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I do not see any problem to Aquaculture as it produces nutritious food to people; Ensure quality produce !

Dear Readers,

The July 2020 issue of ***Aqua International*** is in your hands.

Even if Covid Pandemic continues, I do not see any problem to Aquaculture sector as this industry produces nutritious food like fish, shrimp etc for the people, and the people any time need these food products. Farmers, Hatcheries, Feed – Nutrition – Healthcare products producers, Processors and Equipment suppliers should play their role effectively and ensure supply of quality inputs for the production of antibiotic-free healthy fish and shrimps. All these segments should work sincerely and do not give any chance to be pointed out at the quality of fish and shrimp products for the consumers. Besides, there is a need of timely supply of inputs for the farming with smooth transport system for the transport of harvested shrimps to the processing plants and to consumer centers as well as to the export zones.

Help the needy people at this critical period

If Covid pandemic scare continues like this, people will in near future may find it difficult to have sufficient meal, particularly the poor and lower middle class category. Let us all try to check and help the needy people as much as possible and see that no one is empty stomach and in hungry. If things continue the same way, number of people die due to hungry will be more than the pandemic.

The Prime Minister now left this issue to the State governments, and many of the state governments are not working with a commitment to check whether people are infected with Corona virus. If it is positive, it is the responsibility of the government to protect the health and safety of the people. It would be better the government team go door to door and test people for the virus, and help people if found positive with virus.

The Central and State Governments are not spending any money from their own pocket, it is the public money collected through taxes and contributions which they are spending, and the Govt should be liberal in taking care of the needy people for food, healthcare, education, housing and other infrastructure facilities.

****

In the News section, you may find news about – In a bid to incentivise private investment in dairy and meat processing infrastructure, the Cabinet Committee on Economic Affairs has given its nod to set up a Rs 15,000-crore Animal Husbandry Infrastructure Development Fund. The Fund had been proposed as part of the Aatmanirbhar Bharat package last month. For the first time since its inception in 2009, the Aquatic Quarantine Facility (AQF), a premier institution of RGCAMPEDA, received 3,600 nos. of L. vannamei (White leg shrimp) broodstock imported by India's shrimp hatchery operators from Hawaii, USA in June, providing a firewall against the entry and spread of pathogens in animals through rigorous quarantine measures during the COVID-19 pandemic. The import of broodstock, which came as a single consignment from a single source, was facilitated by a chartered flight by six hatchery operators on June 4. The broodstock were successfully quarantined for five days and handed over to the hatchery operators with 97.12% of survival on June 8.

The production of Karimeen or Pearl Spot fish, globally known for its tender flesh, delectable taste and high-yielding market value, has got a major boost with the Multispecies Aquaculture Complex (MAC) of MPEDA at Vallarpadam developing facilities for its commercial scale breeding and seed production, offering a lucrative alternative to fish farmers to grow it round-the-year.

Andhra Pradesh government has initiated several measures to improve the blue economy, which is not only expected to rake in more revenue, but also augment employment. According to the Socio-Economic Survey, fish production improved to 41.75 lakh metric tonnes (MT) in 2019-20 compared to 39.92 lakh MT in the fiscal year 2018-19. Andhra Pradesh has favourable agro-climatic conditions for the growth of fisheries and aquaculture sector. Contributing over 24 per cent to national fish production, the State is a major exporter of shrimps in India with a share of 36 per cent in total value of sea food exports. The sector has also given employment to 14.5 lakh persons. T Purushothaman, a leading shrimp farmer from Kerala who adopted innovative technologies for sustainable utilisation of highly prospective brackishwater resources in the state has won national recognition. He received the prestigious Jagjivan Ram Innovative Farmer award instituted by the Indian Council of Agricultural Research under the Ministry of Agriculture and Farmers Welfare. The award is in recognition of his outstanding contributions for the development of diversified aquaculture practices utilising the technological advancements.

In the articles section, there are five articles published in this issue on different topics on aquaculture .

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

M.A.Nazeer
Editor & Publisher
Aqua International

NRS GROUP

Aqua International

Our Mission

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

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

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

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

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

EU-Vietnam free trade pact may hurt India the most

Export of footwear, garments, marine products and furniture may take a knock

Marine exports is one area which is causing concern to India

India's exports of footwear, garments, marine products and furniture to the European Union stand to be the worst-hit once the 27-member bloc starts dismantling its tariffs for Vietnam under the EU-Vietnam free trade agreement (EVFTA) to be operational soon.

New Delhi is keen to expedite its own bilateral free trade negotiations with the bloc, which could level the playing field for its exporters, but will not be rushed into a deal, say experts and officials.

There are still wide gaps between the two in areas such as intellectual property, government procurement, investment protection, labour, environment and market access for sensitive products that need to be bridged, they say.

The EU-Vietnam free trade agreement is an ambitious pact eliminating almost 99 per cent of customs duties between the EU and Vietnam.

Exporters worried

"Indian exporters are apprehensive about losing their markets in the EU to Vietnam for key products where its competitor will soon have the advantage of duty-free access because of its FTA with the bloc. India can nullify this advantage by concluding its own FTA but it needs to move carefully as a hurried deal may result in the industry losing more than it gains.

"We are ready to talk with the EU whenever it shows interest," a government official told BusinessLine.

In the EU market for apparels and marine products, where the two countries have almost equal share of $7 billion and $1 billion each respectively, Vietnam will benefit when its import duties reduce to zero under the FTA while India continues to pay 9 per cent duty on apparels and 6 per cent on marine, said Ajay Sahai from the Federation of Indian Export Organisations (FIEO).

"In footwear, where Vietnam exports $7.5 billion worth of items compared to India's $1.6 billion, the advantage will be enhanced once EU reduced tariffs for Vietnam to zero from 8 per cent. Similarly, in furniture, where India had started making inroads into the EU with imports of over $900 million, Vietnam's share of $1.5 billion is likely to increase several-fold when the import duty of 6 per cent is eliminated, Sahai said.

'Speed up talks'

FIEO has recently asked the Commerce Ministry to expedite negotiations on the broad-based trade and investment agreement (BTIA), launched way back in 2007, but stalled since 2013 due to disagreements over key areas.

Although India expressed its willingness to get back into the talks late last year, the EU had made it conditional that issues such as government procurement, labour standards and sustainability have to be included which India finds difficult to accept.

"Trying to undercut the EVFTA by doing our own FTA will have its own problems. We can't ignore the fact that there are market access issues on the EU side as well with the bloc insistent on opening up of sensitive sectors such as automobiles and wine & spirits," pointed out Biswajit Dhar, Professor, JNU.

The EVFTA will also make Vietnam a more advantageous location for investments moving out of China due to the China-US trade war, Dhar added.

Vietnam, which had lagged much behind India in the EU market some years back, has almost caught up with the country. Vietnam's exports to the bloc in 2019 was $53 billion compared to India's exports of $58 billion, Sahai said.

Courtesy: Business Line

Vietnam to ramp up organic aquaculture production before 2025

Vietnam's push towards organic agriculture could impact aquaculture output, creating market space for organic aquaculture

The Vietnam News Agency reports that Deputy Prime Minister Trinh Dinh Dung has recently signed off on the Organic Agriculture Development Project for 2020-2030 in hopes of seizing the leading edge in organic agriculture production.

As part of this push to convert land to organic production, the government hopes organic aquaculture will account for about 0.5 to 1.5 percent of the total aquaculture area before 2030. Vietnam also plans to improve the efficiency of organic production across all sectors aiming to have the product value per one hectare of organic cultivation and aquaculture land perform 1.3 to 1.5 times higher than that of non-organic production.

The Vietnam News Agency says that the project will initially focus on developing concentrated organic agricultural production regions and then move towards diversifying forms of organic production.

The initiative also plans to embrace new technology while increasing processing, consumption and export of organic aquaculture and agriculture products from Vietnam.

Indian seafood export to pick up in the second half of 2020

After a decline in the first half of 2019, the seafood exports rose sharply towards the end of the year resulting in record shrimp production of over 800,000 tonnes. China and the US bought substantial quantities of shrimp from India in the last few months of the year, the president of Society of Aquaculture Professionals said.

KOCHI: Indian seafood industry expects the exports to pick up in the second half of the year with the increase in the import of shrimp broodstock.

The broodstock import of Vannamei shrimp, the mainstay of $6.7 bilion Indian seafood export, was disrupted for several weeks due to Covid 19 lockdown.

``It has improved and we foresee a jump in export in the second half of 2020 like it happened in the previous year,'' said Ravi Kumar Yellenki, president of Society of Aquaculture Professionals ..

After a decline in the first half of 2019, the seafood exports rose sharply towards the end of the year resulting in record shrimp production of over 800,000 tonnes. . China and the US bought substantial quantities of shrimp from India in the last few months of the year, Yellenki said.

In April this year we had 25% increase in exports to the US with China also consuming higher quantities. But broodstock imports not being there for 50 days from March 22 to May 12 and the subsequent imports at 50% of normal may impact the export in June and July,'' he said.

He anticipates the shrimp production to be down by 10-15% down from last year because of a gap in broodstock imports, on which India is heavily dependent for shrimp aquaculture production.

About 70% of the seafood export proceeds of the country are from shrimps.

Overseas demand has picked up from last month but as most of the countries have initiated measures to tackle Covid-19, it is still subdued. ``Aggressive demand is not there and the prices have dropped in China and the US markets. In Europe, however, there is 10 to 15% slump in demand,'' said Jagdish V Fofandi, president of Seafood Exporters Association of India.

He said while there has been only a marginal drop in the prices in the US market, it is 20 to 25% for various products in China. ``We are seeing lower demand for cuttle fish, croaker and ribbon fish , regular imports by China. They have cut prices citing lower movement of products in the market,'' Fofandi said.

Official data of Indian seafood exports for 2019-20 is yet to be announced but the industry reckons that it could fall short of targeted $7 billion as the exports were hit by Covid pandemic in the last two months of the fiscal. The US is currently the largest buyer of Indian seafood followed by China.

Centre keen to boost fisheries economy

Under various schemes, the government is looking to invest $9 billion over the next five years

Kochi, July 20: The Centre has come up with a comprehensive plan to revamp and accelerate the growth of the fisheries sector through various schemes, including the recently launched Pradhan Mantri Matsya Sampada Yojana (PMMSY).

Explaining the Centre's proposed plans, the Secretary of Fisheries, Rajeev Ranjan, said the government was looking at scaling up the fisheries economy. Citing the latest data, he claimed that India's fisheries sector was on a trajectory of progress, with an average annual growth rate of close to 11 per cent over the last five years. The growth rate of the country's fish production during this period was 7.53 per cent while it was nearly 10 per cent in exports, he added.

He was speaking after inaugurating a digital conference on "Emerging technologies in brackishwater aquaculture" hosted by the ICAR-Central Institute of Brackishwater Aquaculture (CIBA).

Indigenous shrimp varieties

The government was eyeing a total fish production of 220 lakh tonnes over the next five years. The latest estimate of the fish production during 2019-20 in India was close to 150 lakh tonnes, he said.

The government has unveiled a comprehensive plan that aims to address infrastructure modernisation, critical gaps in value chain, post-harvest management, traceability and quality control under the PMMSY scheme. Under various schemes, the government was looking for a total investment of $9 billion over the next five years from the government sector, he said.

The government also aims to double the average per capita fish consumption in India to 9-10 kg, which at present is 5-6 kg. But this is still far below the global average of 20-21 kg.

The Centre is looking to double the exports of aquaculture production. Presently, the export in terms of value is almost $ 7 billion of which the majority share comes from shrimp export.

The government was in favour of producing diversified aquaculture species, especially indigenous shrimp varieties. He signalled shifting of the trend from single focus on vannamei to diversified shrimp species, including the native varieties such as the Indian white shrimp.

The Fisheries Secretary asked CIBA to take up leadership in a flagship programme enabling the commercial production of such shrimp varieties.

