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Aqua International

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Inside...

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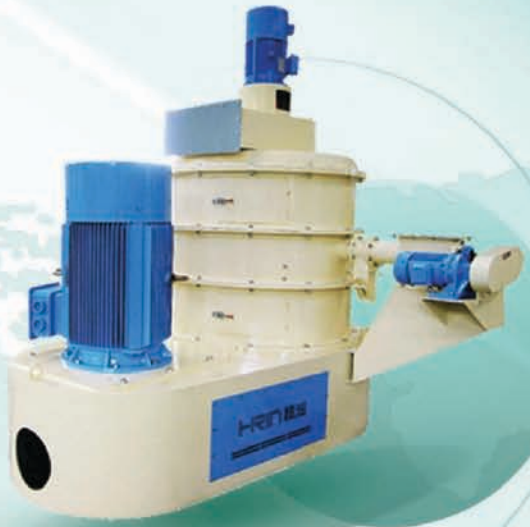

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Bile acids protect shrimp successfully pass liver transition period

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The liver transition period is one of the most important periods for shrimp farming. The hepatopancreas are main digestion organ of the shrimp, which is responsible for secretion, detoxification, immunity, hematopoiesis, and physiological regulation of digestive enzymes. Even a small problem happening during the liver transition period will affect the whole breeding result and even lead to its death.

1. What is the liver transition period of shrimp?

In general, after shrimp breed fry for more than 20 days, or when its body grows up to 4-6 cm, a white covering will be formed around the hepatopancreas, and after the white covering disappears, the covering of the hepatopancreas will turn to dark brown. The above process is called liver transition period. After shrimp liver transition period, shrimp will increase feed intake and grow faster than ever before.

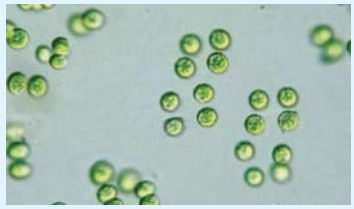
How to make sure shrimp successfully pass liver transition period?

1. Pond bottom regulation in shrimp liver transition period

In the liver transition period, in addition to paying attention to how to protect and care about the hepatopancreas, the pond bottom quality is also an important aspect. Since the temperature during the liver transition period is relatively high and the water temperature is above 25°C, bad control of pond quality will cause the bottom with a large amount of toxic and harmful substances like hydrogen sulfide and methane in the bottom spilling into the water, which directly harm the health of hepatopancreas of shrimp . Therefore, we need to use the oxidative base to oxidize the bottom organic matter during the liver transition period to reduce the generation of harmful substances at the bottom and prevent the bottom heat.

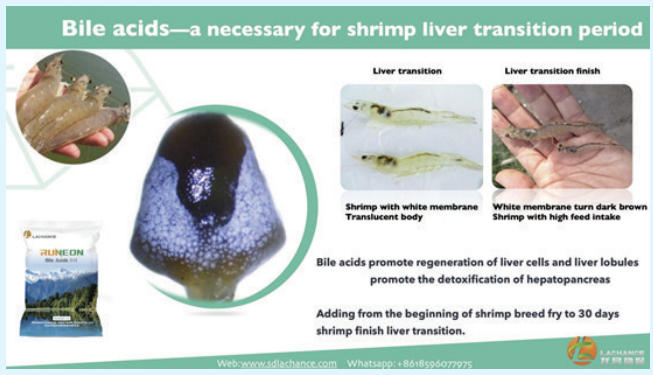
2. Algae cultivation during liver transition period

It is also very important to cultivate excellent algae during the liver transition period. The most important thing is to stabilize the water, prevent algae death, and inhibit the growth of harmful algae. If harmful algae such as dinoflagellates predominate in the pond, it will produce large amount of algae toxins, which can cause irreversible damage to the hepatopancreas and nerve system of shrimp. Therefore, we should cultivate excellent algae in ponds, and if there are more excellent algae, bad algae will not accumulate. Chlorella and diatoms are the best examples of excellent algae, and chlorella is the most common and effective product in the algae cultivation process.



3. Protect shrimp hepatopancreas during liver transition period

The feed contains a lot of fat and protein, and the daily feeding amount is very large, which inadvertently increases the burden on the hepatopancreas, so we can mix bile acids in the shrimp feed during normal feeding. The main role of bile acids is to protect the shrimp hepatopancreas and to promote the development of hepatopancreas. The use of bile acids during liver transition period can promote the regeneration of hepatopancreas cells and hepatic lobules, promote hepatopancreas development, enhance hepatopancreas function, and promote hepatopancreas detoxification to ensure shrimp successfully pass the liver transition period. Also, adding bile acids we can see shrimp with white and clean membrane, translucent body and strong intestine. By the way, bile acids can also improve anti-stress ability to get higher survival rate, reduce the incidence diseases, and ensure the health of the shrimp farming.



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M. A. Nazeer

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CONTENTS

ADVERTISERS' INDEX

World Fisheries Day celebrated on Nov 21

Dear Readers,

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

In the News section, you may find news about - The Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, GoI, celebrated 'World Fisheries Day' on 21 November 2020. World Fisheries Day is celebrated on 21 November every year to demonstrate solidarity with all fisher folk, fish farmers and concerned stakeholders throughout the world. It started in 1997 where "World Forum of Fish Harvesters & Fish Workers" met at New Delhi leading to formation of "World Fisheries Forum" with representatives from 18 countries and signed a declaration advocating for a global mandate of sustainable fishing practices and policies. The event aims to draw attention to overfishing, habitat destruction and other serious threats to the sustainability of our marine and inland resources.

The Marine Products Export Development Authority is planning to boost exports by promoting young entrepreneurs in the trade. During the financial year 2019 - 2020, a volume of 12,89,651 metric tonnes of seafood products worth Rs 46,663 crore (USD 6.68 billion) was exported. India is shipping seafood products to the U.S.A., China, European Union, South East Asia and the Middle East. Frozen shrimp, which earned about Rs 34,152 crore, retained its first position in seafood exports accounting its share of 50.58 %.

Andhra Pradesh Chief Minister Y S Jagan Mohan Reddy, on World Fisheries Day on November 21, laid the foundation stone in virtual mode for the construction of four new fishing harbours and 25 aqua hubs in the State with a total outlay of Rs 1,735 crore. The harbours will come up at Juvvaladinne, Nizampatnam, Machilipatnam and Uppada along the Bay of Bengal coast.

