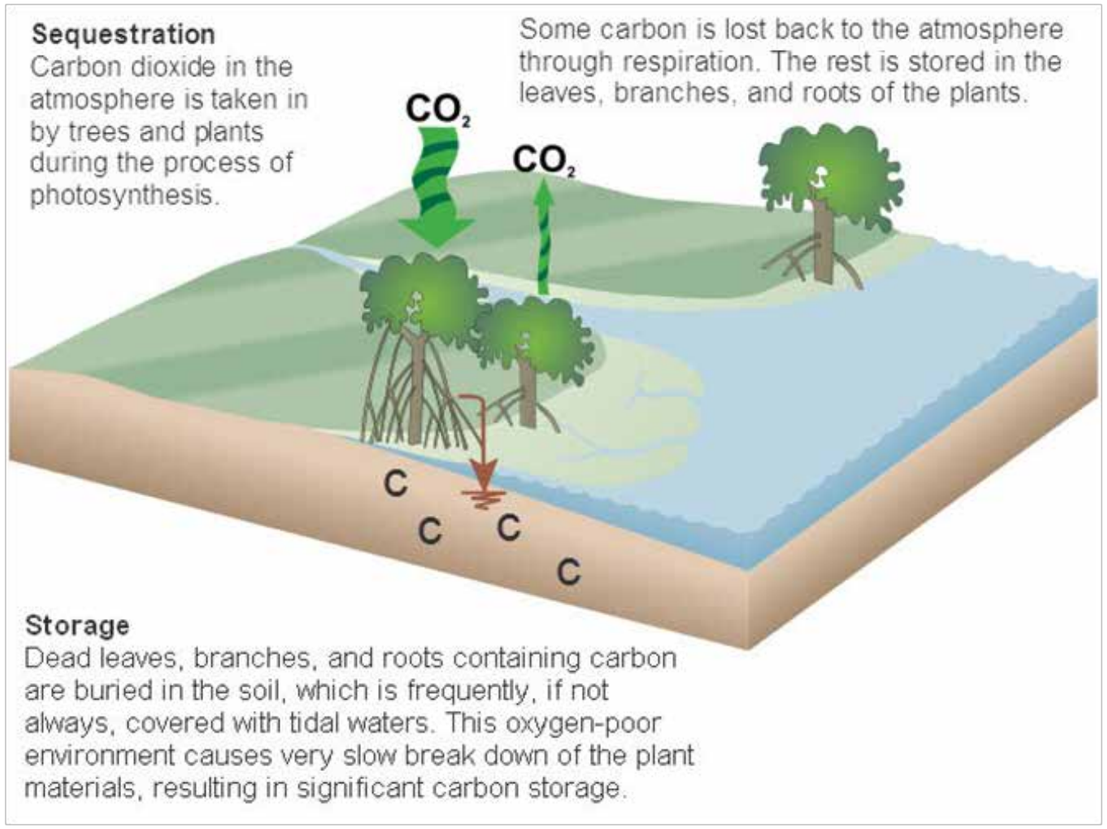
7 key attributes of mangrove:

Mangrove forests are incredibly important ecosystems and provide ecosystem services (benefits to humans) valued atUSD 194,000 per hectare annually.

Here are a few reasons we should care about mangroves – and invest in protecting them:

The value of an estuary is calculated as USD 19120 per hectare per year if all "goods and services" are taken into account: shrimps, fish and crabs; mangrove shrubs; nutrient cycling, hydrology, soil protection and a sink for carbon.

1. Biodiversity. Home to an incredible array of species, mangroves are biodiversity hotspots. They provide nesting and breeding habitat for fish and shellfish, migratory birds, and sea turtles.
2. Livelihoods. The rural communities we work with are fishers and farmers who depend on their natural environment to provide for their families. Healthy mangrove ecosystems mean healthy fisheries from which to fish and healthy land on which to farm.
3. Water. Mangroves are essential to maintaining water quality. With their dense network of roots and surrounding vegetation, they filter and trap sediments, heavy metals, and other pollutants. This ability to retain sediments flowing from upstream prevents contamination of downstream waterways and protects sensitive habitats like coral reefs and seagrass beds below.
4. Coastal defence. Mangroves are the first line of defence for coastal communities.
5. Carbon storage. Mangroves



"sequester carbon at a rate two to four times greater than mature tropical forests and store three to five times more carbon per equivalent area than tropical forests" like the Amazon rainforest. This means that conserving and restoring mangroves is essential to fighting climate change, the warming of the global climate fueled by increased carbon emissions.

6. Materials. In addition to consuming fish and shellfish from the mangroves, communities have historically used mangrove wood and other extracts for both building and medicinal purposes.

7. Sustainable development. Intact and healthy mangrove forests in El Salvador have an untapped potential for sustainable revenue-generating initiatives including ecotourism, sport fishing, and other recreational activities.

The decline of mangroves:

The main threat to mangroves throughout the world is their over-exploitation by man. Development along the coastline often results in the removal of mangroves by dredging for marinas or filling for construction. This has damaging effects on adjacent habitats, such as coral reefs and seagrass beds, as well as on the fish and shellfish that rely heavily on mangroves for the completion of their different life stages. The destruction of mangrove forests will decrease biodiversity within these areas, increase coastal erosion, storm impacts and decrease fisheries production. It is therefore very important that mangrove lagoons are protected and conservation methods are implemented to ensure their continued health.

Coastal Karnataka is one of the better-developed geographical areas of the State with a high degree of economic development and density of population. The settlements in the coastal region consistof 22 urban agglomerations and 1044 villages. The region supports a high degree of agricultural and horticultural activities, fishing and aquaculture, sand and shell mining, industry, harbour development, trade and transport etc. which naturally have their toll on coastal ecosystems, including mangroves.

According to the State of the Environment Report and Action Plan, 2003(Department of Forest, Ecology and Environment, Government of Karnataka) "Many coastal depressions in the vicinity of mangrove habitats are filled with mud scooped from lagoons to cultivate coconut plantations. The coir retting carried out

India has approximately 700,000 ha of the area covered by mangroves along the estuaries and major deltas.

mainly in mangrove cleared areas, is a microbial process and causes pollution of water, air and soil, which in turn, affects the marine resources, quality of estuarine banks and nearby beaches." Some of the major reasons for the decline of mangroves, especially along the central west coast, including that of Karnataka, are:

- Over-exploitation or deforestation of mangroves for fuel and fodder
- Reclamation of mangrove swamps
- Sand and shell mining
- Grazing and trampling by livestock
- Damages to saplings from native crafts and fishing activities
- Bund and road making
- Dumping of rubbish and solid waste into the swamps
- Impact of dams and barrages

How to protect the mangrove environment?