MPEDA's Multispecies Aquaculture Complex develops commercial-scale seed production of Karimeen fish

Initiative to boost round-the-year production of Karimeen, the 'State Fish' of Kerala

K.S. Srinivas, Chairman, MPEDA & President, RGCA inaugurating the sale of first batch of Karimeen seed produced from MAC recently. K.V.Gangadharan, Asst.Technical Manager, MAC, Jeevan, P. Gangadharan, Farmer, B.Sreekumar, Advisor, MPEDA, Dr M.Karthikeyan, Director, MPEDA and Dr T.G.Manojkumar, Project Manager, MAC are seen in the picture.

Kochi: The production of Karimeen or Pearl Spot fish, globally known for its tender flesh, delectable taste and high-yielding market value, has got a major boost with the Multispecies Aquaculture Complex (MAC) of MPEDA at Vallarpadam developing facilities for its commercial-scale breeding and seed production, offering a lucrative alternative to fish farmers to grow it round-the-year.

Girija Sankar GRD Enterprises and K.S.Srinivas, Chairman, MPEDA & President, RGCA

MPEDA Chairman Mr K S Srinivas, while inaugurating the sale of first batch of Karimeen seed produced from MAC here recently, said the commercial production would enable farmers to get good quality seeds throughout the year and enhance the production of the fish in the state.

In 2010 the Kerala government had declared Karimeen (Etroplus suratensis) as the 'State Fish' to protect this costly fish from over-exploitation, considering its food and economic value and a major attraction of culinary tourism. Cultured in traditional ponds in the state, it commands a high price of Rs. 500-600 a kg.

"The production of Karimeen should be substantially boosted in order to make it a candidate species for export. Now a days, the farmers are mainly depending on wild caught seeds for culture. Too much dependency on the seeds from the wild will lead to over-exploitation," Mr Srinivas pointed out.

"To overcome this, MPEDA has developed facilities for commercial-scale breeding and seed production for Pearl Spot at its Multispecies Aquaculture Complex at Vallarpadam," he added.

> *"Initially only seeds of tiger shrimp were produced in MAC and the smaller seeds of other species brought from other RGCA facilities were sold to farmers after nursery rearing"*

Known as the unofficial brand ambassador of God's Own Country, Pearl Spot is an indigenous fish extensively found along the east and south-west coasts of Peninsular India. It is an important candidate species for aquaculture in ponds, in both brackish water and freshwater.

> *"During the current year, seed production of GIFT and Karimeen, along with tiger shrimp, has been initiated in MAC. The seeds will be supplied to farmers on a continuous basis. MAC has also planned to initiate seed production of other commercially important species in future"*

The Marine Products Export Development Authority (MPEDA), through its R&D arm Rajiv Gandhi Centre for Aquaculture (RGCA) initiated the functioning of MAC during December 2018 to revive the farming of Black Tiger shrimp and also to diversify the aquaculture in the west coast of the country through continuous supply of GIFT (Tilapia), Asian Seabass and Pompano seeds. In 18 months, MAC has supplied 11.7 million seeds of different species to 3,236 beneficiaries.

The MPEDA Chairman said initially only seeds of tiger shrimp were produced in MAC and the smaller seeds of other species brought from other RGCA facilities were sold to farmers after nursery rearing.

During the current year, seed production of GIFT and Karimeen, along with tiger shrimp, has been initiated in MAC. The seeds will be supplied to farmers on a continuous basis. MAC has also planned to initiate seed production of other commercially important species in future.

Fish Farmers Day 2020 celebrated by ICAR-CIFRI, Barrackpore

The National Fish Farmers Day (NFFD 2020) was celebrated by ICAR-CIFRI, Barrackpore in virtual mode on 10/7/2020 during 3.00-6.00pm. Dr B. K. Das, Director, CIFRI and Convenor, NFFD 2020 spoke about discovery of induced breeding of fishes, significance of this day and aiming to achieve 22 million tonne fish production target in India by 2024-2025 by implementing PMMSY (Pradhan Mantri Matsya Sampad Yojana) scheme. Dr M. Sinha, Former Director (FD), CIFRI paid tribute to predecessor Dr Hiralal Chaudhuri, highlighted the incident of 1957 when IMC could be bred in captivity for first time, efforts of Dr Chaudhuri and Dr K. H. Alikunhi that helped us to reach great heights in fish production. Dr A. P. Sharma, FD, CIFRI spoke about need of conservation/ resurrection of wetlands adjoining river Ganga, its fishery and small fishes, occurrence of reduction in their ecological services, Matsyasamriddhi, increasing area of fish culture and species diversification, production and supply of quality fish feed in current pandemic situation, road map to prepare fisheries hub for north Indian states.

Dr C. N. Ravishankar, Director, ICAR-CIFT, Kochi spoke about post-harvest processing protocol developed for different fishes, its extension (technology transfer), fish safety and business incubation unit at CIFT.

Dr A. Gopalakrishnan, Director, ICAR-CMFRI mentioned about farmers' meet organized in morning at CMFRI Mandapam and significance of Matsyakisan Divas. Dr Gopal Krishna, Director, ICAR-CIFE, Mumbai stated that farmers are real backbone of fishery sector; spoke about controlled exploitation of aquatic resources for benefit of mankind, use of resources for benefit of society, importance of fishery sector to society, great revolution brought about by Dr Chaudhuri's discovery, development and innovation, bringing ICAR technologies to people and making their use by fish farmers that will bring real success.

Dr J. K. Jena, DDG (Fisheries Science), ICAR and Patron, NFFD 2020 spoke about remarkable success achieved by Pond Culture Division of CIFRI at Anugul farm and Cuttack Kila farm in 1957; induced breeding technology developed for 60-62 fish species in India, no use of riverine seeds now; 200 billion spawn produced annually and 60% contributed by West Bengal using the technology; separate Ministry for Fisheries established at Govt of India and significance of novel PMMSY scheme; need of proper dissemination process of technologies via FPOs, NGOs, SHGs and reaching to farmers; importance of ornamental fishery and fish feed plant; infectious diseases, climate change, anti-microbial resistance and COVID-19 as challenges to Indian fishery and aquaculture sector. Dr Jena also spoke about doubling farmers' income, production of quality fishes, different edible fishes to be produced and brought to market in different areas, increasing fish production and productivity, problems faced by farmers must be noted, PM's initiative of 'Atmanirbhar Bharat'. Dr Jena praised efforts of CIFRI in holding this NFFD celebration programme, which has brought (connected) farmers from different states together even in midst of unexpected COVID-19 situation. Hatchery seed producers deserve credit; he congratulated society, fish farmers and fishery science for contributing to fishery development, stated that 20-25% of all ponds do not hold water for more than 3-4 months and resource assessment is important. He highlighted issues like hybridization, inbreeding depression, problems due to backcrosses in fish seed production and possible means to improve fish seed quality; NBFGR project with hatcheries on application of bulk cryopreserved milt from high quality brooders for breed improvement; importance of RAS, biofloc technology, value addition and education system in fisheries; existence of proper market for fishes produced in ponds; quality product must reach to consumers; improvement in market of processed fishes. Farmers, scientists, Hon'ble PM - we all have expectations and opportunities and we must not lose hope.

Mr P. C. Sarangi, Hon'ble Minister of State, Ministry of Fisheries, Animal Husbandry and Dairying and Chief Guest remembered Dr H. L. Chaudhuri as 'Father of induced breeding', whose discovery was a milestone in Indian fishery and we have to march ahead; mentioned that Hon'ble PM has understood importance of Fishery Department, separate Fisheries Ministry set-up, earlier PM introduced Neelkranti and now announced PMMSY; fish can remove hunger and is cheapest source of protein; our target to become first in fish production in world; research and innovation should be given more importance; increasing income of farmers by year 2024; increasing production of reservoirs; capturing domestic market, reducing cost of production and post-harvest losses; potentiality of seaweed culture; importance of organic fish farming; promoting exports. Mr Sarangi also spoke about raising standard of living of fish farmers who possess vast knowledge and years-long experience (Anubhab); emphasizing researches; exchange of knowledge between farmers and scientists, learning from farmers; our nation can reach to new heights through involvement of all concerned. Dr B. K. Das expressed his interest to Sri Sarangi about converting Anugul fish farm (fish breeding site near Jagannath

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Rs 15,000 cr. to promote private investment in dairy, poultry and meat-processing units

90% of loan component of beneficiaries to be made available by scheduled banks, says govt.

In a bid to incentivise private investment in dairy and meat processing infrastructure, the Cabinet Committee on Economic Affairs has given its nod to set up a ₹15,000-crore Animal Husbandry Infrastructure Development Fund. The Fund had been proposed as part of the Aatmanirbhar Bharat package last month. Although there are several schemes to promote investment by dairy cooperatives, the Centre now realises that private players, especially small enterprises, also need incentives to invest in dairy and meat processing, value addition infrastructure and establishment of animal feed plants, according to an official statement. "Eligible beneficiaries include Farmer Producer Organisations, MSMEs, Section 8 companies, private companies and individual entrepreneurs with minimum 10% margin money contribution by them. The balance 90% would be the loan component to be made available by scheduled banks," said the statement. The Centre will provide 3% interest subvention to the beneficiaries, with a two-year moratorium period for the principal loan amount and six year repayment period after that. Animal Husbandry Minister Giriraj Singh told journalists after the Cabinet meeting that exports would also benefit pointing to the huge market for international cheeses which could be met by the dairy players if the infrastructure was available. As almost 50-60% of the final value of dairy output flows back to farmers, the Fund will have a direct impact on farmer's income, he said, adding that it would result in direct and indirect livelihood creation for 35 lakh people.

Fish Farmers Day 2020 celebrated by ICAR-CIFRI, Barrackpore

Contn from Page 20

mandir) to a heritage centre.

While speaking about the significance of this day, Dr D. Kumar, FD, ICAR-CIFE stated that no farming sector can prosper without quality seed. Now 20 times more fish produced in India since 1957; neighbouring countries have adopted this technology also and it will help us to reach the 22 million tonne production target. He upholded contribution of fish farmers, spoke about further innovation and modification of the technique and farmers' involvement with ICAR institutes, honouring technical knowledge, building technical capacity in research and academic institutions can become a way forward to progress.

In this programme, progressive and experienced fishers and fish farmers viz., Sukdev Nath; S. Rangasamy, Tamil Nadu; Dinanath Singh; Alakesh Das, Meghalaya; Ajith P. K., Kerala; Pabitra Tripathy, Ganjam and another farmer from Keshpur, Balasore, Odisha; Prashant Jaiswal, Gujarat; Naresh Sahni, East Champaran, Bihar; K. N. Rishi; Tutumoni Medhi, Assam; Biswajit Majumdar, Tripura; Bijoy Roy, Kalna, Purba Bardhaman, Bablu Majumdar, North 24 Pgs and a farmer from Kolaghat, Purba Medinipur, WB; H. Sanayaima, Manipur; H. Gogoi, Arunachal Pradesh expressed the benefit/ success they obtained in cage culture and pen culture after obtaining training, demonstration and guidance of CIFRI scientists. Few farmers raised genuine problems like new disease of fish brooders; non-availability of fish feed and loss incurred in lockdown situation; need of ice box, more training and facilities to test pond water and soil; initiation of FPO - these were addressed by Dr Jena and other scientists. News communicator Subrato Ghosh participated in this NFFD 2020 programme entirely.

India's marine fish production records slight increase in 2019

Kerala's landings down by 15%; Oil sardine catch lowest in two decades in state

Kochi: India's marine fish production registered a marginal increase of 2.1% in 2019 compared to the previous year with the country recording 3.56 million tonnes in total landings from across the coasts during the year, according to the Central Marine Fisheries Research Institute (CMFRI). A study report on annual marine fish landings estimates in the country during the last year released here by the CMFRI also showed that Tamil Nadu grabbed the first position in the landings with 7.75 lakh tonnes followed by Gujarat (7.49 lakh t), which was holding the first position for a past few years, and Kerala (5.44 lakh t) which retained the third position.