Central Inland Fisheries Research Institute, Barrackpore published a leaflet 'Small Scale Inland Fisheries in India' where concept, characteristics, advantages of small-scale fisheries, factors affecting and suggestive measures for development written comprehensively. CIFRI organized an informative webinar *'Understanding and managing small-scale fisheries in inland open waters - Status and Opportunity'* on September 9 & 10, 2020 where listeners were informed about new studies, concepts and strategies for way forward in this field. Aspects of scientific presentations of invited scientists in two sessions on day 1 may be seen in news pages.

In the Articles section, article titled ***Fresh water pearl production: A futuristic approach for empowering women in Northeastern States of India*** written by Dr Sampa Baidya highlighted that household women of northeast can easily involve in culture of pearl. The main advantage of pearl farming or pearl culture is the high market value. The final product i.e. pearl is non lightweight and nonperishable

Another article titled ***Seaweed Importance in Fisheries*** written by Dr Rajesh D. P and other authors highlighted that the Indian seaweed resources and subsequently lot of utilization and commercial cultivation has been added. The most recent quantitative estimates for seaweed biomass recorded in the literature for different coastal areas of India are given. An attempt has also been made to provide information on commercial utilization of natural resources, import–export trend for seaweeds and seaweed phycocolloids. Industrial utilization of seaweeds and cultivation of economically important seaweeds in India, socio-economic profile of seaweed collectors, future possible utilization strategies to be adopted for conservation of germ plasm and introduction of legislation policies for their controlled harvesting and sustainable utilization are elucidated in detail. When compared with the world scenario, estimates for India do not suggest the existence of rich seaweed resources.

Another article titled ***Technology for Voluntary Captive Spawning of Magur*** written by Dr Himanshu Priyadarshi and other authors highlighted that efforts have been made for 50 years to breed Clarias magur in captivity without sacrificing male. This is the first report of voluntary spawning of C. magur in captivity through hormonal manipulation. This technology will enable hatchery operators to produce sufficient quantity of C. magur seed, suitable for aquaculture diversification due to its hardy nature, high market price, delicacy and medicinal value. The species is also suitable for aquaculture in large number of water bodies such as marshy area, weed chocked pond and paddy fields.

M.A.Nazeer
Editor & Publisher
Aqua International

Our Mission

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

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

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

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

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

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ICAR - CIBA wins two national fisheries awards

Best Fisheries SHG Award for Nambikkai fish farmers group in Tamil Nadu for adopting ICAR-CIBA's 'Waste to Wealth' technology.

Best Fisheries Enterprise Award for Sai Aqua Feeds for commercializing ICAR-CIBA formulated Desi Feeds.

Chennai: Nambikkai fish farmers group in Tamil Nadu has won this year's 'Best Fisheries Self Help Group' award instituted by the National Fisheries Development Board (NFDB) under the Ministry of Fisheries, Animal Husbandry and Dairying. The self help group from Pattinapakkam in Chennai bagged this award for successfully adopting the technology—conversion of fish wastes into value added products—developed by the ICAR-Central Institute of Brackish water Aquaculture (ICAR-CIBA). In recognition for the research initiatives of Chennai-based institute, a start-up company from Andhra Pradesh Sai Aqua Feeds who adopted the technology of CIBA in formulating feeds for shrimps won the Best Fisheries Enterprises award. Having included a financial incentive of Rs. 2 lakh, both the awards come under the category of the best enterprises or entrepreneurs.

T. Kennit Raj, Head of the Nambikkai fish farmers group in Tamil Nadu receiving the award for the Best Fisheries Self Help Group from Pratap Chandra Sarangi, Union Minister of State for Fisheries, Animal Husbandry and Dairying at a function held at New Delhi on 21 November 2020.

'Waste to Wealth' initiative wins recognition

Nambikkai fish farmers group started functioning during 2017-18 under the aegis of CIBA to commercialize the latter's ambitious technology of recycling fish wastes to develop value-added products named Plankton plus and Horti plus. While the product Plankton plus is used in aquaculture system to boost and maintain the healthy plankton blooms, the Horti plus is used as organic manure in horticulture. The products are developed under the concept of 'Waste to Wealth' initiative of CIBA in line with the Swachh Bharat mission of the central government.

Members of Nambikkai fish farmers group in Tamil Nadu engaging in recycling fish wastes.

Constituted by the CIBA under the Scheduled Cast Sub Plan Scheme (SCSPS) of the government of India, the start-up processing unit of Nambikkai self-help group produced 16; 345 kg of value added products and attained an annual turnover of Rs 1.68 million. The group has seven fishermen members, all from the Scheduled Cast community, being four of them are women. Even at the tough time of COVID-19 pandemic, the group managed to earn Rs 2 lakh as livelihood support. The group is collecting fish wastes from markets and fish trimming from fish processing companies persistently and producing the value addition.

"This technology of CIBA has the potential to propagate across the country in cleaning the fish markets and also providing alternative livelihood to many as a circular economy", said Dr K. K. Vijayan, Director of CIBA.

"We are very much excited to receive this achievement. This award is recognition of our hard-work and gives enormous confidence to upscale the production", said Mr T. Kennit Raj, Head of the self-help group. The CIBA's training was very much effective in materializing its technology in viable way, he added.

Low-cost Desi Feed recognized

Sai Aqua Feeds received the

A view of the training programme by CIBA for Nambikkai fish farmers group.

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Members of Nambikkai fish farmers group in Tamil Nadu engaging in recycling fish wastes.

Best Fisheries Enterprises award for commercializing the indigenous shrimp feed Vannamei plus developed by the CIBA. Formulation of this feed on a commercial scale by the Andhra-based company helped reducing the production cost in shrimp aquaculture in the country and effectively contributing towards doubling of farmers' income.

According to Dr K. K. Vijayan, CIBA's technology focused on addressing the higher production cost in shrimp farming owing to the costly foreign feeds and introduced Vannamei plus in line with the Make in India concept of government of India. "In shrimp aquaculture, the feed constitutes around 60 per cent of the production cost. Further, this Desi Feed is a compliment to shrimp feed sector in India, which is mostly led by multi-national feed companies being the front runners in the sector", he said.

The company started operation in 2017 and had an overall production of 7633 lakh tonnes of shrimp feeds in the brand "Vasanthi Premium" with an average annual production of 2585 lakh tonnes. An overall turnover of nearly Rs. 5cr. was earned by the Sai Aqua Feeds by producing desi shrimp feeds. Hundreds of shrimp farmers are still getting the benefits of this feed in their aquaculture ventures. It is estimated that the production cost could be reduced by 20 per cent with the commercialization of CIBA's desi feed technology. Many shrimp farms in Guntur district remained unaffected by the COVID-induced lock down as the company produced the feeds and managed to supply them using the available logistics. Apart from Andhra Pradesh, the service of the company is available in Tamil Nadu, Kerala, West Bengal and Odisha.