It is essential to conserve the mangrove ecosystem and manage them for the use of human beings in future. The management issues are categorized into two categories.

a) Conservation of the Mangrove ecosystem.

It the important for the conservation and management of the mangrove ecosystem. Ministry of Environment and Forests has set up a National Committee on Mangroves and prepared the management plan which includes

I. Afforestation

II. Regeneration of degraded mangrove area,

III. Protective measures and

IV. Eco-development.

Mangrove forests are incredibly important ecosystems and provide ecosystem services valued at USD 194,000 per hectare annually.

Natural and artificial regeneration involves the natural process of establishment of the 'seed' of mangroves. Artificial regeneration involves the planting of seeds or seedlings in areas where there is inadequate availability of planting materials. There is an imperative need to formulate proper restoration practices for mangrove plantations in degraded coastal areas.

Grow mangrove plants along the coastline to increase the nursery

grounds for the marine organisms which come for feeding and breeding. Help in formulating Government regulation for the protection of mangrove areas. Mobilise community opinion on the same platform for the management of mangroves. Help the conservation agencies involved in mangrove protection to continuously assess the area of mangrove to check the destruction. Mobilise your communities on the need to develop parks and reserve areas to protect Mangrove vegetation.

Mangrove leaf provide food for sea life.

b) Sustainable use of Mangrove wealth:

• Agriculture, Aquaculture, Capture Fisheries, Culture fisheries activities should be conducted without destroying the mangrove environment. For example, wild collection of juveniles of prawns is practised in some parts of the country in mangrove areas that seriously deplete the prawn fishery. Mangrove plants should be used to obtain natural medicinal products by making sure that they will be available for future use also.

• Use of mangrove for timber, honey collection should be done at a level to get the same resources time after time. Traditional communities living around mangrove forests should take part in the activities like mangrove plantations, awareness campaigns, and maintenance of mangrove canals to jointly manage the resources along with the government agency. Eco-Tourism in mangrove areas should be popularized.

Conclusion & Recommendation

Proper monitoring is imperative to prevent illegal activities such as poaching of mangrove fruits, fishing activities, movement of barges etc so that young plants do not get damaged, fish germplasm is not depleted. Fisheries should be encouraged with proper

vigilance and legislation to avoid damage to the existing mangroves. The speed of the barges should be maintained. Aquaculture should be practised in thinly populated mangrove areas. With proper planning for activities such as aquaculture, agriculture, construction,mining, industrialization etc, proper survey, monitoring and proper restoration can be done.

Along with the restoration work, an awareness programme should be mounted, educational materials should be madea vailable to improve knowledge on mangrove habitats,resources, relevant legislation, policies and conservation strategies with the help of media like magazines, films,posters, pamphlets, documentary, exhibitions, birdwatching tours, study tours, competitions on mangrove knowledge etc.

Mangroves serve as a critical nursery for young marine life and therefore play an important role in the health of fisheries and the economic well-being of fishermen. The ecosystem is also considered as most productive and biodiversity providing significant functions in the coastal zones as a buffer against erosion, storm surge and tsunamis. Afforestation of mangrove areas on a large scale is the most urgent need of today if the coastal environment is to be brought back again to its earlier pristine glory.

If we think about the short term benefits we get from developing

Mangroves are facing threat from over-exploitation.

the mangrove areas rather than thinking about the long term gains through conservation, things would be out of control. If we do not protect this wetland ecosystem created for us they would not be in any position to protect and help us.

(The authors are associated with the Department of Fisheries Resources and Management, Karnataka Veterinary, Animal and Fisheries Sciences University, College of Fisheries, Mangalore 575002, India and can be reached out at d.prajesh@yahoo.com)

Sustainability key to marine ornamental fish trade in India

By Raswin Geoffery. G.K., Dr Judith Betsy .C., Green Sea.K

Introduction

Globally ornamental fish production is a multibillion-dollar industry. Since 1985 the value of international trade in exports of ornamentals has increased at an average growth rate of approximately 14 per cent per year. Ornamental fish keeping was initially considered as one of the attractive hobbies practised in the developed countries but recently it is gaining impetus in developing countries too as they now contribute for about two-thirds of the total export value. Worldwide 1.5 to 2 million people are believed to keep marine aquaria. Ornamental marine species (corals, sponges, fishes and other invertebrates and fish) are collected and transported mainly from Southeast Asia, but also increasingly from several island nations in the Indian and Pacific Oceans.

The Philippines, Indonesia, Solomon Islands, Sri Lanka, Australia, Fiji, the Maldives and Palau supplied the major share of marine ornamental fishes during recent years. The main destination

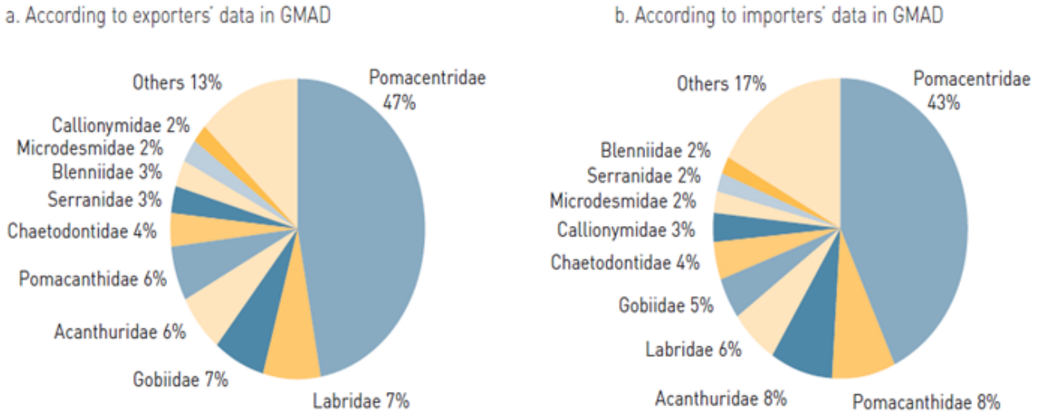
Worldwide 1.5 to 2 million people are believed to keep marine aquaria

markets are The United States, The European Union (EU) and, to a lesser extent, Japan. Nearly 98 per cent of the marine ornamental species marketed are wild-collected mainly from coral reefs of tropical developing countries. Trade is mainly contributed by wild collection, unlike inland ornamental industry. Furthermore, rapid changes in husbandry technologies have allowed marine aquarists to move from normal fish tanks to aquariums that replicate living ecosystems (reef aquariums).