The data showed an unusual feature of a commercially unimportant fish becoming the most landed resource with the red toothed trigger fish (2.74 lakh t)registering a huge increase in the landings across the coasts of the country. Ironically, this fishhas little demand in domestic markets and ismostly caught for the purpose of feed mills. In another major highlight of the data, Indian mackerel, which was in the first spot in 2018, suffered the highest setback with its landingsdeclining by 43% during the last year. While the states such as West Bengal (55%), Andhra Pradesh (34%), Odisha (14.5%),Karnataka (11%) and Tamil Nadu (10.4%) recorded increase in the landings, the marine fish catch decreased in Maharashtra (32%), Goa (44%) and Kerala (15.4%)compared to the previous year. The second highest landings in national-level is ribbon fish(2.19 lakh t) followed by penaeid prawns (1.95 lakh t) and non-penaeid prawns (1.80 lakh t).

As many as 8 cyclonic storms in and around India of which 6 of them turned out to be severe cyclones (Fani in April, Vayu in June, Hika in September, Kyarr in October, Maha in Oct-Nov and Bulbul in Oct-Nov) affected the fishing calendar days more adversely on the west coast of the country.

Kerala's landings down by 15%; sharp decline in oil sardine and Indian mackerel

Kerala suffered a significant drop of 15.4% in the marine fish landings during the last year witha total landings of 5.44 lakh tonnes. Sharp decline in the catch of oil sardine and Indian mackerel, the two major resources in the state, is the major highlightof Kerala's landings. While oil sardine dropped to a meagre 44,320 tonnes, the lowest catch in two decades, Indian mackerel (40,554 t) experienced a steep decline of 50% compared to the previous year. In 2012, the catch of oil sardine in Kerala was 3.9 lakh tonnes. Since then, there was a substantial decrease in the catch every year, but it moved up in 2017. The oil sardine landings again continued to decline for the past two years thanks to the unfavourable changes in ocean environment. After analysing the correlation between the ocean environment and biological cycle of the oil sardine, the CMFRI had forecasted in January last year that sardine would be declined in the yearin Kerala waters. The contribution from Kerala towards the overall landings in the country reduced to 15.3% from 18.4% in 2018.

The anchovies group (74.194 t) tops the list of the most landed resources in the state followed by red toothed trigger fish (62,782t) and penaeid prawns (46,615 t).

Increase in value of fish

The estimate of the value of marine fish landings based on price at landing centres across the country during 2019 was Rs 60,881 crores with 15.6% increase over 2018.The unit price per kg of fish at landing centre rate was Rs. 170.5(12.2% increase). At the retail level, the estimated value of marine fish was Rs. 92,356 crores (15% increase over 2018). The unit price at the retail market level was Rs.258.7 (12% increase over 2018). The marketing efficiency determining the producer's share of the consumers was found to be 66 (0.6 % increase over 2018).

The Fishery Resources Assessment Division of the CMFRI estimated the annual marine fish landingsof the country through its online data collection system.

CMFRI DirectorDr A Gopalakrishnan, Dr T V Sathianandan, , Dr PrathibhaRohit, Dr P U Zacharia, Dr P Laxmilatha, Dr E M Abdussamad, Dr C Ramachandran and Dr Josileen Josewere present on the news conference.

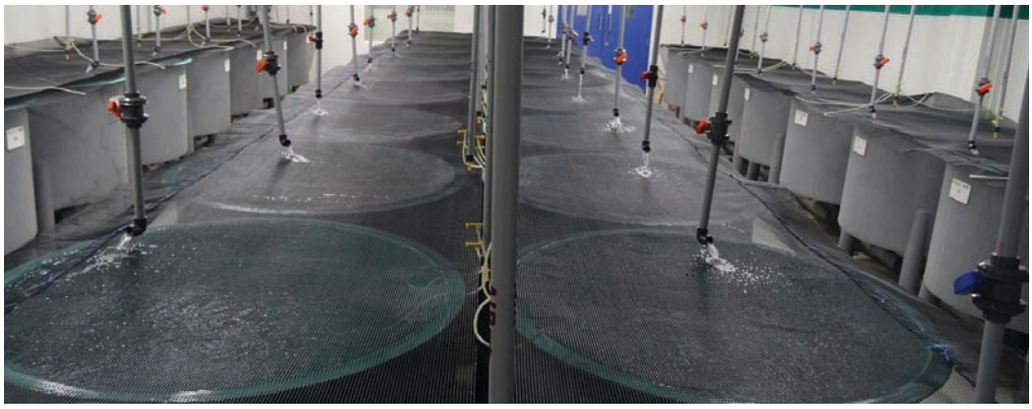
Top 5 species (All India)

1	Red toothed trigger fish	: 2.74 lakh tonnes
2	Ribbon fish	: 2.19 lakh t
3	Cephalopods	: 2.18 lakh t
4	Anochovies	: 1.95 lakh t
5	Penaeid prawns	:1.95 lakh t

Top 5 species (Kerala)

1	Anochovies	: 74, 194 tonnes
2	Red toothed trigger fish	: 62, 782 t
3	Penaeid prawns	: 46, 615 t
4	Oil sardine	: 44,320 t
5	Indian Mackerel	: 40, 554 t

MPEDA's Aquatic Quarantine Facility receives consignment of Whiteleg shrimp broodstock from USA



Kochi: For the first time since its inception in 2009, the Aquatic Quarantine Facility (AQF), a premier institution of RGCA-MPEDA, received 3,600 nos. of L. vannamei (Whiteleg shrimp) broodstock imported by India's shrimp hatchery operators from Hawaii, USA in June, providing a firewall against the entry and spread of pathogens in animals through rigorous quarantine measures during the COVID-19 pandemic.

The import of broodstock, which came as a single consignment from a single source, was facilitated by a chartered flight by six hatchery operators on June 4. The broodstock were successfully quarantined for five days and handed over to the hatchery operators with 97.12% of survival on June 8.

Marine Products Export Development Authority (MPEDA) Chairman K S Srinivas said all the broodstock were confirmed their SPF (specific pathogen free) status by screening of OIE (World Organisation for Animal Health) and non-OIE-listed pathogens.

Although the broodstock arrived at the airport 10 hours later than the scheduled time, the strict bio-security protocol followed in the AQF ensured their successful quarantining and secured the high survival percentage, a press release from MPEDA said.

The brooders were brought through cargo flights instead of passenger flights and the animals were under severe stress due to longer travel time, it said.

"However, the dedicated and positive efforts of AQF team ensured better survival of the brooders during difficult times of quarantine, and such an initiative was highly appreciated by the hatchery operators and farmers," he noted.

Srinivas said the remarkable feat would play an important role in sustaining the shrimp farming sector in the country.

He also appreciated the help rendered by Coastal Aquaculture Authority (CAA) of the Ministry of Fisheries, Government of India, for the successful operation of AQF in these difficult times.

India holds second position in shrimp production in the world mainly due to L. vannamei species and Chennai-based AQF has rendered unstinted service in supporting the Whiteleg shrimp farming sector in the country.

"During the COVID-19 pandemic and prolonged lockdown, AQF was made open for the hatchery operators in May and meticulous planning was done to accommodate maximum hatcheries and import maximum broodstock to ensure that the hatcheries get adequate brooders to produce seeds," he said.

AQF is being operated by Rajiv Gandhi Centre for Aquatics (RGCA), an institution under MPEDA.

At present, 20 cubicles are established for quarantining 4,12,500 nos. of L. Vannamei broodstock in a year and an average 2.5 lakh of broodstock are being quarantined in the AQF every year. It has so far quarantined more than 15 lakhs of Whiteleg shrimp broodstock imported by shrimp hatchery operators in the country.

The facility also caters to the needs of quarantine of Post Parental Larvae (PPL) of Whiteleg shrimp and facilitates quarantine of imported broodstock of P. Monodon (giant tiger prawn or Asian tiger shrimp) as well.

Srinivas said that the announcements made by Finance Minister Nirmala Sitharaman on April 23 with regard to AQF operation during the COVID pandemic, such as rebooking of quarantine cubicle for cancelled consignment, condoning of delay up to one month in the arrival of the consignment and extended period of SIP (Sanitary Import Permit) for three months up to June this year, have been complied successfully.

He lauded the service rendered by the AQF team which worked round the clock during the COVID-19 pandemic to support the shrimp sector.

So far since the re-opening of AQF in May this year, 46 hatcheries have brought 25,496 nos. of broodstock from various overseas suppliers and one entrepreneur brought 40,000 nos. of Parental Post Larvae (PPL) for their Broodstock Multiplication Centre. All these were quarantined in the facility. Further, another 25,000 nos. of broodstock are expected to be quarantined by the end of June, which will support L. vannamei aquaculture sector in India, the release added.

Andhra Pradesh government focusing on rejuvenating blue economy in the State

Fishing on high seas is a perilous activity and the fishermen ply their trade risking their lives to support their families

Vijayawada: The state government has initiated several measures to improve the blue economy, which is not only expected to rake in more revenue, but also augment employment.

According to the Socio-Economic Survey, fish production improved to 41.75 lakh metric tonnes (MT) in 2019-20 compared to 39.92 lakh MT in the fiscal year 2018-19.

Andhra Pradesh has favourable agro-climatic conditions for growth of fisheries and aquaculture sector. Contributing over 24 per cent to national fish production, the State is a major exporter of shrimps in India with a share of 36 per cent in total value of sea food exports. The sector is also given employment to 14.5 lakh persons.

To utilise the State's coastline, construction of fishing jetties and fish landing centres have been planned and, to this end, Rs 100 crore was allocated during 2019-20. Promotion of deep sea fishing, open sea cage and seaweed culture, promotion of alternative species for brackish water aquaculture, promotion of value-added products, cold chain facilities, promotion of new technologies, cage culture in suitable reservoirs, supply of nets, boats and other inputs on subsidy basis, aqua zonation for area expansion, organic aqua farming are part of strategy adopted by the government.

Apart from improving infrastructure, the State, focusing on welfare of the fishermen, is implementing YSR Matsyakara Bharosa to provide financial aid to them, during the ban on fishing in the sea. Under the said programme, relief being provided to the fishermen has been enhanced from Rs 4,000 to Rs 10,000 per family. In 2019-20, an amount of Rs 102.33 crore was spent to benefit 1,02,332 fishermen families.

Fishing on high seas is a perilous activity and the fishermen ply their trade risking their lives to support their families. In case the fishermen lose their lives, a compensation of Rs 5 lakh is paid per family till 2018-19. The same was doubled in 2019-20 to Rs 10 lakh.

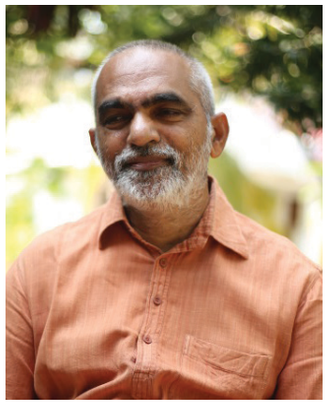
Kerala shrimp farmer wins national recognition

Kochi: T Purushothaman, a leading shrimp farmer from Kerala who adopted innovative technologies for the sustainable utilisation of highly prospective brackishwater resources in the state has won national recognition. He received the prestigious Jagjivan Ram Innovative Farmer award instituted by the Indian Council of Agricultural Research (ICAR) under the Ministry of Agriculture and Farmers Welfare. The award is in recognition of his outstanding contributions for the development of diversified aquaculture practices utilising the technological advancements.

An experienced aqua-farmer who specially focuses on farming indigenous species by strictly follows scientific principles, Shri Purushothaman adopted various technologies of the Chennai based Central Institute of Brackiswater Aquaculture (CIBA), which helped him develop innovative practices such as zero water exchange system of indigenous shrimp farming and multi-trophic species diversification.

The award includes a cash cheque of Rs 50,000 and citation.

Utilising the brackishwater resources, both ponds and open water bodies, he optimised his farm resources by integrating farming of brackish fish and shrimp with vegetable cultivation on farm bunds.