The award was presented by Mr Pratap Chandra Sarangi, Union Minister of State for Fisheries, Animal Husbandry and Dairying at a function held at New Delhi on 21 November 2020.

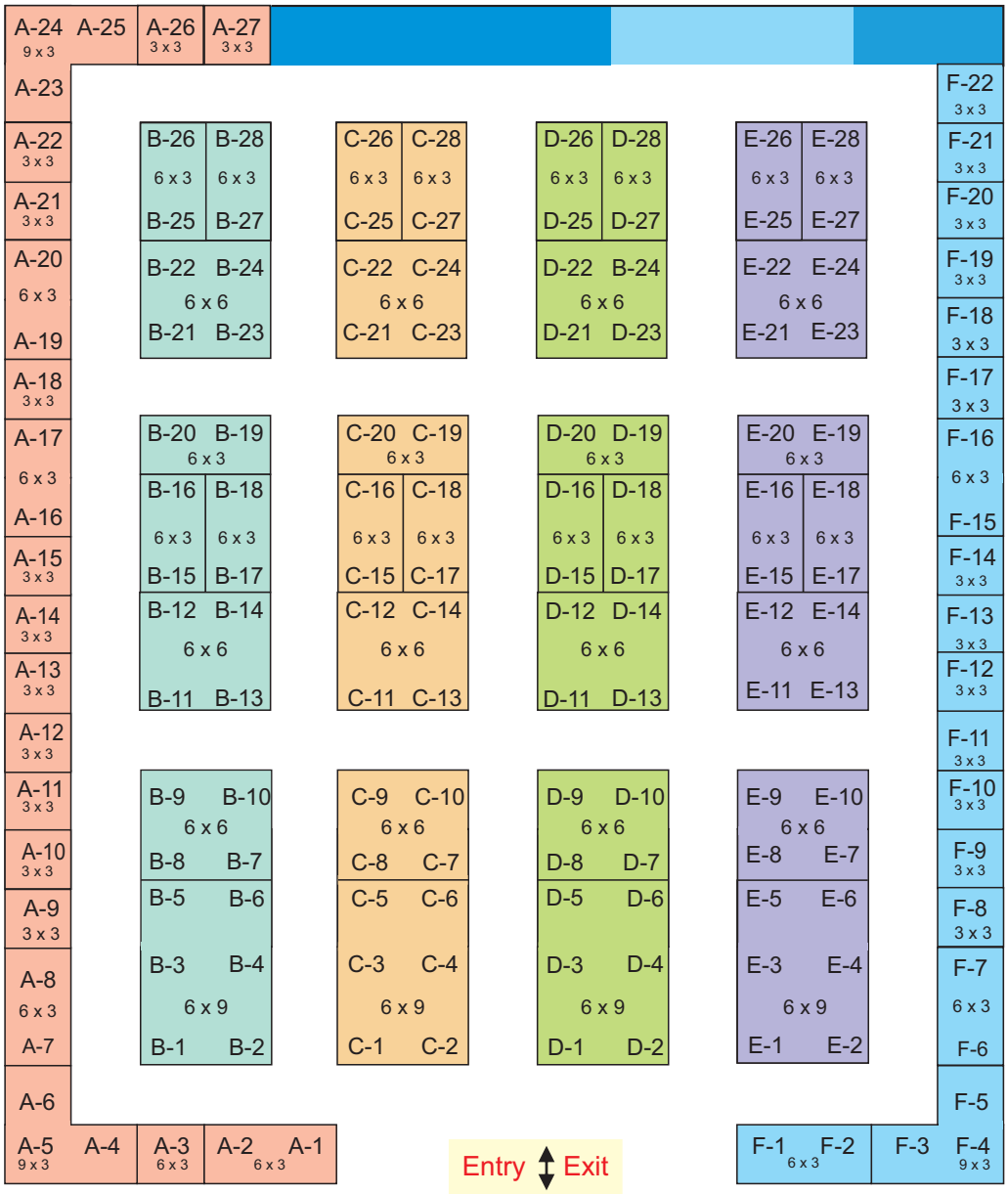
The winning of the esteemed awards mark that CIBA's technologies have enormous impact in the development of aquaculture sector in the country, said CIBA Director Dr K. K. Vijayan. "We are happy that the technologies developed by CIBA reach out to the targeted community and emerge as the best livelihood option for them", he added.

India International Aquaculture Expo 2021

28 - 29 - 30 January 2021, Hyderabad, India

35th Edition

Layout of Stalls



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Reinventing Gandhian Philosophy in Improving Fisher Livelihood

On occasion of 151 Birth Anniversary Celebration of Mahatma Gandhi, ICAR-Central Inland Fisheries Research Institute, Barrackpore organized Virtual Mode programme in hindi on 'Reinventing Gandhian Philosophy in Improving Fisher Livelihood' on 2 October 2020. Dr B. K. Das, Director, ICAR-CIFRI spoke about sensitizing rural people; right technology must reach to fish farmers/fishermen; fish production will be good this year as we got normal monsoon after 61 years; special programme for North-East planned by CIFRI. This institute is working on wetland and reservoir development, also helping to strengthen livelihood of fishermen living on banks of river Ganga. He highlighted National Mission for Clean Ganga Project initiated by CIFRI; major carp fingerlings liberated at different sites of Ganga; necessary inputs given (livelihood support) to about 500 nos tribal and 1500 nos SC/ ST farmers in Sundarbans region under institute's TSP programme in ongoing COVID-19 situation. Dr V. V. Sugunan, Former ADG (Inland Fisheries), ICAR said that according to Gandhiji, ministers and Government officers in India should make policies considering the poor and weaker communities in rural India, who must be benefitted. Owing to this CIFRI programme, fish farmers and fishermen are able to listen to talk of scientists and participate in discussion.

Dr D. Kumar, Former Director, ICAR-CIFE, Mumbai remarked that Satya and Ahimsa were keynote message given to world by Gandhiji, who wanted India to become self-reliant (Swabalamban), awakened country's farmers with slogan 'Jai Jawan Jai Kisan'. Gandhi ji used to emphasize on Swadhinata, Swaraj and self-reliance (Atmanirbharta) that must exist in every village in food grain production, clothing (Khadi-type) and housing (Ashram-like); gave ideas of 'Swachh Bharat Abhijan' and 'Atmanirbhar Bharat'. CIFRI is pioneer in making villages self-reliant, targeting for food and nutritional security and livelihood for fishermen communities, to uplift their condition. They must gain knowledge and technology from CIFRI, must not solely depend upon inputs provided to them free of cost. Videos were played on 'Canal Fisheries Development in Sundarbans' and 'Namami Gange Karyakram'. CIFRI is working with Rotarians in downtrodden villages of Odisha.