Unlike freshwater ornamental fishes, where the trade is mainly contributed by species that are farmed, marine ornamental fishes are obtained from wild collections. Since the tropical marine aquarium fish and invertebrates in the trade are directly exploited from the coral reefs, the long term sustainability of the aquarium industry is a controversial aspect.

The damaging techniques such as the use of sodium cyanide used for wild collection, the over-harvesting of target organisms

Figure 1: Global trade of fish broken down by family



Nearly 98 per cent of the marine ornamental species marketed are wild-collected mainly from coral reefs of tropical developing countries.

and the high level of post-harvest mortality are the major constraints associated with the trade of marine ornamentals based on the wild collection. But if managed properly, the aquarium industry could support long term conservation and sustainable use of coral reefs.

Management of marine ornamental fisheries has to be implemented in such a way that they are biologically sustainable, do not conflict with other resources and keep post-harvest mortalities to the minimum. Habitat damage and negative impact on the ecosystem have to be avoided. Species that are unsuitable to aquaria should not be collected. It is evident from the global scenario of the marine ornamental trade that even though the trade is very lucrative and is expanding rapidly, the problems involved are complex and requires appropriate management strategies.

Common Marine Ornamental Fishes of India

India is endowed with more than 200 varieties of export-oriented marine ornamental fishes. The Gulf of Mannar is the First Marine Biosphere Reserve not only in India but also in South and Southeast Asia. The recorded marine ornamental fishes come under 24 families, of which the family Acanthuridae, Balistidae, Chaetodontidae, Haemulidae, Labridae, Pomacanthidae, Pomacentridae, Scaridae and Syngnathidae have a very rich biodiversity perspective in the Gulf of Mannar.A total of 1,471 species of fish are traded worldwide. Damselfish (Pomacentridae) make up almost half of the trade. Species of angelfish (Pomacanthidae), surgeonfish (Acanthuridae), wrasses (Labridae), gobies (Gobiidae) and butterflyfish (Chaetodontidae) accounts for approximately another 25-30 per cent.

The most-traded species are the blue-green damselfish (Chromis viridis), the clown anemone fish (Amphiprion ocellaris), the whitetail dascyllus (Dascyllus aruanus), the sapphire devil (Chrysiptera cyanea) and the threespot dascyllus (Dascyllus trimaculatus).Two species such as the bluestreak cleaner wrasse (Labroides dimidiatus) and the mandarin fish (Synchiropus splendidus) known not to acclimatize well to aquarium conditions are nonetheless very commonly traded.

Organization of Trade

It is complex and extremely dynamic. In exporting nations it is likely to involve a series of collectors/ fishers, wholesalers, middlemen and exporters, while in importing nations it involves many importers, wholesalers, retailers and, more recently, transhippers. It involves the following steps.

Collection

Collectors tend to be small-scale fishermen from tropical countries who work alone or in small groups, often composed of family units, and who are either self-employed or working for a wholesaler/ exporter. Fish are collected using nets (e.g. hand nets, cast nets) and fishing lines. In Sri Lanka and the Maldives, collectors catch most of their fish using hand nets. In Australia, the Pacific region and Florida, fishers often use a much larger barrier, drop or fence nets. Upon collection, fish, corals and invertebrates are placed separately in plastic containers or individual bags. Coral pieces tend to be covered with plastic wrap to prevent injury. To avoid the fishes' air bladders rupturing due to decreasing hydrostatic pressure, individuals caught on deeper parts of the reef are often placed in a dark mesh cage and lifted to the surface very slowly (3 m every 30-40 minutes) to allow their bladders to decompress. Once ashore, fish and invertebrates are placed in separate holding tanks, or immediately packaged for transport and/or export. Collectors are usually paid for the number of fish/invertebrates they have collected and prices for individual species vary greatly depending on their popularity in the market.

Transport

Fish are quarantined and starved for at least 48 hours before shipment. To avoid putting the health of fish at risk, a recommended maximum travel time of 40 hours has been suggested for shipments. For each consignment, a licence has to be issued allowing it to leave the exporting country. Cartons of coral species and giant clams need to be accompanied by the relevant CITES permits. Transport associations such as the International Air Transport Association (IATA) and the Animal Transportation Association (AATA) organize and manage the transport of live marine ornamentals. At the receiving end, importers must clear the shipment with customs and the consignment undergoes another veterinary check.

Transhipping

Transhipping is an activity that emerged during the 1970s and 1980s. It involves grouping the orders of several retailers and/ or wholesalers and placing them with an exporter, collecting the shipment at the airport, clearing customs and redistributing the boxes without opening them. The responsibility for the entire shipment falls on the retailer. Where additional services, beyond picking up the consignment, clearing customs and transport are required, the activity is referred to as 'consolidating'. Transhippers are required to hold a licence to operate particularly in Europe. However, no skills for fish handling are necessary to obtain such a licence.

Governments and Associations

Governments of many exporting countries often play an important role in the trade of marine ornamentals, ranging from financial assistance to improved management schemes and trade regulations. Certain countries/ states set fishing quotas (e.g. Florida), prohibit collection from certain sites (such as designated restricted areas in Hawaii) or prohibit certain capture methods (such as cyanide in Indonesia). Individuals involved in the marine ornamental industry often join forces and form associations or syndicates like the Singapore Aquarium Fish Exporters' Association (SAFEA), OFI, OATA (Ornamental Aquatic Trade Association) and the Pet Industry Joint Advisory Council (PIJAC) which is the world's largest pet trade association, representing all segments of the pet industry.