T Purushothaman

Mr Purushothaman used species such as indigenous shrimps (Tiger shrimp and Indian white shrimp), Asian seabass, milkfish, pearlspot and green mussel for the farming by adopting novel farming systems like cages, pens and rope culture methods which in turn helped him enhance overall production and profit. Purushothaman, who hails from Kannur, is operating 4.5 ha water spread area and two acres of aquaculture ponds.

During the last five years, this is the fourth time the CIBA is bagging ICAR's fish farmer award.

About the Jagjivan Ram Innovative Farmer Award Indian Council of Agricultural Research (ICAR) announces this award every year in order to recognise the outstanding contributions of innovative farmers for initiatives in development adoption, modification and dissemination of improved technology and practices for increased income with sustainability.

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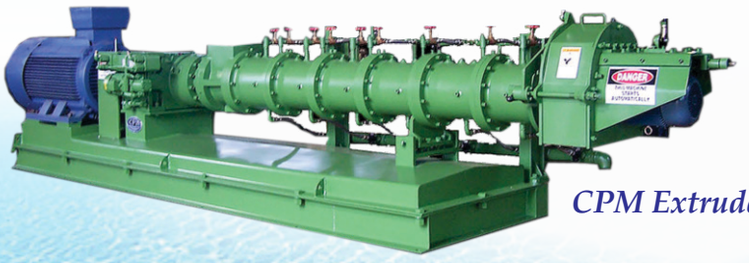

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Digestion and absorption of nutrients in fish larvae

▶ The knowledge on digestive system of a fish larvae is essential to understand the functions and limitations underlying in physiological mechanisms during early life stages. ▶ The complete development of the alimentary canal of larvae and its associated organs has been observed after the onset of exogenous feeding. ▶ Hence, wide understanding is essential regardingoptimal ingestion, digestion, and absorption of nutrients to formulate and preparethe diets for larval culture and rearing conditions.

Sangavi. S

Introduction

The digestive system of a fish larvae is the entrance of nutrients into the body, and it is, therefore, essential to understand the functions and limitations in underlying physiological mechanisms during early life stages. The morphological development of the alimentary canal, together with a few key factors such as digestive enzymes, has been studied in several species. It has been found that the complete development of the alimentary canal and its associated organs after the onset of exogenous feeding.

Morphology of the digestive system

In general, the gastrointestinal tract of first-feeding larvae is a simple, relatively undifferentiated tube with only one sphincter (intestinal-rectal valve) before the anal opening. Some species have a rotated gut at the onset of exogenous feeding, while other species have a straight gut. Different cell types that can be identified in the epithelial layer include enterocytes, single enteroendocrine cells (produce and secrete peptide hormones), goblet cells (mucus-producing cells), and special enterocytes identified as "antigen-presenting cells." Goblet cells can be identified in all abdominal regions, while the distribution of the enteroendocrine cells varies between larval types.

The stomach develops from a transitional region between the esophagus and the intestine after peak metamorphosis. After the onset of metamorphosis, there is a steady fall in luminal pH, and the specific activity of pepsin continues to increase. The pyloric cecae develop slowly and in parallel with the development of the stomach.

The midgut appears to be alkaline throughout development (Rønnestad *etal.*, 2000a). The hindgut is a separatecompartment from the onset of first feeding. Inadult vertebrates, the hindgut is mainly associated with final adjustments in the water and ioncomposition of the feces.

The exocrine pancreas appears to be functional before the onset of exogenous feeding. The secretory cellsproduce characteristic zymogen granulae thatcontain a series of proenzymes. In contrast to adults, the exocrine pancreas in teleost larvae is acompact and distinct organ - *pancreas compactum*.The adult *pancreas diffusum* is acquired during thelate larval and early juvenile phases.

In terms of digestion, the primary role of the liver is the production of bile. The hepatocytes produce biliary salts before the onset ofexogenous feeding. The liver and gall bladder are differentiated at hatching and functional beforefirst-feeding in many fish species. The gall bladder servesas a storage site for bile produced by the liver and isresponsible for the release of bile into the midgut.

Secretion and re-absorption of secretes

Digestive enzymes, bile, ions, and mucus are secreted in a watery solution into the lumen of the digestive tract as part of the digestive process. As part of the mass balance, a large amount of these secretes must be reabsorbed to save energy, water, and ions. The secretion of these components is believed to be under both hormonal and neural control. The amount of pancreatic trypsin and trypsinogen secreted into the gut increased as the number of ingested prey increased until a plateau was reached at high levels of food intake. Marine fish larvae live in a hyperosmotic environment, which makes regulation of water and ions a demanding and critical task. Bile is known to be reabsorbed and reused during the processing of a meal in fish larvae, particularly during periods of high ingestion rates and short gut retention times.

Digestion of nutrients Proteins

Fish larvae protein digestion, along with proteolytic enzymes secretions, is found to be low until the commencement of exogenous feeding. Due to the lack of a stomach, altricial fish larvae lack HCl- and pepsin-secreting cells and so the digestibility and assimilation of protein in pregastric larvae is lower than in post-metamorphic fish. In cod and halibut, the enterocytes enzymes activities present in the brush border membrane are low at first feeding but increase during larval development (Kvåle *et al.*, 2007). It has also shown that cytosolic peptidases involved in the breakdown of protein after pinocytosis. Studies suggest that uptake of FAA, peptides, and hydrolyzed proteins in larvae increases gradually throughout ontogeny by proteolytic enzymes rather than by its absorptive capacity (Tonheim *et al.*, 2005).

Lipids

In fish larvae, the major lipase found to be bile-salt dependent and non-specific, producing mainly FFA and 2-MAG (monoacylglycerol). Apart from these, significant levels have been observed on pancreatic lipases at the onset of exogenous feeding. Also, lipid absorption capacities were found even before the complete absorption of yolk reserves, and the activity of BAL is induced by feeding and is low in unfed larvae. Morphological observations of the digestive tract just after the start of exogenous feeding revealed the presence of lipid vacuoles in the larval intestine of several species, e.g., Gilthead seabream, and Senegalese sole, etc. Therefore, the prevailing opinion is that fish larvae are capable of digesting and absorbing lipids from the start of exogenous feeding (Hoehne-Reitan *et al.* 2001c).

Absorption of nutrients Protein

The main absorption of dietary proteins, peptides, and AA in larval fish has been proposed to occur in the midgut (Rønnestad &Conceição, 2005). In general, the intestinal enterocytes transporter that is responsible for AA transportation in marine fish larvae is the oligopeptidetransporter 1 (PepT1). The PepT1 transporter is expressed athatching, both in zebrafish and Atlantic cod (Rønnestad *et al.*, 2007a; Amberg *etal.*, 2008). Also, transporters for basic amino acidshave been identified before hatching in zebrafish (Narawane *et al.*, unpublished).

Lipids

The uptake of lipids quantitatively may be via energy-dependent carrier-mediated processes and have indicated the existence of an FA binding protein (FABP) associated with the brush border membrane. Once absorbed by the enterocyte, the products oflipid digestion migrate from the site of absorptionto the smooth ER, where complex lipids areresynthesized, being deposited in large lipiddroplets of the mucosal epithelial cells (Nordskog *et al.*, 2001). In zebrafish larvae, the presence of microsomaltriglyceride transfer protein (MTP) large subunit gene (Marza *etal.*, 2005) has been identified. However, the many aspects of lipidresynthesis, intracellular transport, and lipoproteinassembly are poorly described in marine fish larvae. Larvae fed TAG rich diets commonly show anaccumulation of lipid vacuoles in the basal zone ofthe enterocytes, which indicates that dietary TAG isdigested and absorbed but that the transportcapacity out of the enterocyte is low (Morais *et al.*, 2004c). Iritani *et al.* (1984) reported that the glycerophosphateacyltransferase activity of fish is deficient in thelarval stages, have a limited capacity forendogenous *de novo* PL biosynthesis. However, thecauses and consequences of lipid accumulations inthe enterocytes of fish larvae and the mechanismsinvolved are still not fully understood.

Digestion and absorption of micronutrients

Micronutrients often exist in several forms with different biological availability; some micronutrients are believed to be absorbed by diffusion while others have specific carriers. There is very limited information on the digestion and absorption of micronutrients in fish in general, andvirtually no information on these processes and the ontogeny of them exists for marine fish larvae.

Gut motility

Gut motility includes a range of movements basedon smooth muscle contractions, including tonic(support and sphincters), phasic (move products),peristalsis (moves the chyme along the digestivetract) and segmentation (mixes the diet withsecretions). There are almost no systematic studieson these properties in larval fish, although someauthors comment on visual observations of muscular contractions. The few availablequantitative data are from zebrafish (Holmgren andOlsen, 2008) and Atlantic halibut (Rønnestad *et al.*,2000a). Gut motility is mediated by circular and longitudinal smooth muscles in the intestinal walland is under the control of the enteric nervous system(Holmgren and Olsen, 2008). The central nervoussystem and peptide hormones, e.g., motilin, can also influence peristalsis.Prey size has been hypothesized to affect intestinalperistaltic movements through an effect on the distension of the gut, with larger prey (such asadult copepods) inducing a more pronouncedmechanical stimulation (Pedersen, 1984) and is mediated by the autonomic nervous system of the larvae.

Regulation of Digestion

Digestion is a complex and closely orchestratedprocess. The available data suggest that theregulative pathways and molecules are conservedamong vertebrates, but specific responses in fishmay be different from mammals (Buddington andKrogdahl 2004). There are few studies concerningthe control systems of digestion in larval fish.

Cholecystokinin (CCK) is an important gastrointestinalhormone and plays a crucial role inpancreatic enzyme secretion, gall bladdercontraction, intestinal peristalsis as well as controlof ingestion. It is uncertain if CCK is present insufficient amounts to allow proper control ofdigestive functions at first-feeding (Kamisaka *et al.*, 2001; Rønnestad *et al.*, 2007a). From mammals, it is known that regulation ofdigestion involves the central and enteric nervoussystems with communication between the brain andthe different regions of the digestive tract andassociated organs, in addition to internalcommunication within and between the differentparts of the digestive system and there are nodata exist for fish larval stages.

Conclusion

Therefore, a holistic understanding of the digestive functions is essential to develop larval diet during culture period and adaptations of rearing conditions is crucial, that helps to meet the requirements of larvae for optimal ingestion, digestion, and absorption of nutrients from the larval diets.

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More References can be provided on request

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Sea Sparkling Phenomenon by the Bloom of "*Noctiluca Scintilans*" at Chennai Coast

Highlight Points

▶ The bloom of *Noctiluca scintilans* is responsible for the Sea sparkling phenomenon which is one of the undesirable chronological occurrences being happened in many parts of the world due to the sound effects of climate change. ▶ N. *scintilans* is a unicellular dinoflagellate species capable of bioluminescence when the presence of adverse environmental condition bounds especially increasing of SST. ▶ Most marine organisms are susceptible to the impact of climate change in effect mode. Taking the appropriate measures against climate change with proper governance may rescue biodiversity from the risk of vulnerability.

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Abstract

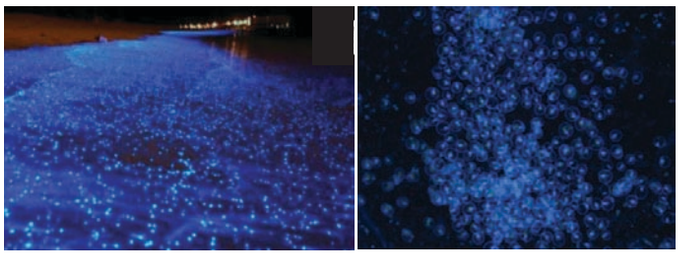
The rare phenomenon of "Magical glow" has been reported recently at the Chennai coast which was found to be caused by the bioluminescence of "*Noctiluca scintilans*" bloom. These dinoflagellates are floating at surface water which produces light when they are disturbed by something. This is the most common phenomenon occurs along the coast of Japan, California and the South American coast due to the tidal amplitude. Although the sea sparkling phenomenon along the Chennai coast has happened due to the effect of climate change. The massive population of *N. scintilans* may produce luminescence due to the thermal stimulation by ocean warming.