Dr J. K. Jena, DDG (Fisheries Science), ICAR in his Presidential address spoke about philosophy of Gandhiji, 'Gram Swaraj'; his demonstrations of simple living and high thinking (even after studying in England and working in South Africa) and of power of truth and non-violence; remembered his sayings 'India lives in 7.5 lakh villages' and 'Country's progress depends upon progress of rural economy'. Dr Jena mentioned that we have to strengthen rural skills, rural industry, agriculture, Indian villages. Now we have sufficient food grain production, storage and processing facilities must be strengthened. In present COVID-19 situation, growth reduced in all sectors of economy in India but agriculture showed increase by 4 % (owing to rural farmers). Technologies from ICAR institutes should be extended and disseminated. We achieved self-sufficiency in food, which must be safe and completely free from pesticides and antibiotics. Dr Jena also discussed about helping each other; learning in some way or other in every moment; no age barrier in gaining knowledge; efforts have been taken to establish more links with fish farmers/fishermen by ICAR institutes, which will also be possible in PMMSY scheme; implementation of 'development' will be possible and can be taken ahead by establishing connectivity with State Govt Line Departments. We must take pledge on quality food production, India has developed cleanliness, rural economy must be improved.

Talking about CIFRI activities in COVID-19 situation, Dr Das said that five wetlands have been developed by CIFRI; visits made on road to villages at Mayurbhanj and Farakka and being with fish farmers and fishermen, who were adopted at different places; COVID-19 prevention guidelines developed for them by CIFRI; input support given to above 500 nos Amphan-affected families in Sundarbans in West Bengal. Nowfish farmers are met on online platform, suggestions obtained from them and information got about their farming situation, their problems and guided accordingly. According to Dr Das, farmers should maintainsustainability of fish farming and move ahead; technology given by CIFRI for increasing fish productivity in wetlands; good quality seeds for farmers; improving fish production in inland open waters that can cause 2 to 3 fold increase in farmers' income; implementation and extension of technologies to more people to bring development in rural India and aiming to fulfill Gandhiji's dreams with guidance (Magdarshan) of DDG Fisheries Science.

In this programme, fish farmers and basic stakeholders namely Jyotish Talukdar; H. Sanayaima, Manipur; W. Tiewsoh, Meghalaya; Amal Medhi, Nalbari, Assam; M. Girish, Secretary, Cauveri FCS, Harangi reservoir; Nagesh, R., Kanakpura, Bangalore; M. Ajit, Kerala; Sukdev Nath, Sundarbans, WB; Bankim Malakar, Secretary, Chamta FCS, Bongaon, WB; Atanu Das, Keshpura wetland, Odisha; Krishna Halder, Gopalnagar Beldanga FCS, WB; R. Mustafa, Gosaba, WB; Sudhansubabu, Kumribeel, Assam; Yogendra Choudhury, Amit Kumar and Naresh Sahani, all from East Champaran, Bihar; Nitul Ch. Das, Barbilabeel, Assam spoke about their association (involvement) with CIFRI at Barrackpore and its Regional Centres; the support, training and benefits they obtained; increase in fish production due to adoption of cage and pen culture and composite fish culture (CIFRI technologies); improvement in beel fisheries. News communicator Subrato Ghosh participated in this programme live on Google Meet.

Raising hopes for native oyster restoration

Extensive knowledge on how to restore native European oyster habitats will be published in a landmark special issue of Aquatic Conservation: Marine and Freshwater Ecosystems.

The ground-breaking compendium of articles detail, more than any publication before, the value that shellfish habitats bring to society, how to deal with oyster diseases and the financing solutions required to restore native oysters to seas throughout Europe.

The findings originate from the global meeting of the Native Oyster Restoration Alliance (NORA), which was held in Edinburgh in May 2019 and hosted in partnership between The Glenmorangie Company, Heriot-Watt University, The Marine Conservation Society, Nature Scot and Scottish Enterprise.

Marine scientists, conservationists, administrators and oyster producers from across Europe gathered to unlock the blueprint for oyster restoration. Plans across Europe will see millions of native oysters (Ostrea edulis) returned to the seas around France, Germany, Ireland, the Netherlands, Belgium, Italy, UK and Spain, where many populations were wiped out by overfishing as long as a century ago.

This special issue will be released this week ahead of the launch of the UN Decade on Ecosystem Restoration, beginning in 2021, which aims to give a sharp focus to ecosystem restoration, 'mainstreaming' it into policy and planning.

Dr Bill Sanderson, MASTS reader in marine biodiversity at Heriot-Watt, co-authored several research articles in the issue and was the scientific chair for the global meeting held at "The Royal Society of Edinburgh". Speaking of the publication, he said: "This volume is a milestone for marine environmental restoration, containing state-of-the-art scientific evidence of, for example, the value of shellfish habitats to society; whether it's their ability to store carbon, filter large volumes of seawater, or create habitats that are biodiversity hotspots."

Dr Philine zuErmgassen, from the secretariat for the pan-European NORA, who also led the authorship on key articles, noted: "The publication shows the way forward and identifies the top 40 most important questions that need to be answered to make oyster restoration a reality across its former range."

Professor John Baxter, lead editor, added: "From predicting the dispersal of larval from restoration sites, dealing with oyster diseases or financing solutions, this compendium of scientific articles is a very significant moment that will propel restoration activities across Europe."

Dr Peter Nelson, operations director of The Glenmorangie Company, commented: "We are incredibly proud to be helping to pioneer this vital environmental work with our partners and NORA, it is all part of our strategy, through our DEEP project, to protect and enhance the environment at the Glenmorangie Distillery on the Dornoch Firth, as part of making the distillery sustainable for future generations."

New fish species found in Kawal Tiger Reserve

It is among the first vertebrates to bear the name of Telangana.

A new fish species discovered in the hill stream area of Kawal Tiger Reserve (KTR) is among the first vertebrates to bear the name of Telangana.

Called Indoreonectes Telanganaensis, the new species of loach, is distinguished by pectoral fins as long as the head, large eyes, nasal barbel reaching the middle of the eye and a number of other distinguishing features.

"The hill stream is seasonal and is part of the Godavari river basin but does not flow into the main river directly. It was discovered there," informed Srinivasulu Chelmala, the corresponding author of the paper published in Zootaxa, a peer-reviewed scientific journal for taxonomists. The research team was led by Krishna Prasad Kante, a scholar from Osmania University. The researchers backed up their claim for the new species with DNA analysis information.