Global Marine Aquarium Database (GMAD)

Since April 2000, UNEP-WCMC and MAC have been collaborating with members of trade associations such as SAFEA, OFI and OATA to establish GMAD as a freely available source of information on the global aquarium industry. The common objective of GMAD is to gather, integrate, collect, standardize and provide fast and easy access to data on the trade of individual species by placing this information in the public domain, through a web-searchable interface (http://www.unep-wcmc.org/ marine/ GMAD). GMAD was designed to allow for import and export data to be queried separately.

MAC Certification and Aquarium Trade

- The Marine Aquarium Council (MAC) is a not-for-profit organization working to protect coral reefs worldwide.
- MAC has developed internationally approved standards and a third-party

certification system for the trade-in marine aquarium organisms to ensure they remain healthy.

- MAC Certification delivers sustainable livelihoods and poverty reduction to rural villagers in developing countries
- It transforms an industry that has been responsible for environmental destruction into a positive force for conservation and sustainable use
- Provides an assessment and monitoring protocol for reefs from which marine aquarium organisms are collected
- Provides training to collectors on proper collecting and post-harvest handling techniques
- MAC has developed standards for quality products and sustainable practices; established a system to certify compliance with these standards and label the results; and begun creating consumer demand and confidence for certification and labelling
- Requires the use of non-destructive fishing methods by collectors
- Improves the occupational health conditions of collectors
- Improves business relationships

Certification and Labeling

The MACSM Certification system was launched in November 2001 along with the unveiling of the MACSM Certified label. Following the launch, 70 marine aquarium companies in more than a dozen countries worldwide publicly stated their commitment to becoming certified. MAC has accredited five independent certifiers to audit compliance of marine aquarium operators to the MACSM Standards. The first implementation of MACSM Certification took place in the Philippines in June 2002. Three export companies, three collector associations and three collection areas were audited by a MACSM Accredited certifier. The exporters were located in Metro Manila. The collector associations and collection areas were located in Palauig (province of Zambales in Luzon) and Tubigon and Clarin (province of Bohol in the Visayas). Informal communications from the certifier sound promising. The results will be made public after the certifier's formal audit reports are finalized.

India is endowed with more than 200 varieties of export-oriented marine ornamental fishes.

Marine Aquarium Trade in India

Table 1. Institution wise marine species list

Institution	Species
CMFRI	Clown fishes (Amphiprion chrysogaster; A. sebae), Sea horse (Hippocampus kudu), Star fish (Peataceraster regulus), Cuttle fish (Sepiella inennis), Abalone (Haliotis larria), Sea cucumbers (Holothuria scabra and H.atra).
CAS-MB, Annamalai University, Parangipettai	Sebae clown fish (Amphiprion sebae), Orange clown fish (A. percula), Clown anemone fish (A. ocellaris), Yellow tail clown fish (A. carkii), Spinecheek anemone fish (Premnas biacueatus), Coral demoiselle (Neopomacenttrus nernurus), Caerulean damsel (Pomacentrus caeruleus), Whitetail dascyllus (Dascyllus aruanus) and Three spot dascyllus (D. trimaculatus).

It is well understood that India has a wealth of marine ornamental fishes in our island ecosystems of Lakshadweep and Andaman Nicobar, besides many areas of the mainland. Ornamental fish trade is mostly with freshwater fishes (90 per cent) of which 98 per cent are cultured and 2 per cent are captured from the wild. The rest 10 per cent of the total ornamental fish trade are with marine fishes of which 98 per cent are captured and 2 per cent are cultured.

The world trade of ornamental fish is estimated to be about Rs. 2000 crores, but, India's share is only Rs. 15 crores, which is very insignificant. The marine fish and invertebrate resources from the Andaman, Nicobar and Lakshadweep Islands are reported to be the greatest in Asia. More than 500 species of fish and 200 species of invertebrates are available in these islands.

The actual potentials of the ornamentals are remarkable that India can annually export marine ornamental fishes to the tune of USD 340 million. About 90 per cent of Indian aquarium fish exports from Kolkata, followed by 8 per cent from Mumbai and 2 per cent from Chennai. In Bangalore, the number of outlets selling ornamental fish is more than 1,200 with a monthly turnover of around Rs 1.5 crore.

A total of 400 species (250 indigenous freshwater fish and 150 marine fish) have been identified as potential and suitable for the tropical climate of India. Potential marine ornamental fish species resources found in India include Clown fish, Damsel fish, Moorish idol, Lion fish, Parrot fishes, Box fishes or trunk fishes. Marine angels, Butterfly fish, Cleaner wrasse, Cardinal fishes, Surgeon fishes, Hawk fishes, Bat fishes, Puffer fishes and Seahorses.

The public and private sector entrepreneurs who have approached for the technology were given training under the Consultancy Processing Cell (CPC) of the CMFRI. This has resulted in the emergence of several marine ornamental fish trade shops all over the country. The National Fisheries Development Board (NFDB) has also developed schemes to fund marine ornamental fish culture. Some institutions have taken species of their interest and the details are given in Table 1.

Management strategies for a sustainable marine ornamental fish trade

- Habitat damage and negative impact on the ecosystem have to be avoided
- Setting up of quotas and size limits, temporary closures and restricting access to the ornamental fishery through the use of permits
- MAC certification
- Policy intervention
- The exploitation of species that are not suited for aquariums should be avoided

Conclusion

If managed sustainably, the trade could support jobs in predominantly rural, low-income coastal communities and provide strong economic incentives for coral reef conservation in regions where other options for generating revenue are limited.Most of the traded marine ornamental fishes are being collected from the wild and, therefore, the development of marine ornamental hatchery technology and production of young ones to fulfil the increasing demand in the export market is necessary.

Zero waste aquaculture systems and the way forward

Megha S Vinod & Mohammed Meharoof

Introduction

The aquaculture sector has a long history, but it has gained prominence in recent decades because of population pressures on food security, as well as an increased understanding of the vital nutrient contributions that fish and related entities can make to human health and wellbeing.

Raw materials produced by the aquaculture sector are used in a variety of commercial and businesses today such as the pharmaceutical and cosmetics industries. As a result, the industry plays a significant role in the country's economy, food security and livelihood. The sector today has come a long way ahead surpassing the traditional practices and being more intensive and technology-driven.