Introduction

Climate change takes place when changes in the earth's climate system arises, which is expected to have major impacts on the aquatic ecosystem. Temperature is the prominent factor that influences the physical, chemical and biological activities on the earth either directly or indirectly. Since the greenhouse gases affect the atmospheric gas composition, leads to global warming which has shown its effect on the lithosphere as well as hydrosphere. These are the changes we are facing in the earth often. Hence, the effects of this climate change have been induced by extensive human activity such as construction, industries, transport, and consumption. Consumerism creates mountains of waste. All this has contributed to a rise in greenhouse gases in the atmosphere. In the case of the marine ecosystem, it causes the ultimate impacts like sea-level rise, ocean acidification, reducing dissolved oxygen concentration, coastal erosion, coral bleaching, reducing primary production and shifting of organisms. Moreover, changes in the distribution pattern of organisms, changes in the physiological parameters, phenological changes are some of the biological effects observed in the aquatic biodiversity. The variation in the metabolic rate of aquatic organisms due to the high temperature and the changes in the distribution of planktonic organisms causes drastic changes in the aquatic environment.

Sea Sparkling phenomenon at Chennai coastal region

The historical phenomenon of sea sparkling has frequently been reported by the sailors and coastal populations of many countries. Sea sparkling is an unusual phenomenon in which



Sea sparkling phenomenon

the bioluminescence of *Noctiluca scintilans* has been seen as the 'burning of the sea'. *N. scintilans*, a large dinoflagellate is the only species of the family Noctilucaceae which are mostly distributed in the coastal water of the subtropical and tropical region. The abundance of *N. scintilans* bloom has been observed at its peak during June to July period (Uhlig and Sahling, 1990). It also associates with the red tide phenomenon of the Arabian Sea generated by the nutrient enrichment

of water combined with the effect of cold and dry north easterlies (Padmakumar et al. 2010; Padmakumar et al. 2016). The bloom of *N. scintilans* causes the massive glowing of the sea during night time that was reported for the first time along the East coast of India. This is not a preferable phenomenon and happened by the intolerable condition of *N. scintilans* in its habitat concerning the effect of climate change.

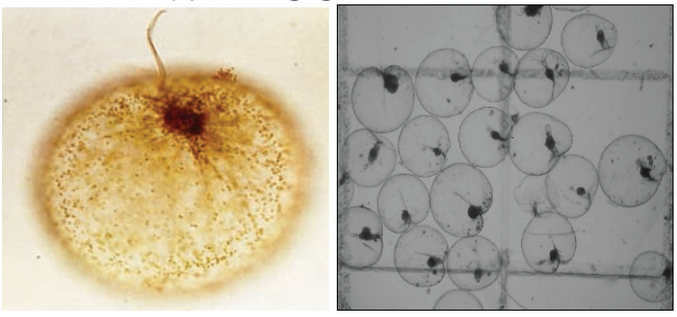
The ecological role of *N. scintilans*

Noctiluca, a dinoflagellate responsible for the open water bloom has been noticed during the last phase of the productive seasons. It is classified as Harmful Algal Bloom (HAB) that causes adverse conditions such as oxygen depletion, ammonia production in water and gill clogging which leads to the large scale mortality in cage cultured fishes and other finfishes. *N. scintilans* bloom causes the large oxygen minimum zone (OMZ) in the coastal and open ocean waters during its death phase which has been reported often along the north and the south Arabian Sea. Red *Noctiluca* is a voracious feeder, plays a vital role in the pelagic food web and its growth and proliferation are entirely based on the quality and quantity of prey. Whereas, the growth of green *Noctiluca* depends on the photosynthetic product of endosymbionts. In addition to that, the nutrient availability of water also influences the intensity of bloom. In some cases, *Noctiluca* species are acting as a vector for carrying toxicity to the higher trophic level causing fish mortality and shellfish poisoning in humans (Padmakumar et al. 2010).

Oil sardine is a competitor to *N. scintilans* according to their same feeding behaviour i.e, feeds on algae such as *Carcinodiscus, Fragilaria, Psedonitzschia*, and *Thalassiosira.* Moreover, *N. scintilans* and *Sardinella longiceps* have shown an inverse relationship in their distribution. Likewise, the pelagic shoaling fishes like mackerels, sardines, anchovies are also trying to avoid such waters due to its unfavourable condition like high NH3 concentration. So, there was no reported natural mortality of fishes during the bloom period (Padmakumar et al. 2010).

Characteristics of *Noctiluca scintilans*

N. scintilans is a large, spherical, gelatinous, and single-celled organism enveloped by a thin cell wall. The size of the cell ranges about 1-2 mm in diameter. It consists of a centrally located nucleus embedded within the cytoplasm. The membrane-bounded vacuoles are arranged irregularly from the centre of the cell to its peripheral wall. The substances responsible for the bioluminescence reaction are luciferin and luciferase. The mechanical stimulation such as the agitation of water and wind-generated waves causes the luminescence of cells by producing light.



Structure of *Noctiluca scintilans*

A flagellum and a tentacle are merged to form a cytostome (mouth), located at the one end of the cell which is used for the movement, and to capture food. The midline of the cell is known as the peristome groove. *N. scintilans* are heterotrophic, feed on the variety of microorganisms like bacteria, phytoplankton, zooplankton, and their eggs. They do engulf their prey through cytostome, known as phagocytosis. In some cases, *Noctiluca* consumes its required nutrients through endosymbiosis with the photosynthetic algae *Pedinomonas noctilucae.* These organisms are responsible for the green colour of the *N. scintilans* due to the presence of thousands of *P. noctilucae* in their vacuoles. The reproduction of *Noctiluca* has been performed through binary fission or multiple fission in which the budding parent cell produces numerous motile swarmers.

The occurrence of food vacuoles inside* Noctiluca *cells

Influences of Upwelling phenomenon

The occurrence of *Noctiluca* bloom along the west coast of India is mainly based on the upwelling phenomenon. The Upwelling phenomenon consists of various phases depending on the intensity and periods of algal bloom abundance. The last phase of upwelling was found to be associated with the calm sea with low temperature, high salinity, muggy weather, and high prey concentration. This environmental condition especially low Sea Surface Temperature (SST) might have initiated the occurrence of bloom and the proliferation of *Noctiluca* on the west coast of India. The initial blooming stage is always triggered by the SST ranging from 26.03°C to 27.24°C and the salinity around 34 ppt. The dissolved oxygen content was found to be maximum in the bloom water due to the photosynthetic activity of algal bloom. During the upwelling phenomenon, macronutrients such as nitrate, phosphate, and silicate are abundantly available at the surface water which enhances the proliferation of diatoms. The weakening phase of upwelling causes the decreasing of nutrient content that also united with the dominance of larger diatoms and dinoflagellates due to their low growth rate. *Noctiluca* and zooplankton consist of the same feeding habits which showed an inverse relationship and acts as competitors to each other. The frequency of red tide is linked to the eutrophication of coastal water and *Noctiluca* has been found as the biological indicator of eutrophication (Padmakumar et al. 2010).

Bioluminescence of *N. scintilans*

Noctiluca is commonly known as "Sea sparkle" or "Blue tears of Sea" which can produce blue bioluminescence at night time in the coastal waters. This bioluminescence of *N. scintilans* is an interaction of luciferin and luciferase system in the thousands of spherical shaped organelles or micro sources which are located throughout the cytoplasm. The non-bioluminescence *Noctiluca* species lack these micro sources. The

researchers have been tracking *N. scintilans* bloom over 17 years from 2000 to 2017 in the East China Sea. They stated that the red *N. scintilans* bloom has become more frequent in recent years. This is common in some countries like Japan, California and the South American coast due to the tidal amplitude. The bloom is usually formed near to the shore, river mouth and deltas where abundant nutrients are available. The size and duration of bloom are varying from year to year. The SST of bloom water is increasing continuously for the last few years. In previous days, it was found as 20 to 25°C and now it is increased to 28°C. At present, Sea Surface Temperature of the ocean being increased results in a lot of changes in the marine ecosystem. Global warming and the effect of climate change might be the major reason for this bioluminescence of *N. scintilans*.

Conclusion

Abnormal behaviour of many aquatic organisms may convey the message with respect to the impact of climate change. The necessary action has to be taken regarding this to rescue the biodiversity from the risk of vulnerability. For that, we have to concentrate on the drop in greenhouse gases in the atmosphere in order to reduce the consequence of global warming. Carbon sequestration is one of the measuresto mitigate global warming whichboosts the long term storage of carbon in plants, soils, geologic formations, resulting in either CO_2 is removed from the atmosphere or diverted from the emission sources and stored in the ocean and terrestrial environments. Ecologically sensitive areas like wetlands, forests, and mangroves ecosystem are playing a major role in carbon sequestration. Silviculture practices for mangrove and other trees may widen the potential of terrestrial and ocean carbon sequestration. In the future, the necessary action must be taken into account regarding this with the support of the Government.

***References can be provided on request**

megalai.frmpa908@cife.edu.in

Jayanti Rohu farm of Debakinandan and pisciculture at Sargachhi RKM Ashram

Highlight Points

▶ Mr Debakinandan Patra, ICAR-CIFRI and ICAR-CIBA awardee elderly fish farmer of South 24 Pargana district in WB possesses vast experience in different spheres of aquaculture, cultivating new species like Jayanti Rohu, *Mylopharnygodon piceus* and *Chanos chanos*. Revered Swami Viswamayanandaji, Secretary, Sargachhi Ramkrishna Mission Ashram, Murshidabad district is pivotal person in installation and execution of Biofloc-based fish farming practices in Ashram premises. They were kind to spend some time with author, shared their knowledge and expressed viewpoints on pisciculture on 19/1/2020 and 31/1/2020 respectively. It has been presented here.

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Innovative fish farmer Debakinandan Patra

Mr Debakinandan Patra, aged 63, is an experienced professional fish farmer of West Bengal and President of Madanganj Matsyachasi Samabaay Samity Ltd. His own fish farm is located at: Vill. and P.O. Madanganj, Block and PS Namkhana, Dist. South 24 Pargana. Namkhana is in close proximity to Sundarbans forest. Mr Patra owns 23 perennial freshwater fish ponds but presently concentrates on fish farming in 7 ponds having total 9 bigha (1.4ha) water area and one brackishwater pond (7-8ppt salinity). Recently he was pleased to talk with author at farm site. Mr Patra is cultivating 16-18 commercially-important inland fish species of compatible nature. He focuses on organic semi-intensive aquaculture, with zero use of chemical fertilizers, commercial growth promoters, antibiotics, etc. In recent years, he procures 4,75,000-5,00,000nos of Jayanti Rohu (JR) spawn annually from ICAR-CIFA, Bhubaneswar. After raising them

Biofloc unit at RKM Ashram

Carp hatchery complex at RKM Ashram

to advanced fry stage in earthen nurseries, part of it is sold to other fish farmers in Kakdwip Sub-Division and rest reared upto advanced fingerlings and adult stage. Initially in 2013 and thereafter, he used to procure 10,00,000nos JR spawn annually.

Besides JR, he is cultivating normal *Catla catla*, *Ctenopharyngodon idella*, *Cirrhinus mrigala*, *Puntius javanicus*, *Amblypharyngodon mola*, *Mystus vittatus*, *Tilapia nilotica*, *Chanos chanos*, *Mystus gulio*, *Clarius batrachus* upto marketable size and promoting sustainable freshwater and brackishwater fish farming technologies, also helping neighbouring fish farmers. A portion of IMC stocked in his ponds attains 400-500gm in five months. JR fingerlings (50-150gm) stocked in February attain 500-750gm in end of May. Beginning from spawn stage, JR attains 800-1000gm in 9-10 months in organic system with home-made feed and upto 1500gm if paddle-wheel aerators used, Sri Patra stated.