Clown loaches with their interesting golden-yellow and black patterns are a favourite of aquarists who keep ornamental fish. Clown loaches are native to the inland water systems in South East Asia.

While clown loaches have shorter bodies and pinkish fins and tails, the loach discovered in Telangana is a little less colourful and has a longer body with bands of black.

"The naming after Telangana will make scientific people take notice of the new State," said

Mr Chelmala, who is part of the Osmania University faculty.

Uni-President

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Probiotics for water treatment

1. WATER QUALITY CONDITIONING

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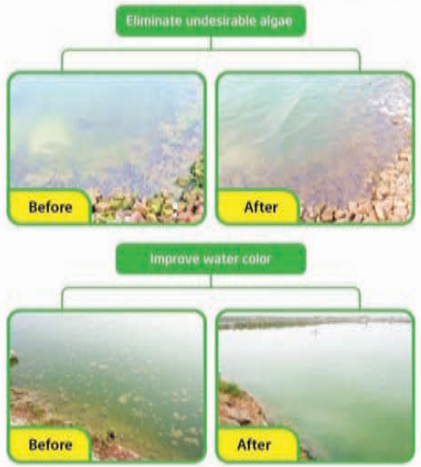
No cultivation is needed. Easily adapt to the changes of surroundings and grow fast in freshwater or seawater culture farming, even under low oxygen environment

3. DECREASE AMMONIA CONTENT

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

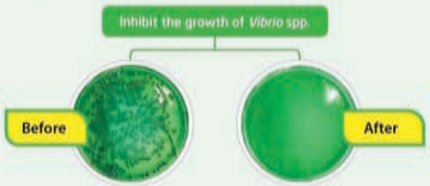
4. IMPROVE WATER COLOR

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



5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

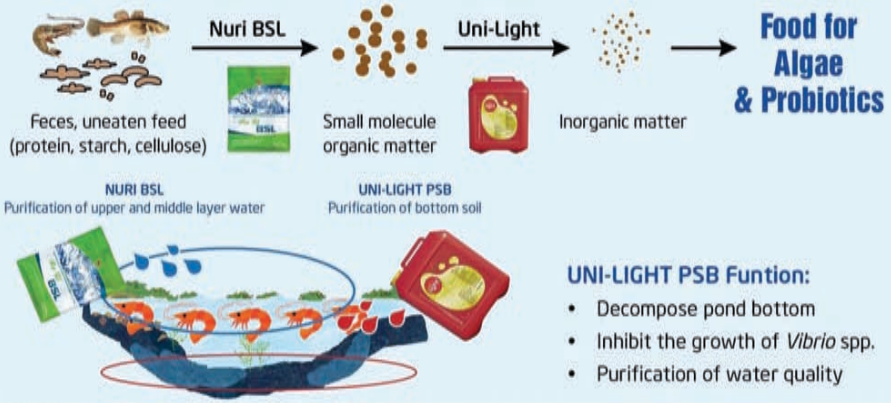
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

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

* DIRECTION OF USE:

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



UNI-LIGHT PSB Funtion:

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

BSL Dosage:

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

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

UNI-PRESIDENT VIETNAM CO., LTD

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Webinar held on Aquaculture: Innovations, Sustainability and Beyond

The National Webinar entitled 'Aquaculture: Innovations, Sustainability and Beyond' was organized by Department of Aquaculture, Fisheries College and Research Institute, Thoothukudi, Tamil Nadu during November 18 to19, 2020. Dr B. Sundaramoorthy, Dean, FC and RI gave welcome address and Dr G. Sugumar, Hon' ble Vice Chancellor, Tamil Nadu Dr J. Jayalalithaa Fisheries University gave inaugural address. Prof. B. Manimaran, Founder VC, TNJFU spoke on 'Shrimp farming - current scenario and way forward'. He discussed about Indian marine products export trend in last 10 years; shrimp sharing 42 % in quantity and 69 % in value in export; capture and culture marine fisheries contributing 68.51 % and 31.49 % share in quantity in export; marine product export is farmed shrimp centric (Penaeus monodon and Litopenaeusvannamei) that contributed a lot to our foreign exchange; India's position is top in world in global farmed shrimp production among 15 shrimp farming nations in last three to four years; India as largest shrimp exporter in world in 2019; Indian shrimp industry projected to grow to 1.4 million tonne in 2024 from 0.65 million tonne now; infrastructure in India (shrimp farms, hatcheries, feed mills); Indian shrimp market and dominance by size, by regions and by species; geographic distribution of shrimp export from India;status of summer crop and impact of COVID-19; shrimp production and supply chain; transforming shrimp farming from basis of traceability to transparent visibility through modification of supply chains (as priority); other priorities recommended for Indian shrimp farming; Govt schemes for brackishwater aquaculture targeting export; innovative technology deployment for shrimp farming and improvement programmes; importance of establishing FPOs in this sector.

Dr A. K. Jain, Former Principal Scientist, ICAR-CIFE, Mumbai spoke on 'Aquariculture: a lucrative potential in Indian scenario'. He discussed aboutdemand and supply of ornamental fishes that are increasing thus promoting the hobby; its demand will be more with increasing number of MIG and nuclear families and existence of large domestic market;development of ornamental fisheries in India with objectives and activities; prospectful activities that can be taken up by entrepreneurs, which are: 1) Aquarium service providers, 2) Setting up of aquarium retail outlet with Rs 50,000 as initial investment, 3) Manufacturing of aquarium and its accessories (that contributes 63 % of aquarium trade), 4) Culture of freshwater ornamental fishes in states other than WB (55 % contribution) and TN (30 %) starting with low value and medium value fishes and shifting to high and premium value fishes, 5) Culture of marine ornamental fishes, 6) Culture ofaquarium ornamental plants, 7) Setting up of garden ponds, 8) Culture of live fish food / feed organisms (backbone of ornamental fish industry), 9) Preparation of ornamental fish feed which does not require big set up, with pelletizer or small extruder, 10) Preparation of water and fish heath management chemicals / medicines, 11) Export of ornamental fishes with MPEDA registration. Funding support will be available from PMMSY, State Fisheries Dept, Skill development trainings, MANAGE and bank loans.