So far, so good, but in an era of global warming, climate change, and scarcity in production factors, strategic management, and sustainable resource exploitation, particularly in aquaculture, is inevitable. Traditional systems, which encourage extensive culture with little supervision, have been contaminating and damaging the environment for years. It lacks sufficient biosecurity and discharges wastewater without scientific treatment, resulting in deterioration of the surrounding soil and water quality as well as spread of diseases. The method also requires a large amount of water, which could lead to a shortage of water for human needs. Hence a skip over traditional systems was essential.

The zero-waste aquaculture systems are an alternative that decreases environmental effects due to nutrient-rich water discharge, increases biosecurity, and secures higher output with less water exchange, higher aeration, and mixing rates.

This article discusses some forms of efficient cultural practices over the traditional systems.

Integrated Multi-Trophic Aquaculture (IMTA)

Integrated multi-trophic aquaculture (IMTA) is based on the concept of utilizing unutilized organic and inorganic nutrients resulting from feeding in intensive aquaculture systems of various trophic levels in an ecosystem. It is a combination of aquaculture (fish/shrimp) with organic and inorganic extractive culture species like shellfishes, seaweeds etc. to create balanced systems for environmental remediation, economic stability, and social acceptability.

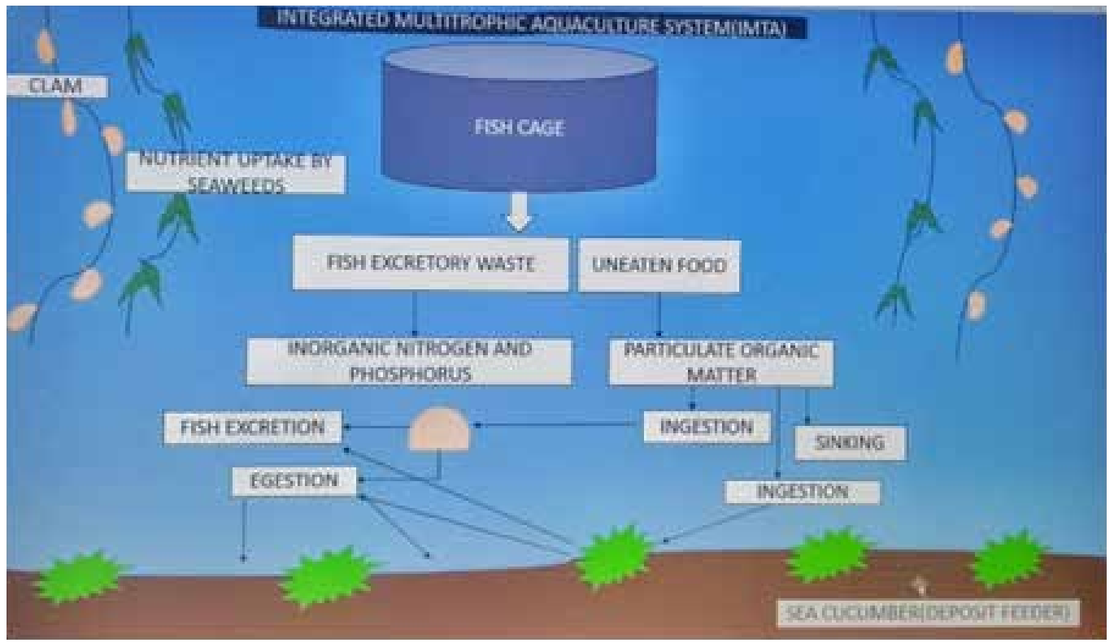
The system in itself has the bio-augmenter, the bio-filter and the bio-mitigator precluding the need for expensive additions to the system. By transforming by-products and uneaten feed from the system into extractable products, the method improves economic and environmental sustainability while minimizing eutrophication.

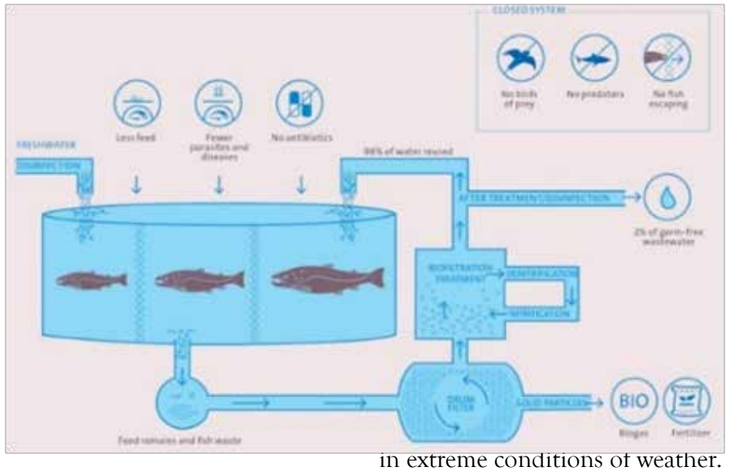
This sort of polyculture varies from others in that it cultivates diverse types of organisms that thrive in water bodies at different trophic levels to obtain a high yield through a synergistic effect with minimal environmental impact. There is a plant component, mostly the seaweeds which act as bio-filter, filtering out the nutrients for self-consumption as well as making it available to others for consumption.

Thus, the system offers species diversification, nutrient cycling and disease control by self-regulating the ecosystem as well as protecting antibacterial properties of the components. The system also rules out the disadvantages of prominent cultural practices of the era and avoids the chance of water quality deterioration by transforming the unspent feed and added fertilisers into useful and utilisable nutrient components.

It is also recognised as an effective strategy against climate change and provides scope for rural empowerment just by taking benefit of the locally available resources. The practice is flexible enough to be done across different kinds of water bodies, as IMTA raise the assimilative capacity of the farm as well as provide farmers with better income via more growth and production as well as the provision for species diversification. Some of its disadvantages include lower productivity compared to monocultures, public perception issues, limited species culture possible and food safety concerns due to the involvement of bacterial species in a closed system of culture.

Sticking to tradition doesn't always take you a long way; changes are inevitable for the food and nutritional security along with the sustainability of resources.





The zero-waste aquaculture systems are an alternative that decreases environmental effects.

Recirculatory Aquaculture System (RAS)

As the name implies, the process entails the recirculation of the water and the related filtration using mechanical and biological filtering methods for the growth of fish species without the water being discharged. This is one of the best examples of the method that uses minimal inputs, such as land or water, and produces maximum output with nearly no environmental impact.