Fish feed preparation

Mr Patra is into fish farming since 1988. He aims to develop indigenous technologies and products to bring down cost of production, to produce quality fish and fish feed sustainably with small amount of capital using locally-available farm resource. He is producing home-made feed, both in pelleted form for fingerlings and higher stages and dust feed for early stages. He installed mini fish feed production unit beside home, prepares feed with own hands which, according to him, is 'mind recreation'. As ingredients, he uses dust of green leaves of plants like Subabul (*Leucaena leucocephala*), Arjun (*Terminalia arjuna*), blackberry, Sundari (*Heritiera fomes*) dried under shade (8-10%); paddy dust (15%); wheat flour or rice dust (15%); oilcake of coconut, sunflower, linseed, flaxseed or mustard (30-35%); finfish meal, excluding crab meal (15-20%); husk of khesari daal *Lathyrus sativus* or muung daal (5-10%); turmeric powder (2%); dust of neem leaves (*Azadirachta indica*, 2%) and common salt (1%).

He opined that IMC and JR spawn and fry exhibit good growth when this mixture is pulverized upto 100micronmt particle size and fed. For every 5,00,000 spawn, 2.5-4.0kg feed used daily and IMC fry fed @ 12-8% of body weight till fishes attain 150-200gm. He increases protein content in feed using more fish meal and oil cake and lesser amount of rice polish/bran. Fry are fed 25-20% protein-rich feed till larger fingerling size and fishes above 600gm fed 15-12% proteinaceous feed. Larger fingerlings and sub-adults require 18-15% protein in feed. According to him, sunflower dust is more nutritious than rice bran and protein content of pulp inside Sundari fruit is higher (35%) than its leaves (15-18%).

Mr Patra's opinion

Mr Patra is worried about issues, *viz.*, Mohua oil cake adulterated in markets nowadays by adding low-cost wheat flour, reducing its effectiveness, which is not getting fully mixed in pond water; fish farmers and aqua-entrepreneurs incurring loss; shrinkage in water depth, reduction in area of beels and wetlands suitable for pisciculture in Namkhana and other Blocks in Sundarbans region; intermediaries or middlemen (locally called 'Phorey') involved in freshwater fish market channel (local traders, agents/suppliers, wholesalers, retailers) earning huge income in present day system in WB, much higher than fish farmers and capturing bulk of profit; farmer community suffering and sinking into poorer condition; stretches of freshwater canal and roadside water bodies 'Nayanjuli' in villages are being filled-up and captured for construction work; huge stretches of canal in Namkhana have been encompassed ('Khal bendhey phela' in Bengali) for human settlements and shops; poultry litter unsuitable in fish ponds as growth promoting compounds and hormones used along with feed in most poultry farms; seed resource of *Mugil cephalus* and *Scatophagus argus* became markedly scanty in Hooghly-Matlah estuary and brackishwater rivers of South 24 Parganas.

Chanos chanos at Debakinandan's farm

He advised that fish spawn brought to site in Hundi or oxygenated packets should not be directly released (stocked) in main pond, first should be reared in hapa cloth enclosure fitted in pond; plastic/polythene bags must be avoided in 'bag feeding' method; milkfish, preferring lab-lab and phytoplankton as food attains better growth in brackishwater ponds (7-10ppt salinity); banana pseudostem facilitates reduction of NH_3 in pond when kept submerged. Freshwater-reared mullets are tastier but its growth is slow in comparison to brackishwater ponds. Earlier Sri Patra reared *Lates calcarifer* and *Scatophagus argus* (500-600kg/year production), obtained technical guidance from Dr A. R. T. Arasu, Principal Scientist, ICAR-CIBA, Chennai who visited his farm. His black carp *M. piceus* attained 400-600gm in 5 months. As South 24 Pargana's Namkhana was badly affected due to cyclonic storm Bulbul in Nov 2019, he suffered loss in fish farming and less-favourable water condition is prevailing since then in few ponds.

Awards and Recognition

Mr D. Patra was conferred with Hiralal Chaudhuri National Best Fish Farmer Award by ICAR-CIFRI, Barrackpore on 10/7/2017 (Fish Farmers Day); conferred with 'Innovative Farmer, Mentor and Entrepreneur' Award by ICAR-CIBA, Chennai at Brackishwater Aquafarmers Conclave on 23/1/2019; Special Citation received from Dr A. G. Ponniah, Former Director, CIBA on 23/2/2013; obtained 1st Prize and 'Kriti Krishak' Award from Asst. Director of Agriculture, Namkhana Block on 24/12/2019; felicitated as progressive farmer for his innovations in brackiswater aquaculture in Brackishwater Farmers Meet, organized by Kakdwip RC of CIBA on 15/5/2013. With his active involvement, ICAR-CIFA, Bhubaneswar organized awareness workshop on 'Importance of quality fish seed and growth evaluation of JR in low saline water' on 27/2/2017 at Madanganj. Another Farmers' Meet on JR was organized at Ukiler Hat, Namkhana. He is invited as trainer/

Dust feed prepared by D. Patra

resource person in 4-day fishery training programme organized for fish farmers in different Blocks of Kakdwip Sub-Division every year.

During 2017-2018, *Clarius batrachus* seed production hatchery was constructed under leadership of Sri Patra near office of Madanganj Matsyachasi Samabaay Samity Ltd., Namkhana with financial support of Department of Fisheries, Government of WB. This Fishermen Cooperative Society, having 25 members, got registration in the Department during 2012-2013 and nurtured by Sri Patra. Former DG of World Fish Centre, Malaysia and Scientists from Kakdwip RC of CIBA visited his farm. Besides fish farming, Sri Patra cultivates *L. sativus*, mustard, sunflower, green leafy and other vegetables in pond embankment. He did not encounter fish disease incidences owing to proper management practices. He is dedicated and hardworking and expects it from farm labours. Native of marginal village, Sri Patra is an example for rural entrepreneurship development through fish culture, who remarked: 'Sustainable fish farming is only means to keep village ponds and bigger water bodies clean and hygienic'.

Biofloc technology at RKM Ashram, Sargachhi

Author humbly expresses homage and gratitude to *Pujoneeyo* Swami Viswamayananda Maharaj, Secretary, Sargachhi Ramkrishna Mission Ashram, Beldanga-I Block, Murshidabad for patiently explaining Ashram activities in horticulture and pisciculture and its genesis. This Ashram, founded in August 1897, identified areas where technology can come to aid of farmers. Besides organizing livelihood-oriented training on vermicompost, horticulture, mushroom, corn, ornamental fish farming and dissemination of high-yielding seed varieties, experiential learning programme on freshwater fish production through Biofloc Technology is initiated at Sargachhi RKM Ashram. Biofloc-based fish culture system is being executed here under Swamiji's initiative, guidance, inventiveness and coordinatorship in properly-managed circular tanks (10000lit capacity).

Fish feed production unit of D. Patra

Young aqua-entrepreneurs and rural fish farmers in WB, interested in fish culture in artificial fish-rearing structures like circular FRP, polythene-surfaced and tarpaulin tanks in Biofloc model, may avail for monthly/bimonthly 2-day hands-on training and demonstration programme on Biofloc fish culture technology organized here to get well-versed with science, principles and management practices of this novel-cum-innovative technology, acquaint with its appropriate use, get correct conception and avoid losses. Trained aqua-entrepreneurs and young farmers will be able to adopt and continue with Biofloc technology successfully.

Conversation with Swamiji

Swami Viswamayanandaji guided author to fish hatchery premises, aquarium unit, fish skeleton preparation unit, fish and animal museum at this holy place and briefed about importance of fish culture in rural socio-economic development in WB. Emphasizing on '*Jnaner charcha*' and '*Jnaner bikash*', he outlined Ashram activities like propagation of threatened fishes *Colisa fasciatus*, *Heteropneustes fossilis*, *Esomus danricus* and completion of life cycle in rectangular cement cisterns; FRP carp hatching-cum-incubation pool under construction; seed production of *Cyprinus carpio* in breeding pool filled with water hyacinth; pangas catfish culture in pond; high-valued aquarium fishes maintained in large glass tanks; indoor seed production unit of indigenous fish *Mystus* sp, *Anabas testudineus* and others and newly-constructed outdoor concrete culture chambers. Author had a glimpse of three Biofloc fish culture tanks well-maintained within Ashram premises in shade.

Author with revered Swamiji

According to Swamiji, rural women needs training on value addition of fishes, intramuscular spines removal and fish fillet preparation; existence of good market and market channel for ornamental (aquarium) fishes produced by women SHGs; kind of phytoplankton species found in native habitat (northern and south-eastern Africa) of *Oreochromis mossambicus* and *O. nilotica* and studying their real habitat; Biofloc technology needs to be improvised and expedite; possibility of value addition or preparation of by-products from commercially-important medium-sized fishes left unsold in market; study on life cycle and characteristics of probiotic bacteria used in Biofloc and analysis of Biofloc consortium; probably it will be good if fish species suitable for culture in Biofloc tanks reared upto sub-adult stage from 1.0-1.5 inch size therein and grow-out culture done in earthen ponds; preparation of soup and pickle from Singhi and Pangas catfishes respectively at Sargachhi RKM Ashram; women SHGs should be trained to prepare fish byproducts and make it commercially available; preparation of indigenous farm-made pelleted fish feed using indigenous ingredients; goat and chicken entrails should be cut into pieces, boiled and made available as feed for indigenous Magur and Singhi *via* 'blanching' process.

Demolishing ego

During last 7 years, special emphasis is extended to agriculture and rural development sector at Sargachhi RKM Ashram through developing sound integrated farming system for livelihood development of rural community. According to Swami Viswamayanandaji, we, as intellectual learned persons and extension workers must conceptualize and do something fruitful to bring welfare of rural people; develop their knowledge and skill; extend guidance and moral inspiration; be with them in field, note down their problems (obstacles); devise means and ways and recommend suitable (proper) corrective and remedial measures to overcome them; create socio-economic upliftment. To achieve these, first and foremostly we must demolish ego within ourselves to perform better and can become truly successful extension worker and technology disseminator. It was a great principle taught to author by revered Swamiji.

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Commercial Processing of frozen Shrimps – A way of Value Addition for Export and Marketing

Highlight Points

▶ Processing of frozen shrimp products freezing at various temperatures is widely used in the preservation. ▶ Processing and freezing methodologies differ according to consumer preference, importer countries demands and duration of storage. ▶ The superior quality of frozen shrimp product obtained by maintaining the hygienic process environment, use of portable water, good quality raw material. ▶ Coated or breaded ready to cook frozen shrimp products are much more popular among the consumer

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Introduction

Seafood is a nutritious food that constitutes one of the desirable components of a healthy diet. Shrimp is highly valued seafood, one of the important foreign exchange earners for the country, caught from brackish waters or inland saline water, processed and exported to other countries as frozen shrimp (Dabade *et al.*, 2014). Frozen shrimp products also have great demand in the national market. The change of shrimp flesh quality may be initiated by various factors, i.e. enzymes and microbiological activities. The highest shrimp quality can be obtained in the shrimp frozen immediately after harvested. Processed frozen shrimp fetch three to four times higher value than the raw materials and hence has great scope to increase the domestic as well as export earnings. Application of appropriate freezing technique is essential to preserve the taste and nutritional value of the product. There are many commercial methods for freezing shrimp. The aim of this article to promote the various freezing style of shrimp and their processing that will add value to the products as well as it not only increases the consumer's attraction towards the variety of value-added frozen shrimp products but also help the stakeholders to gain maximum profit for export and selling in the national market.

General processing step

Raw material

Frozen products shall be prepared from freshly caught wholesome with best quality texture, preferable colour shrimp.

Pre-Process Handling

- Separate from other fish. Sort the species wise and if possible, size-wise.
- Wash well in potable water.
- Ice it immediately and stock in insulated boxes in alternate layers of ice and raw material. Use only clean crushed/flake ice made from potable water.
- Height of the iced pack shall not exceed 50cm.