Dr V. Rajaram, Nutritionist, Grobest India Pvt Ltd, Chennai spoke on 'Formulated aqua feeds-some thoughts on industrial potential and research needs'. He discussed about Indian aquafeed market 2019; research needs and aquafeed evaluation for culture system, life stages and species, feed delivery and waste management; 2.36 million tones of finfish and shrimp feed sold in 2019 in India from 55 feedmills;fish feed for improved performance and sustainability; balance between fish's requirements and nutrients we provide;evolution of feed from mash feed, dough ball to floating extruded feed with no dust;different feed suiting for different culture systems and life stages of fish;different manufacturing and physical formsof feed for shrimp, herbivorous and carnivorous fishes, also for different feeding habits and ecological niches; evolution of feed due to farmers' wants (better water stability/ gelatinization, better FCR, differentsize, no bacterial contamination and less dust); close view of feed pellet structure prepared in traditional and modern pellet mills and extruder for better nutrient delivery and utilization; processes followed in reduction of microbial load from feed and need for microdiets; intrinsic and extrinsic factors affecting feed performance; 'connecting to farmers and exploring the unknowns' as research need; fish nutrition research covering areas like nutrient profile, sustainability, customer preference and feasibility (availability and cost); functional fish feeds for immunity enhancement, disease control, pigmentation, growth and health improvement.

Dr M. K. Anil, Principal Scientist, Vizhinjam Regional Centre of ICAR-CMFRI spoke on 'Production of marine bivalves: trends, challenges and research progress'. He pictorially discussed about mussel landing centre and underwater green mussel bed at Vizhinjam; farmed oyster and farmed mussel production in India; colour variation in Perna indica; edible oyster; Kollam green mussel landing centre; mussel spawning technique,green mussel pediveliger larva development and settlement; seeded ropes with P. viridis, spat production in hatchery; stocking mussel spat in nursery cage; one month old seeds for stocking with nylon ropes to be hung in backwaters in farms for producing adult size; advanced phytoplankton culture method for mussel seed in hatchery; edible oyster spawning and seed production by heat shock;supply of oyster rens to farmers; edible oyster eye-spot larvae with oyster shells;bivalve hatchery established at Sindhudurg, Maharashtra; steps followed in mussel seed quality test; mussel seed transportation protocol, long line and on bottom culture methods;

Perkinsusolseni infection in mussels and invasive mussel Mytellasrigata in Trivandrum; features of Pinctada imbricatafucata, itsin vitro fertilization; process of image pearl and designer pearl production.

Dr V. R. Suresh, Principal Scientist, ICAR-CMFRI, Kochi spoke on 'Cage-based aquaculture: status and future'. He discussed about cages that can hold finfishes and shellfishes as captive stock in inland and marine open waters; 80% of marine farmed finfish comes from cage culture; production in conventional pond aquaculture (0.5kg/cub.mt) and in cages (35kg/cub.mt); five families of fishes that contributes to 90% of cage-reared fishes; experiments of ICAR-CIFRI in raising fingerlings (12cm) of major carps in low-cost floating cages in 2007- 2009, fry to fingerling raising in cages in wetlands; standardization of fish culture in galvanized iron cages and HDPE net enclosure in Jharkhand reservoir in 2011 by CIFRI; entrepreneurs involved in cage business, materials used, species cultured and fish production in cages in inland open waters; state-wise cage fish production and cage culture conducted by private entrepreneurs; evolution of cage design and materials; scope of cage culture in inland floodplain wetlands and reservoirs; mariculture in cages conceptualized by CMFRI in 2005; cage culture technology packages for cobia, seabass, mullets, lobsters, pompano and snappers; about 3,000 nos cages deployed in Indian coastline; advantages and disadvantages; 'Mission Cage Culture 2022', programme of Department of AHD & F, Govt of India; integrating cages with hatchery, nursery systems and grow-out linked to marketing channels as future of cage farming; automation and artificial intelligence and remote controlled fish cages; research and development initiatives, institutional support and policy.

Dr P. Kaladharan, Principal Scientist, ICAR-CMFRI, Kochi spoke on 'Potential and future of seaweed mariculture in India'. He discussed about Sargassumsp, three Ulvasp, Enteromorphasp, Caulerpasp, Kappaphycusalvarezii, Porphyrasp; 896 species of marine algae found in Indiabelonging to 4 classes;quantity of harvestable seaweed from different states (total 260876 tonnes wet wt.); species exploited for commercial production of phycocolloid in India, exploitation of Agarophytes and Alginophytes from TN coast; number of villages and people involved in seaweed exploitation in Gulf of Mannar and Palk Bay region;cost of dry seaweed per tonne(Rs 40,000/- for each of Gracilaria and Kappaphycus, Rs 80,000/- for Gelidiella); agar, algin and carrageenan production in India; CMFRI Cadalmin nutraceuticals from seaweeds and mode of action;Cadalmin TM immunoboost extract;use of seaweeds in agriculture (liquid seaweed fertilizer and mulch for basal application); seaweed as better alternative to inorganic fertilizers; shell weight reduction (dissolution of shell) in Pernaviridisdue to ocean acidification suppressed by presence of live seaweeds; demand and threat; mariculture of seaweeds in India, suitable sites, important factors; culture method of Kappaphycusspand others in TN coast; problems encountered; promising species for culture in intertidal and deepwaters; comparison of cost and returns of seaweed cultivation with and without IMTA; large scale seaweed mariculture along coastal area is green, climate-smart and cost effective method of carbon sequestration and aquapreneurship capable of socio-economic empowerment of fishermen.

Dr Paramita B. Sawant, Senior Scientist, ICAR-CIFE, Mumbai spoke on 'Aquariculture: a focus towards sustainability and revival of endemic ornamental fauna'. She discussed about ornamental (Orn) fish genetic resource in India that offer more than 374 freshwater and 700 marine Orn fish species; distribution of indigenous Orn fishes in India; Orn fisheries for livelihood generation, its development with MPEDA, NFDB and PMMSY funding support; stakeholders in Orn fish industry; diversity of native Orn fish species, different groups; Orn fish diversity in NE and peninsular India and species those could be bred successfully; top 10 high value indigenous Orn fishes exported from India; indigenous species with major composition in exports; development and standardization of broodstock development, breeding and larval rearing technology;innovative sustainable approaches for revival of endemic fauna; researchable solution (academicians and researchers) and technology certification solution (budding entrepreneurs);painted, pink, long fin and mix colour glassfish Chanda rangaandvalue-addedzebrafish produced; concept towards sustainability of Orn fish culture;need for development of innovative sustainable value chain approach for collection/ culture to export of freshwater Ornfishes; technology interventions for handling and transfer of fish, primary holding facility, exporting facility and fish health monitoring and management; environmental integrity in Orn fish culture; Green Seal labeling; Action Plan for development of Orn fisheries in India' Aquarainbow Vision 2030'.