According to NFDB figures, RAS system can produce 60 MT per year with only 1/8th hectare of land and 1/6th of the water required by traditional methods. It filters, recycles, and reuses water in a regulated environment with high stocking density resulting in a tremendous output. Additional water is added to compensate for evaporation, splash out, and waste flushing, with daily replacements of not more than 10 per cent of the total water. The technology can be used indoors or outdoors, providing flexibility in the culture practice with better biosecurity thus preventing diseased conditions. The method can be practiced in different geo-climatic zones and provides an opportunity in extreme conditions of weather.

The system has a simple and basic design consisting of fish tanks, mechanical filter, biofilter, trickling filter, oxygen enrichment unit and UV disinfector. The water from the tank moves through the mechanical filter; remove carbon dioxide before getting aerated and is further returned to the tanks.The biofilter forms the most important part of RAS whose media is made up of materials like plastic sheets, beads, lava rock, gravel or sand grains and possess a high surface area for bacterial growth, pores for water movement, is clog-resistant and are rendered easy to clean.

The temperature should be between 10-35°C and the pH should be between 7-8 for the biofilter to effectively function. A sump or clarifier tank, shaped "V", even forms a part of the biofilter as it is used to collect and sediment all the solid waste which could otherwise block the biofilter and use up the oxygen.

The microbes, Nitrosomonas and Nitrobacter are employed in nitrification whereas Pseudomonas is employed in denitrification while sodium bicarbonate and calcium bicarbonateare used as buffers in maintaining pH balance. Since recycled water turns out to be warmer than natural, the system isn't suitable for cold water species and thus species like African catfish, barramundi,

carps, perch, tilapia, pangasius, white fish, Atlantic cod, bluefin tuna, rainbow trout, sturgeon, seabass etc. is preferred.

BioflocTechnology (BFT)

In aquaculture, around 60-75 per cent of the operating cost are incurred for fish feed and it forms the most critical factor in the achievement of profit. BFT, an eco-friendly model, employs minimal feed through recycling and reusing of nutrients in the culture media and also ensures minimum water exchange.

The system has a microbial aggregation combined with other particulate organic matter, phytoplankton which provides protein-richfood resources to the cultured species as well as helps in the treatment of water ensuring minimal environmental damages. Here the various biofloc particles are maintained in suspension by supplementing with aeration and mixing of water and they act as an additional food source thusattaining favourable FCR. Biofloc being an aggregation of beneficial organisms promote probiotic effect and improves the organism's digesting ability.

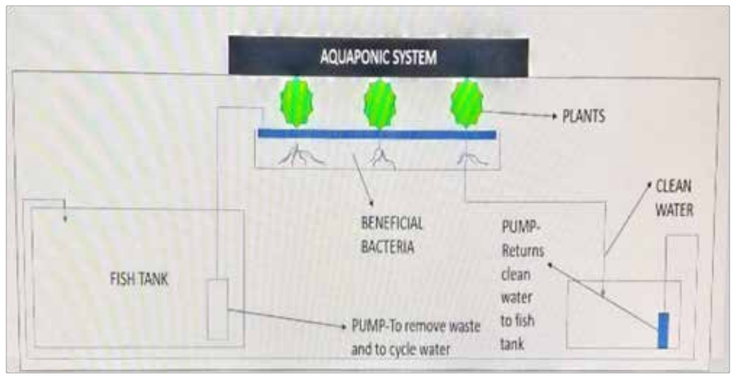
The system maintains a high C:N ratio by adding carbohydrates and allows the proliferation of single-cell microbes. These microbes in turn work to maintain the nutrient level and cycles nutrients in situ, thereby reducing the additional cost of feed as well as filter and cleaning the water medium. The system however has an intense requirement for aeration as it has as its component the microbial population which also consumes oxygen in addition to the cultured species, hence projecting a chance for oxygen deficiency.

Aquaponics

Aquaponics, yet another close-loopself-contained system, successfully incorporates the technology of hydroponics and RAS to sustainably produce both fish and plants. In this method, the waste materials released by the fishes is converted into usable forms by the bacterial consortium which in turn is utilised by the plants. Plants and fish species have a symbiotic interaction in which the plant aids in the filtering of waste from the medium used for fish growth.

As a result, both partners gain in growth and development while having no negative impact on the environment. The waste produced by the system can be collected and sold as fertiliserthus the technique is the finest option for getting fresh, chemical-free fish and vegetables throughout the year.

Forms of alternatives include Integrated Multi-Trophic Aquaculture (IMTA), Recirculatory Aquaculture System (RAS), Biofloc Technology (BFT) and Aquaponics.



Adoption and integration of these methods into practice will improve production and productivity.

The system requiresless land, allowing it to be embraced and practised even in urban settings. The increasing demand for organic vegetables and fish species suggest that farmers will never have to suffer loss in adopting aquaponics as their means of cultural practice. The fact that the produce is grown without any artificial feed or fertiliser increases its market demand especially among the privileged categories of the society and star-rated hotels, thus offering an opportunity for fetching double the normal market price. And that's why and how Cherai, a village in Kerala has become the first aquaponics village in just 2 years, since 2016. The system being costly, having the requirement for uninterrupted power need, requiring professional skills and the limited species available for culture, is however slowing the pace of its adoption among the rural fraternity.

Way Forward

Sticking to tradition doesn't always take you a long way; changes are inevitable for the food and nutritional security along with the sustainability of resources. The discussed methods are all self-sophisticated in their way and don't harm the environment in any way nor do they pose threat to the humans consuming the produce.

Adoption and integration of these methods into practice will improve production and productivity, thereby securing the nutritional profile of the country and its biosphere. Understanding the importance of the blue economy, the governmentis offering various credit and subsidy schemes at all levels to encourage people to uptake such zero impact aquacultural practices.

The schemes under Pradhan Mantri Matsya Sampada Yojana (PMMSY) is promoting all these practices and the farmers can take advantage of this to change their traditional fish culture systems. The fisheries departments, fisheries institutes and related research organisations in the country are offering training as part of the extension and outreach in the modern fishing systems which can be made use of by the farmers. Thus,the adoption of modern environment-friendly fish culture practices can bring a blue revolution in the sector.