Freezing of shrimp

- Freeze the shrimp in cartons in an appropriate type freezer maintained at –40°C till the core temperature reaches –23°C.
- In Individual Quick Freezing IQF, each piece is frozen individually using technique of fluidization resulting in freezing of prawn only in 10 to 12 minutes which otherwise takes at least 3 to 4 hours or even more in the blast freezer. This results in better texture and there is no lump/ block formation and the product is free-flowing. One does not have to thaw or defrost the whole packet to take out only a portion, and the rest will remain frozen till required again.
- Freezing methods include liquid nitrogen dipping, still air at -13 to -19°C, and freezing in brine at -6 to -18°C.

Handling for processing

- Raw material further handled according to the type of pack desired.
- The processing shall be carried out in premises maintained inhygienically. A prohibited chemical shall not be used at any stage of processing and shall be free from defects like dehydration, discolouration, deterioration and objectionable extraneous matter.

Different processing style of frozen shrimp

Whole Shrimp

1. Whole Shrimp: Use only absolutely fresh quality material for this type of pack. Pack uniform size (as per the declared size grade) in polythene lined (optional) waxed duplex carton. Pack the itin a parallel style. Do not allow cross packing. Weight packed shall be as per the agreement between the buyer and processor. Add ice-cold glaze water to the pack; if needed. Use potable water chlorinated at 10ppm level.

2. Headless: Remove head portion, Wash well, Discard discoloured bruised or soft-shelled pieces, Pack uniform pieces in polythene lined (optional) waxed duplex cartons. Pack in a parallel style,do not allow cross packing. Add ice cold glaze water, if needed.

Headless

3. Fantail Round: Proceed as for headless pack, head portion and shell are removed except on the last segment,the tail is left intact.

Fantail Round

4. Fantail Deveined: Proceed as for fantail round; but remove except on the last segment. But remove the alimentary canal.

5. Butterfly: Proceed as for fantail Deveined, but splits open the meat dorsal side and arrange in the required pattern.

Butterfly

6. Raw peeled or peeled undeveined: Remove head, shell and tail completely, Wash well in water chlorinated at 10 ppm-level, Pack uniform sizes (as per the declared size grade) in polythene-lined (optional) duplex cartons. Add ice-cold glaze water, if needed.

7. Peeled and deveined: Proceed as for raw peeled, but remove the alimentary canal completely from the meat.

Peeled and deveined

8. Cooked and peeled: Immerse prawn in 7-10% (w/v) boiling brine for 7 minutes, Take out from brine and cool immediately in ice-cold water containing 3-5% salt and chlorinated at 10 ppm level, Proceed further as in the other types (Note: Cooking conditions may vary depending upon agreement between buyer and processor).

Cooked and peeled

9. Peeled and cooked: Remove head, shell and tail, Wash thoroughly in potable water, Immerse the meat in 3-5% (w/v) boiling brine for 2-3 minutes, Take out from brine and cool immediately in ice-cold water chlorinated at 10 ppm level, Proceed further as for cooked and peeled shrimp.

Peeled and cooked

10. Peeled, Deveined and cooked: Proceed as for peeled and cooked shrimp, but the meat is deveined before cooking.

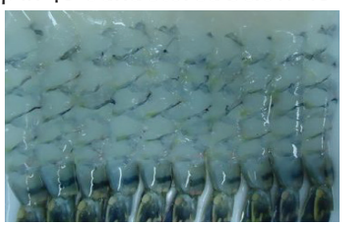
11. Whole cooked: Use only absolutely good quality material for this pack. Wash the whole-undamaged prawn thoroughly in potable water. Cook in 10% (w/v) boiling brings for 7 minutes. Take out from brine and cool immediately in ice-cold water chlorinated at 10 ppm -level. Proceed further as for whole shrimp frozen.

Whole cooked

12.Shrimp skewers: The washed shrimp used in this product is peeled tail on or peeled pulled vein; remove the head placed on a bamboo skewer. The shrimp can be arranged in several forms such as: back to back, U type or coin style. Generally, 4-5 shrimp arranged in each skew. Blast freezing the shrimp in-40˚c and stored below -18˚ c in a master cartoon

Shrimp skewers

13. Stretched shrimp (Nobashi): Fresh washed Shrimps are peeled and un-deveined and arranged in a Nobashi tray. These trays are designed to hold 10-20 shrimps with a separator between each shrimp. After the shrimps are set, it is passed through the freezer and the frozen product is placed along with the tray into the final master carton



Nobashi

14. Trays: In this product, the shrimp is usually decorated in preferably in "well" trays, vacuum packed and frozen in a way that is ready to place in a supermarket.

Trays

15. Coated shrimp: Raw material-Fantail round shrimp or butterfly shrimp, pre-dust batter, bread crumbs.

Coated shrimp

Increasingly popular for restaurant chains, supermarkets.Coated shrimp are shipped completely prepared for cooking at the kitchen. Coat the shrimp with a thin layer of pre-dust batter manually or in pre-dust machine, dip into the conventional (adhesive) or tempura batter depending upon consumer preference in market, coat the battered shrimp with breading Japanese style light coloured coarse crumb or darker coloured yellow-orange crumb depending upon export country and consumer preference, arranging in trays, blast freezing in -40˚c, stored in -18˚c temperature.

References can be provided on request

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Sustainable Fisheries and Responsible Aquaculture for Food Security and Economic Progress

Highlight Points

Aquaculture is emerging fast as a means to achieve nutritional gains and poverty reduction by developing opportunities for employment and trade. If properly developed and managed, it could play major roles in food security and economic progress like many developing countries, including China. Goals for fisheries and aquaculture development are framed in terms of production targets, increasing trade, revenue generation, providing local or national food security, maintaining employment and social stability but the process of arriving at these goals, considered politically legitimate is critical. Therefore, it is important that the process of development and policy reform is based on the best available scientific, economic, and social analysis of these issues.So, for the development of successful, sustainable aquaculture and for it to reach its full resource potential, a number of factors need to be addressed and resolved.

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Introduction

Aquaculture is facing a tough challenge in terms of fulfilling the nutritional requirement of the massive human population which is growing tremendously and accounts for an average annual growth rateof 1.1% per year. It is one of the fastest growing food-producing sectorsworldwide having an average growth rate of 7.1% per year and contributes to 46% of total food fish supply. Yetfish production needs to be enhanced in order to feed the growing population. Also,it is known that the global fish catch is stagnating and is predicted to be exploited to its limit. Therefore, it's an urgent need to increase the production by employing culture-based practices instead of relying on the capture fisheries. This can be achieved by integrated development and management of fisheries in a more responsible as well as sustainable manner.

Tremendous effort is required to make this sector grow as it can provide food and nutritional security. It can alsohelp to achieve economic prosperity of the country,substantial improvement in theincome statusof fishfolks, fish farmersand shall also contribute a major percentage to the gross domestic product of a country.

Blue Revolution, the Neel Kranti Mission aims at developing an enabling environment for integrated developmentto achieve these through full potential utilization of aquatic resources for fisheries development in a responsible and sustainable manner in consideration withthe sustainability, bio-security,and environmental concerns.

Motives of Blue Revolution

- To increase the total fish production in a responsible and sustainable manner for economic prosperity,
- To ensure food and nutritional security by fully tapping the fish potential of the country both in inland and marine watersand tripling the production by 2020,
- To develop the fisheries sector as a modern industry with the introduction of new technologies,
- Employment generation, export earnings,ensuring inclusive participation of the fishers and fish farmers in the socio-economic upliftment,
- Doubling the fish farmers income with an objective of enhancing productivity, better marketing and postharvest infrastructure including e-commerce and other technologies,
- Achieving 15MT production by end of 2019-20 from 10.79MT at the end of 2015-16 at an expecting annual growth rate of 8% annually over a period of five years 2015-20.

Constraints and challenges thataquaculture is facing globally include:

1. Resources and environment

- Environment degradation and habitat destruction,
- Biodiversity loss/extinction of species,
- Overexploitation of fish stocks,
- Biological security,
- Climate changes (global warming leading to a rise in ocean temperature, El Nino, ocean acidification, stock migration, severe weather conditions, etc.)

2. Socio-economic and governance

- Overcapacity
- Bycatch and discards
- Capital and financial services (loans, insurance, etc.)don't meet the requirement.
- Poverty, child labor, etc.
- The public image of fisheries and aquaculture as a career is not thatgood; this is becausepeoplenowadays are attracted more towards ITs and technologies rather than opting agriculture as their career.
- The linkage between fisheries management policies, allocation of rights and economic sustainability.
- Distribution of margins and benefits throughout the fisheries value-chain
- More strict rules for better quality and safety of food products.

Quality assurance is a very important aspect when the aquaculture commodities are trade products. The quality should be addressed regularly as it is highly perishable.

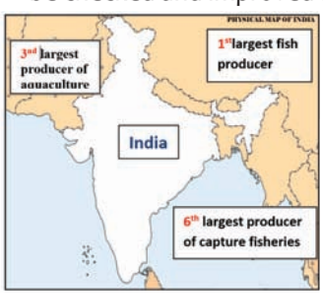
- Lack of capacity in the post-harvest sector.
- A significant increase of eco-labels and their possible effect on market access, in particular for developing countries.
- Advanced traceability system is required.
- The economic crisis and risk of increased import barriers and tariffs.
- Tariffs and non-tariffs.
- Trade in fisheries need to be more inclusive and sustainable.
- Fish subsidies causing distortions including those that can lead to overfishing and depletion of fish stocks putting a huge threat to the sustainability.

Fishery sustainability:

Sustainability refers tothe development that meets the need of the present without compromising the ability of future generations to meet their needs. The sustainability of fisheries and aquaculture production is crucial to the livelihoods, food security as well as nutritional security of the global human population.

Management guidelines for responsible aquaculture

- Aquaculturists should use high-quality seed and feed
- They should maintain a stable pond environment
- Also, dissolved oxygen (DO) should be maintained at a level of at least 4.0ppm at 6 am
- Ideal water temperature is 28 – 32°C, if the temperature exceeds by 32 °C or is reduced below 28 °C, feeding rate should be reduced by 30%
- Water should be exchanged regularly
- Pond pollution should be minimized
- For higher productivity, water quality parameters should be checked and improved at a regular time interval.



Current fish production :-12.60 mmt (approx.)
Out of this Inland fish production is 6.3mmt and marine fish production is 3.79mmt

VISION 2050

- Achieve more production with fewer resources,
- Ensuring food safety, sustainability, and nutritional security,
- Fulfilling demands for consumer preferences food,
- Sensory evaluation,
- Ensure aquaculture is being practiced in a more responsible and efficient manner,
- Develop feed for climate-smart aquaculture.

Aquaculture sector governance and improvements needed at farm levels

Aquaculture is being practiced worldwide but whether it is done in a responsible manner or not is the major matter of concern. Few countries that are culturing fish since past have some governmental regulating bodies to conserve, manage and govern the sector but in other regions aquaculture is lacking pace with the countries like China who is the leading aquaculture producers globally. The reason behind this may be that they lack tradition with aquaculture and it may be due to the scarcity of resources like feeds, seed, and economic support. Besides these, other factors may also be responsible such as the lack of skilled manpower, a fault in the legislation and their implementation and many more.

In the countries that are progressive in aquaculture and is continuing to grow in the sector might have paid a lot. The growth often has come with numerous social, ecological and financial costs. In order to grow more and earn more profit, we often forget our responsibility towards nature and its resources and we perform some activities that are unethical and that is achieved on the cost of our environment which ultimately is going to harm the mankind in the long run.

Like for example, large areas of wetlands are being converted into aquaculture ponds which affect the local communities and interfere with their livelihoods. Many industries are established near the water sources so they discharge their effluents and hot water into it. Also, domestic sewage, hospital wastes, pond effluents, discharge from nuclear power plants and nuclear testing in the water bodies have a very adverse effect on the aquatic environment. This leads to improper functioning of biochemical, metabolic physiological activities in the organism which leads to their death. Converting land masses into ponds is further followed by pumping of fresh or saline water into the pond which can lead tolowering of the level of groundwater tables and also reduce the availability of good quality drinking water. This can also result in the pathogenic condition that may lead to disease outbreak which can have an acute or chronic effect. If these persist for long, it can lead to loss of stocks and native fish population.