Mr Michael Christopher I., entrepreneur and Founder, Aquatic Remedies, Chennai spoke on 'Aquariculture in entrepreneurship development'. He discussed about his ornamental fish R&D farm with rainwater harvesting, 100% renewable energy, integrated pepper plants and solar powered water recirculation; over 200 aquariculture products developed by him; aquariculture industry in India based on his real time distribution calculation; recent trend in aquariculture customer market in India; new opportunities as aquariculture maintenance business, aquascaping, water gardening, manufacturing possibilities of aquariculture accessories and novel fish feed manufacturing; features of export formalities followed for ornamental fishes (basic requirements, third party assistance, document preparation);COVID-19 and aquariculture business and its improvement observed after COVID era. Prof. C. Antony, Head, Dept of Aquaculture, FC & RI, Thoothukudi and Organizing Secretary coordinated this Webinar along with Assistant Professor Dr C. J. Betsy. News communicator Subrato Ghosh participated in this programme.

New research signifies "an important step forward in aquaculture genomics"

New research highlights the possibilities that genetic variation in Atlantic salmon offers for advancing aquaculture production.

Spearheaded by Alicia Bertolotti, the new research involved sequencing the genomes of 492 Atlantic salmon in a project led by professor Dan Macqueen at the Roslin Institute (University of Edinburgh) in partnership with Xelect, the University of Aberdeen, and many international collaborators – including the Norwegian University of Life Sciences.

Published in the journal Nature Communications, the study is the first major investigation of its kind into structural variants in any farmed fish, Xelect – the project's sole industry partner and contributing funder – said in a press release.

Bertolotti accessed Xelect's large archive of DNA samples and trait data for the study, with the company's CEO Ian Johnston co-supervising her doctorate, completed at Aberdeen under the industrial CASE scheme of the UK's Biotechnology & Biological research Council (BBSRC).

The study looked into different types of genetic variations in aquaculture production.

"The most common type of genetic variant distinguishing individuals of the same species are single nucleotide polymorphisms, or SNPs, which are differences in a single 'letter' of the DNA code," Xelect said. "Structural variation is another major class of genetic variation, where large sections of the genetic code can be duplicated, inverted or even completely absent comparing different individuals."

Concerning structural variation, fish farmers can glean a valuable tool as far as maximizing production gains goes, Xelect said.

"As structural variations are passed from one generation to the next, they provide another potentially valuable tool to use when maximizing production gains for fish farmers. Recent breakthrough in computing power, bio informatic algorithms and improvements in genetic sequencing technology have made it possible to identify structural variants, though this remains challenging," the firm said.

One finding of note from the study, according to Bertolotti and Xelect, was "that many structural variations were located in brain-expressed genes that influence behavior."

"Farmed salmon appear to have accumulated more of these variants than their wild relatives, presumably as a result of selective breeding for domesticated strains," the press release stated. "There is clearly considerable potential for structural variations to increase trait gains using natural genetics."

Bertolotti said the team faced some daunting challenges in its work.

"One of the greatest challenges we faced was filtering out the many false variants that were not true structural variations. None of the automated systems were accurate enough, so in the end we did it manually, which was an enormous task," Bertolotti explained.

The research stands as an important milestone for aquaculture genomics, Xelect Operations Director Tom Ashton said.

"Alicia's PhD and the resulting paper in Nature Communications represent an important step forward in aquaculture genomics, bringing us closer to being able to harness the power of structural variations in selective breeding programs," according to Ashton.

Wiltshire trout farm invests in sustainable technology

Trout at Wiltshire-based Trafalgar Fisheries

Wiltshire-based trout rearing specialist Trafalgar Fisheries is doubling production following a £1.5 million investment in sustainable technology.

Trafalgar is located at Barford Fish Farm within the Longford Estate, Salisbury. The business is the biggest producer of rainbow trout for both Waitrose and Abel & Cole. It has also supplied food wholesalers for more than 40 years.

The investment has been financed by a loan from Lloyds Bank. It will be used to implement the latest recirculation technology to improve production and modernise the natural rearing process.

The funding comes via Lloyds Bank's Clean Growth Finance Initiative, which provides discounted funding to help businesses transition to a lower carbon, more sustainable future.

In recent years, the company says, rising water temperatures in the River Avon have seen an increase in fish mortality rates caused by exposure to infectious diseases. The new technology utilises borehole water, to create a stable environment for the fish, improving their quality of health and welfare.

David Canty, resident agent at Longford Estate who is overseeing the project, believes that modernisation is the key to unlocking future growth.

He said: "Becoming more efficient and sustainable, without compromising on quality, is absolutely key if we're to continue to fly the flag for British trout across the world. We're constantly thinking of ways to be more innovative and investing in the latest rearing technology gives us a really solid platform to do this."

Trafalgar Fisheries has been a customer of Lloyds Bank for more than 40 years, when the then-owner of Longford Castle, the eighth Earl of Radnor, began experimenting with rearing trout in small ponds. Since then, the business has grown significantly, supporting 50 local employees and growing annual turnover to £5.8 million.

MPEDA plans to boost exports

Young entrepreneurs in State to be promoted

The Marine Products Export Development Authority (MPEDA), which is exporting seafood products to many countries across the globe, is planning to boost its exports by promoting young entrepreneurs in the trade.

During the financial year 2019-20, 12,89,651 metric tonnes of seafood products worth Rs 46,662.85 crore (USD 6.68 billion) was exported.

India is shipping seafood products to the U.S.A., China, European Union, South East Asia and the Middle East. Frozen shrimp, which earned about Rs 34,152.03 crore, retained its first position in seafood exports accounting its share of 50.58%, said MPEDA Chairman K. S. Srinivas.

The U.S.A. continued to be the major importer of Indian seafood followed by China. Frozen fish was the second largest export item from India, he said.

The MPEDA is planning to encourage fresh entrepreneurs to improve the exports, as the demand for Indian seafood is high in the international market.

"We are trying to improve the area of cultivation and increase shrimp, crab and fish culture. MPEDA officials are identifying the potential areas, develop ports to boost up the exports," Mr Srinivas told The Hindu.

Training and tech share

Private hatcheries and growers have been requested to come into aquaculture and the MPEDA was ready to share the technology and give necessary training to the farmers. Already, training was being given to the farmers in various centres across the country, he said.

Seafood products worth ₹46,662.85 crore was exported during the financial year 2019-20.

The MPEDA is also planning to take up diversified activities, including inland and hinterland culture, in association with the State and Central government departments. As part of it, potential areas away from the coast and river banks are being identified.

"We entered Memorandum of Understanding (MoU) with Andhra Pradesh, Kerala, Tamil Nadu and other states to improve the aquaculture and thereby enhance the exports," the Chairman said.