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Seaweed aquaculture can advance inclusive blue economy in India

CRK Reddy

Seaweed farming is at its infancy in India but it holds immense potential to radically transform the aquaculture landscape in the country and offer rich dividents through policy interventions, technological intervention and support from the scientific community. This article explores the endless posiibilities that seawood production can bring for the Indian economy.

Introduction:

In recent times, seaweeds have gained substantial traction globally owing to their proven economic, social and environmental importance. Seaweeds are harvested throughout the world from the wild as well as aquaculture farms for human consumption or as an export commodity for the production of phycocolloids (agar, agarose, carrageenan and alginate). Nevertheless, the scope of utilisationin recent times has further expanded to produce plant growth stimulants for agriculture, personal care products, nutraceuticals, bioactives, proteins, biofuel products etc. Seaweeds farming represents an important component of aquaculture production and accounted for more than 33 million tonnesof wet weight (about 28% of total aquaculture production) in 2018.

Most of the seaweed production is made through aquaculture practice (94% total production) in Asian countries predominantly from China, Japan, Korea, Indonesia, Philippines, Malaysia and Vietnam (Fig. 1). Seaweed farming has emerged as a successful enterprise, providing a promising, alternative livelihood option for

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

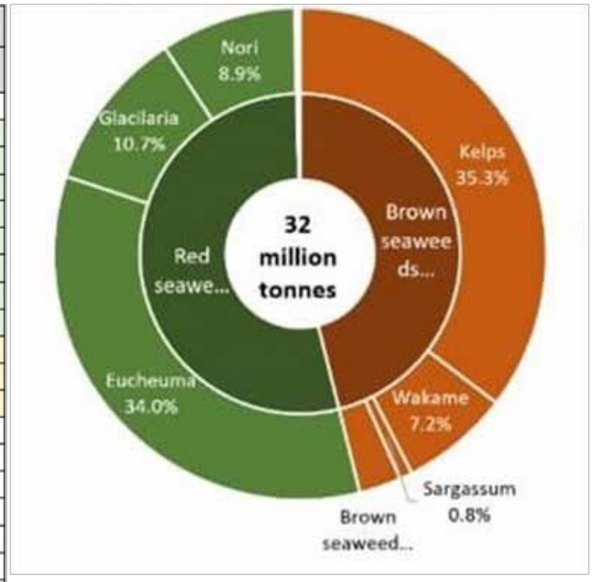


Fig. 1 Seaweed aquaculture production in the world in 2018 (source FAO-SOFIA 2020)

low-income, coastal communities in developing countries with growing economies.

Taking a cue from the global seaweed production statistics for the past decades, it is projected to cross 10 billion tons (wet weight) by 2100 reaching on par with that of agriculture production. However, the projected production volume and the timeline could dramatically change, if all the remaining 154 maritime nations in the world get engaged in seaweed production.

Seaweed farming offers several advantages over terrestrial agriculture and do not compete with crops for land, fresh water, pesticides, fertilizer. In contrast, the plant biostimulants extracted from seaweeds boost agriculture productivity (organic farming) and help in cutting down the usage of chemical fertilizers made with a high carbon footprint.

The seaweed industry in India has not yet developed and continue to be in the nascent stage despite having a long coastline (7500 km long with EEZ of 2.1 million Km2); more than 1.4 million hectares of the coastal sandy area, and developing pioneering technologies in both farming and processing of different economically important seaweeds. The seaweed cultivation has not gained momentum andis not as widespread in the country as expected and has remained confined to limited geographical regions in the state of Tamil Nadu alone (Fig. 2).

Seaweeds farming represents an important component of aquaculture production and accounted for more than 28% of total aquaculture production) in 2018.

This could be partly due to different inherent challenges associated with open sea cultivation as well as poor awareness about the prospects of seaweed resourcesin the country. The seaweed farming in the open sea is interrupted by monsoon and hampers the year-round production efforts and thus sustainability. Variation in yield and quality of the crop, vulnerability to grazers and diseases etc. are some important issues to overcome in the open sea cultivation of seaweeds.

The traditional processing practice of seaweeds is for the production of a single product for a specific purpose or a specific market segment, and a major portion of feedstock remains unutilized, a cause of environmental and commercial sustainability. It is for the first time Indian scientists have developed an integrated technology for coproduction of several other products (biostimulant, lipid,

protein, cellulose, pigments etc.) of commercial value along with the main product (gelling polysaccharides) from fresh seaweed (Fig. 3) This advancement in downstream processing technology gives a major advantage and edge over others in terms of uniqueness and market competitiveness if we strengthen this sector. However, these technologies have not been validated or tested at a pilot plant to study the techno-economic feasibility of the process.

There is considerable potential for developing a technology-enabled platform for sustainable production and utilisation of seaweed resources for a variety of purposes ranging from food, high-value hydrocolloids, speciality compounds, nutraceuticals, fuel compounds to agro-allied products, etc. The entire domestic requirement of agar and agarose (low volume high-value products) is met from overseas markets that are also crippling in recent times due to raw material supply crisis resulting from over-exploitation of natural beds. Similarly, the local market for seaweed-based fertilizer also depends on the Chinese, Canadian and European markets. There is a need to change this scenario and have homegrown technologies catering to the domestic market needs. India has a scope and potential to grow and capture a sizable global market for both phycocolloids and plant growth stimulants in the first phase and the second phase catering to the emerging markets down the line. Also, there is a need to create a conducive ecosystem for nurturing the seaweed sector in the country as part of AatmaNirbhar Bharat Abhiyan. Recently, the Ministry of Fisheries, Animal Husbandry and Dairying, Govt of India also allotted a special financial package of Rs. 640 for the next five years under the PMMSY scheme to support and strengthen various sectoral activities aimed at increasing the seaweed production capability of the country to one million tones fresh weight (value over Rs. 600 Cr @Rs. 6000/- ton

Seaweed farming is projected to cross 10 billion tons (wet weight) by 2100, reaching on par with that of agriculture production.