Despite a number of regulations have been formulated to control these activities yet their proper enforcement and prompt execution still could not be made. So these problems need to be addressed and some stringent action must be taken in order to control the adulteration with nature, especially water bodies which are the most important resource as far as aquaculture is concerned.

List of International organizationsresponsible for fisheries conservation, management, and governance

1. United Nation Convention on Law of Sea (UNCLOS,1982)
2. Food and Agricultural Organisation (FAO) Compliance Agreement (1993)
3. FAO Code of Conduct for Responsible Fisheries (1995)
4. United Nations Fish Stocks Agreement (1995)
5. International Plans of Action-Sharks, Seabirds, Capacity; Illegal, Unreported and Unregulated Fishing (IUU, 1999-2001)
6. Strategy for Improving Information on Status and Trends of Capture Fisheries" (Strategy- STF),Strategic Trade Authorization(STA, 2003-2008)
7. FAO Port State Measures Agreement (2009)

FAO Code of Conduct for Responsible Fisheries, 1995

According to the code of conduct for responsible fisheries, states and whoever is engaged in fisheries management shouldkeep in mind that they should work in a responsible manner and use measures for long-term conservation as well as focus on sustainable use of aquatic resources which should be implemented by following an appropriate legal and institutional framework. It states that conservation and management policies, whether at local, national, sub-regional or regional levels, should be based on the best scientific evidence available and be designed as to ensure the long-term sustainability of fishery resources at levels which promote the objective of their optimum utilization and maintain their availability for present and coming generations.

Improvements at the farm level

The articulation of governmental policies, strategies and action plans for aquaculture development require the involvement of all stakeholders, taking the ecosystem where development is taking place. Good management practices (GMPs) should be applied and environmentally responsible methods can be used to reduce adverse impacts and ensure long-term sustainability. The new technology of feeding management needs to be adopted considering their cost-effectiveness. This will ensure farm benefit along with controlling environmental pollution. The sector provides a large scope for business. It aims at culturing aquaculture commodities without harming the environment and their inhabitants. As already discussed, the problems need to be seriously addressed and improvements should be made at the farm level. For this purpose, the most significant step is to frame laws and their implementation needs to be done on the farm level itself. Good governance can lead to responsible aquaculture development for food security and economic progress.

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Sustainable 'Lab made Fish Meat' for Future

Highlight Points

Next few years could be pivotal for sustainable food- The good news is consumers are demanding more sustainably caught and produced seafood than ever before-Concept of producing seafood from fish cell- and tissue-cultures is emerging for feeding the future in a sustainable way rather than live animal farming- one can see many advantages to growing fish meat in a lab- Critics label it as Frankenfood, a terrible stigmatization word to scare people.

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When the sustainability of our food system is in serious question & new modes of doing are now required (Schneider et al.,2019) for a liveable post-Anthropocene (time scale of human mastery of the planet).Report by the EAT-Lancet Commission as part of a report released in The Lancet (a peer reviewed medical journal) on 16 January 2019 highlights the need for a radical transformation of the global food system to deliver both environmental sustainability and improved human health. It projects a baseline for food consumption to 2050 based on expected population growth and current trends in food consumption.

To cater the increasing demand we are squeezing our marine resources. It has been estimated that due to over fishing of marine resources have lowered ocean biomass content by up to 80% (Myers and Worm, 2003). This activity, along with effects of global warming on tropical oceans and its impact on rainfall threatens to decimate wild fish populations (Funk and Brown, 2009). While some herald the rise of aquaculture as an ecological and economic boon as this industry is now the fastest growing food-producing industry in the world (Tidwell and Allan, 2001).However, apart from

direct consumption, ever increasing demand of fish meal & fish oil, by-catch killing of fish are posing great threat to aquaculture. Others feel that its benefits have been over projected and that it does not fundamentally solve current strains on wild fish populations. Marine ecosystems may only sustain current and increased per capita consumption rates through 2050 if effective fisheries management measures are implemented and some significant technological adaptations are developed (Merino et al., 2012).

Cell-based sea food production

Food production from the oceans carries the risk of ecological damage, cell-based seafood will provide a unique opportunity to transform the sustainability landscape. Cell -based sea food is a nascent technology that allows fish flesh and other products to be cultured from cells in a bioreactor rather than harvested from livestock on a farm. It is a revolutionary technology that presents opportunities to decrease environmental footprint. This sustainable approach for food production will satisfy changing human needs, conserve natural resources.

The future possibilities for cellular aquaculture may sound big but are incredibly exciting. We can define cell based or cellular aquaculture as the production of aquaculture products from cell cultures rather than from whole animals. It means the production of genuine fish & other aquatic animal products (crabs, shrimp, oyster etc) without requiring animal breeding, rearing, and slaughter: in other words, farming cells or proteins directly rather than obtaining them from entire animals. The concept lies in fish cell and tissue culture to address challenges to orthodox industrial aquaculture systems and marine capture. It is to be noted that cell-based aqua products are quite different from genetically modified food. These are aptly called as cell-based meat, clean meat, lab-grown meat or in *vitro* meat.

Till date there are nearly a dozen startup companies are going the cell-to-flesh route with clandestine technique in the laboratories. Among these BlueNalu of San Diego, USA and Finless Foods of Emeryville, California, USA, Mosa Meat (Netherland) are racing to produce seafood at large scale directly from fish cells. BlueNalu's mission is to provide consumers with great tasting, healthy, safe and trusted cell-based seafood products that will also support the sustainability and diversity of our ocean.This alternative production will deliver to the consumer a product that tastes and performs

identically to the fish product it seeks to substitute. Further cellular aquaculture will provide clean meat, genuine meat grown by cultivating fish muscle cells.

In 1931 Winston Churchill, former British prime minister & prominent politician, published an article in *Strand Magazine* where he imagined the world "Fifty Years Hence." In that write up he envisioned lab-grown meat & wrote: "…We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium." Researchers have proved that our imagination can turn into reality. The first lab-grown meat product, a hamburger, was fried up in 2013, eighty two years later than Churchill's prediction. The cost of producing lab-grown meat products is still extremely high ($9,000 per pound for Memphis Meats's chicken).Uma Valeti and Nicholas Genovese founded San Francisco based Memphis Meats in 2015.Valeti grew up in Vijayawada, India, where his father was a veterinarian and his mother taught physics. When he was 12, he attended a neighbor's birthday party & wandered around to the back of the house, where cooks were decapitating and gutting animal.While processing the meat in such an unhygienic manner he was contemplating "It was birthday or death day,". "It didn't make sense."Later Valeti moved to the U.S. for his medical residency. But in time, he found himself increasingly disturbed by food-borne illness by the contamination that happens in slaughter houses when animal faeces get mixed in with meat." He was then contemplating "I thought, there has to be a better way."

Fish without the fish ?

High-tech meat alternatives are grabbing a lot of catchy headlines these days- 'Seafood without the sea' or 'Eating for the post-Anthropocene: alternative proteins' or 'Fish without the fish' or 'Finless fish' or 'Lab grown fish' or 'Cellular aquaculture' or 'Sustainable seafood without the catch' & so on.

Finless Foods hosts a tasting of edible fish grown from cells in September 2017. Image: courtesy Finless Foods

Few companies are progressing fast to bring to market what's known as cell-based fish or seafood --- that is, seafood grown from cells in a lab, not harvested from the oceans unlike today's wild-caught or farmed fish options. Finless Foods of Emeryville, California are using cellular biotechnology to grow fish (also other seafood) in bioreactors. They're doing similar work to Memphis Meats or JUST Foods, but are focused on fish instead of meat. Their first product will be very tasteful blue fin tuna, a species which is threatened with overfishing. They plan to bring it to market very soon.

Finless Foods of California uses cellular agriculture to grow cultured fish meat of highly prized Blue fin tuna. Their work offers a sustainable solution to meet global fish demand without further depleting global fish.

BlueNalu's version of seafood will have no head, no tail, no bones, no blood. It's finfish, just without the swimming and breathing part. It's seafood without the sea. Globally, there are roughly two dozen companies working on growing animal meat from cells, but most of them are looking at traditional livestock meats, like beef, chicken and lamb. Only

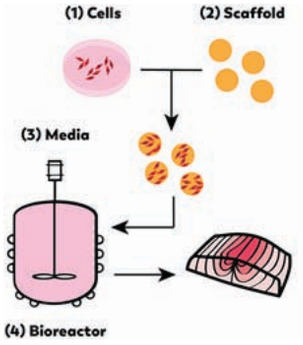
six are focused on cell-based seafood, and three of them are based in California.

All are likely five to ten years away from having actual product on the market. Lou Cooperhouse,President & CEO at BlueNalu says that his company does not rely on fetal bovine serum to feed fish cells. Cell-based seafood is free from potential contaminants that can be found in its ocean-caught counterparts — like mercury, toxins, pathogens and parasites, and even "micro-particles of plastics," as the company's website has projected. Likewise, Finless Foods website boasts that its product will require "no commercial fishing from our precious oceans. No fish farming. No contaminants."

Cooperhouse's partner Chris Somogyi, is confident BlueNalu is not using any genetic modification & not introducing new molecules into the diet.

The Technology, in brief

Cell-based seafood production will require the appropriate: (1) cell line(s), (2) compatible scaffold, (3) medium, and (4) bioreactor (Edelman et al., 2005).



CELLS

It all starts with a cell. We focus on identifying and selecting specific types of cells like mainly skeletal muscles, fat and connective tissues such as myoplasts which are able to self-renew and grow to become meat. They are multipotent cells, capable of transdifferentiation, and therefore need to be reharvested from time to time

FEEDING THE CELLS

You are what you eat, and so are cells. We unpack food into the most essential micronutrients needed for our cells to grow and develop. We can ensure the highest level of purity and achieve the perfect composition, down to a molecular level.

CULTIVATION

Our cells follow their natural process to form muscle and connective tissue, just like they would when growing on an animal. This happens in a vessel we call a 'cultivator'.

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MEAT

The entire process from cell to meat takes between 4-6 weeks. Once the meat is ready, it is simply harvested from the cultivator and it's ready to enjoy.

1)Atlantic salmon primary muscle cells have been successfully cultured and differentiated. Fish cell culture growth media used are salt concentration, suitable buffer, temperature, carbon source, pH, growth factors etc. 2)Cultivating three-dimensional tissues relies on the presence of a scaffold, a biocompatible material capable of supporting cell growth and differentiation by providing a suitable morphology, chemical and structural template. Many scaffolds that support various cell cultures use chitosan solutions. 3) Bioreactors are complex closed-system environments for producing biomass. It maintains well-controlled environment (temp., pH, DO, nutrients, and wastes),supply of nutrients, gentle mixing (avoid shear damage to cells), gentle aeration (add oxygen slowly to the culture medium,but of large bubbles is carefully avoided which can damage cells on contact),removal of wastes.

Benefits of Cell-based seafood production

- Products are free from pesticides, fungicides and antibiotics.
- No issues like absorption of mercury and toxic industrial byproducts such as PCBs and dioxins in sea water.
- Product is 'clean meat' & 'clean conscience'.
- Technology uses the same cell types with the same genes and nutritional value as wild caught or farmed fish. There are no genetic modification involved.

The U.S. Food and Drug Administration(FDA) and U.S. Department of Agriculture (USDA) created a formal agreement to jointly oversee the production of cell-based meat in March 2019 to tackle the uncertainty surrounding cell-based meat regulation and will allow the USDA and FDA to work in tandem to establish regulations and labeling.

What critics say

Critics dismiss it as unnatural 'Frankenmeat', "lab-grown meat", insisting that "they're not fair or accurate". 'Frankenmeat', 'shmeat', or sheet meat are all recent revelation in providing lab-grown burgers that don't require any killing. But one should not expect them to leap from the lab into our frying pan just yet. A lot has to be worked out, like it costs heavily.

However, the technology is still in its infancy, and well-defined research goals have been identified to establish quality improvement, sustainability, scaling of production, lowering price and above all suitable taste for consumer acceptance.

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***More References can be provided on request**

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