Demographic details of people involved in seaweed collection and seaweed industry in India

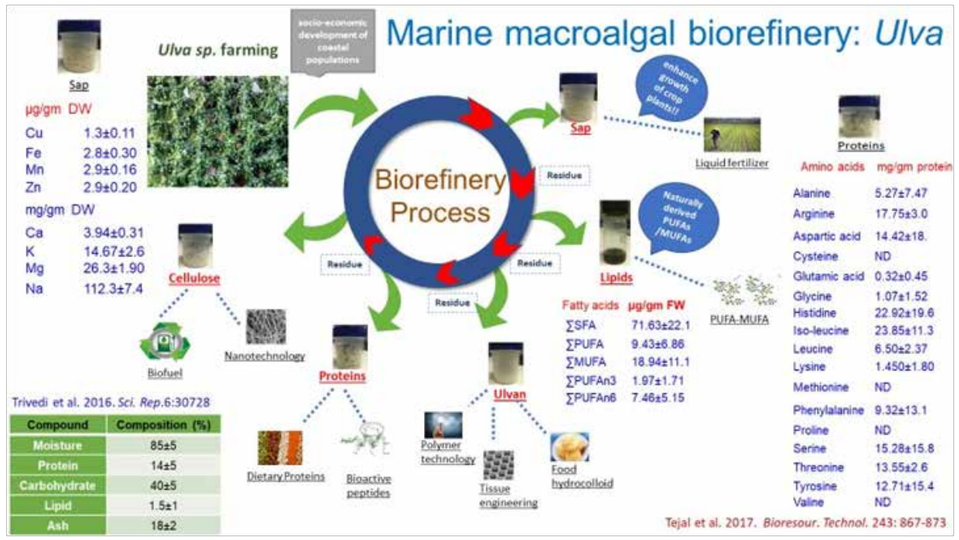
Place	Villages	Seaweed collection	
		Female	Male
Palk bay	24	460	210
Gulf of Mannar	14	1270	285
Total	38	1730	495

Total annual value of seaweeds harvested from wild stocks Rs. 27 crores

Agar industries	25
Alginate industries	7
Total	32

Annual Production:
- **Agar : 250-270 tons**
- **Alginates: 320-340 tons**

Fig.2 Map showing the seaweed cultivation sites as well as data on people engaged in the wild collection of seaweeds along with its market value and annual phycocolloids production



Compound	Composition (%)
Moisture	85±5
Protein	14±5
Carbohydrate	40±5
Lipid	1.5±1
Ash	18±2

Fig. 3 Recovery of multiple products in an integrated manner from macroalgal sources in biorefinery model

wet wt.) by 2025. To fulfil this target, India just needs to have 2000 hectares (or 20 Km2) of sea surface brought under seaweed cultivation and roping in 30,000 farmers to this activity.

To give a kick start to the seaweed programme in the country, there is a need to showcase the seaweed technologies in both farming and processing along with the business plans for wooing prospective entrepreneurs. This is very important for developing reliable production and processing of seaweeds catering to both domestic and global markets.

There is also a need for seaweed clusters development to achieve accelerated growth in the seaweed sector in the country. It needs participation and cooperation from the government authorities, scientific fraternity, industry partners, NGOsto empower the community engaged in seaweed farming by providing requisite training, financial support, market linkages, policy formulations, etc. Such collective efforts help to increase the country's seaweed production and double farmers' income contributing to the inclusive economic growth of the community and promote the blue economy policy of the country.

Since seaweed cultivation is seasonal, it is important to establish seaweed nurseries with quality seedlings catering for the demands of seaweed growers. The scientific fraternity needs to engage in the domestication of more economically important seaweeds along with breeding programmes for developing genetically improved strains or varieties with agronomically important traits with proven growth and yields of quality products.

The proposed seaweed parks should be set up with PPP mode in partnership with the scientific community participation to provide requisite technical services for the successful execution of the project.

The academic institutions in the country should recognize the emerging new seaweed sector and help to build new knowledge talent for strengthening and meeting the future demands of the seaweed industry.

To give a kick start to the seaweed programme in India, seaweed technologies should be harvested in both farming and processing along with the business plans for wooing prospective entrepreneurs.

The government also set up advanced S&T centres which dedicatedly work and bring in required innovations from time to time in the cultivation and downstream processing for sustainable development of seaweed industry in the country.

(The author is from the Indian Centre for Climate and Societal Impacts Research Mandvi-Katch 370465)

Jobs, Admissions & Events

Admissions

Univ of Agri Science, Bangalore Invites application from NRI for undergrad courses

Name of the Institute:The University of Agriculture Sciences, Bangalore.

Admission: Undergraduate degree programmes for 2021-22 under the NRI sponsored quotas.

Ten per cent seats over and above the intake strength reserved for NRI candidates or candidates sponsored by NRI or foreign nationals.

Applications and more:University website uasbangalore.edu.

Last date: November 30.

Seat availability:

1. B.SC. (Hons) Agriculture, College of Agriculture, GKVK Bengaluru ~ 27
2. B.Sc. (Hons) Agriculture, College of Agriculture VC Farm, Mandya – 10
3. B.Sc. (Hons) Agriculture, College of Agriculture, Karekare, Hassan – 10
4. B.Sc. (Hons) Agriculture, College of Sericulture, Kurubur, Chinthamani – 9
5. B.Sc. (Hons) Agriculture, College of Agriculture, Chamarajanagara – 4
6. B.Sc. (Hons) Sericulture, College of Sericulture, Kurubur, Chinthamanai – 4
7. B.Sc. (Hons) Agri-business management, College of Agriculture, GKVK–6
8. B.Tech (Agri engineering), College of Agri Engineering GKVK – 8
9. B.Tech (Biotechnology), College of Agriculture, Karekare, Hassan – 7
10. B.Tech (Food Technology), College of Agriculture, Karekare, Hassan – 7

Eligibility: 50 per cent of total marks in Physics, Chemistry, Mathematics and Biology.

Those who have studied only Physics, Chemistry and Mathematics (with 50 per cent of total marks) are eligible for B.Tech (Agriculture Engineering).

First preference shall be given for candidates with PCMB subjects during seat allotment followed by PCB/ PCM.

Accommodation: Hostel facilities, however, will not be available for NRI/NRI sponsored candidates. They have to make their boarding arrangements.

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ICAR-DIRECTORATE OF COLDWATER FISHERIES RESEARCH
(Indian Council of Agricultural Research)

Introduction

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

Mandate

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

Mission

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

Achievements

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