He appealed to the public to stop juvenile fishing (catching small fish), use square mesh nets, protect water bodies and mangroves to save the environment for the future generations.

Govt celebrates 'World Fisheries Day' on November 21

The Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India has celebrated the 'World Fisheries Day' on 21 November 2020.

World Fisheries Day has celebrated on 21 November every year to demonstrate solidarity with all fisher folk, fish farmers and concerned stakeholders throughout the world. It started in 1997 where "World Forum of Fish Harvesters & Fish Workers" met at New Delhi leading to formation of "World Fisheries Forum" with representatives from 18 countries and signed a declaration advocating for a global mandate of sustainable fishing practices and policies. The event aims to draw attention to overfishing, habitat destruction and other serious threats to the sustainability of our marine and inland resources.

The celebrations serve to focus on changing the way the world manages global fisheries to ensure sustainable stocks and healthy ecosystems.

The Government of India is in the forefront in transforming the sector and to usher in economic revolution through Blue Revolution in the country. India is leading fish producing country and second major producer of fish through aquaculture in the world. Fisheries sector in India provides direct employment to about 28 million fishers and fish farmers besides meeting the food and nutritional security and foreign exchange earnings. India contributes about 7.7% to the global fish production and country ranks 4th in global exports of fish products. The sector envisioned to increase the farmers' income through enhancement of production and productivity, improving the quality and reduction of waste. Taking into account the Centrally Sponsored Scheme "Blue Revolution" which was launched in December, 2015 had made vital contributions towards the development of the sector. The Fisheries sector has contributed about 1.24% to the national GVA and about 7.28% of the agricultural GVA in 2018-19.

On 10 September, 2020, Prime Minister Shri Narendra Modi launched the "Pradhan Mantri Matsya Sampada Yojana" (PMMSY) at an estimated investment of Rs. 20,050 crores for a period of five years, i.e., from 2020-21 to 2024-25. PMMSY aims to achieve fish production to 22 million metric tonnes (MMT) by 2024-25 and also to create an additional employment opportunity to about 55 lakh people.

The new scheme provides thrust for infusing new and emerging technologies in fisheries and aquaculture to enhance production and productivity, welfare of fishers and fish farmers, creating a conducive environment for private sector participation, development of entrepreneurship, promotion of ease of doing business, innovations and innovative project activities including start-ups, incubators etc.

In addition, the Fisheries and Aquaculture Infrastructure Development Fund (FIDF) which was started in 2018-19 Rs.7, 52 248 crores will also cater to creation of fisheries infrastructure facilities both in marine and inland fisheries sectors to augment the fish production in the country. Besides, the Government has also extended to facilities of Kissan Credit Cards (KCC) to fishers and fish farmers to help them in meeting their working capital needs.

NITPY hosts national workshop on Water Quality Management for Aquaculture

A national workshop on Water Quality Management for Aquaculture was conducted by the National Institute of Technology - Puducherry (NITPY) through online mode on Monday, to infuse into fisheries sector the benefit accruing from Internet of Things (IoT) platform.

The workshop organised by the Department of Electronics and Communications Engineering was addressed by experts from ICAR - Central Institute of Fisheries Technology, Kerala University of Fisheries and Ocean Studies, Marine Products Exports Development Authority, and Central Institute of Brackishwater Aquaculture.

Inaugurating the national conference, G. Sugumar, Vice-Chancellor, Tamil Nadu Dr J. Jayalalithaa Fisheries University, said such programmes envisaging dissemination of latest technical know-how were the need of the hour for ramping up the scale of production through inland fisheries, as in advanced countries.

The inaugural session of the workshop was also addressed by Rashmi Sharma, Scientist, Department of Science and Technology, Government of India, and G. Aghila, Professor and Registrar In-Charge of NITPY.

Funded by the Science for Equity, Empowerment and Development (SEED) Division of the Department of Science and Technology, Government of India, the programme was a component of a project titled 'Design and Development of IoT Based Low Cost Water Quality Monitoring and Reporting System for Aquaculture', NITPY Director K. Sankaranarayanasamy said.

The topics covered included prospects of aquaculture diversification in India, advances in shrimp farming, engineering technologies for Aquaculture and inland fisheries, and Internet of Things-based Water Quality Monitoring System for Acquaculture.

Global Water Treatment for Aquaculture Market Forecast by Type and by Application (2021-2026) with Detailed Development History

Rising feed costs will drive advances as fishmeal and fish oil prices continue to grow rapidly, and the ongoing transition from extensive and semi-extensive to intensive aquaculture production supports greater feed demand. However, higher fish product prices — due in large part to increasing feed costs — will result in slower growth in global per capita fish consumption, and bring advances in world aquaculture demand to more sustainable levels. The corresponding moderation in world aquaculture output will be particularly significant in China, which is forecast to grow at a slower pace than not only the rest of the Asia/Pacific region, but also South America and the Africa/Mideast region.

Asia was the largest and one of the fastest growing aquaculture producing regions from 2002 to 2012, with China alone accounting for 61 percent of global aquaculture production and 51 percent of aquaculture supply demand in 2012. While growth in Chinese demand for aquaculture supplies and equipment is expected to moderate, demand in the rest of the Asia/Pacific region is expected to grow rapidly, with only the Africa/Mideast region exhibiting faster gains. Central and South America is also expected to significantly expand its presence in the global aquaculture industry through increased production and higher demand for aquaculture inputs. More mature markets, such as Europe and North America, are also expected to show healthy growth in line with the more modest expansions expected in aquaculture production from these regions.

The global Water Treatment for Aquaculture market is valued at US$ xx million in 2020 is expected to reach US$ xx million by the end of 2026, growing at a CAGR of xx% during 2021-2026.

(This is our latest offering and this report also analyzes the impact of COVID-19 on Water Treatment for Aquaculture market and updated by the current situation, especially the forecast).

The research report has incorporated the analysis of different factors that augment the market's growth. It constitutes trends, restraints, and drivers that transform the market in either a positive or negative manner. This section also provides the scope of different segments and applications that can potentially influence the market in the future. The detailed information is based on current trends and historic milestones.

This section also provides an analysis of the volume of production about the global market and also about each type from 2015 to 2026. This section mentions the volume of production by region from 2015 to 2026. Pricing analysis is included in the report according to each type from the year 2015 to 2026, manufacturer from 2015 to 2020, region from 2015 to 2020, and global price from 2015 to 2026.

A thorough evaluation of the restrains included in the report portrays the contrast to drivers and gives room for strategic planning. Factors that overshadow the market growth are pivotal as they can be understood to devise different bends for getting hold of the lucrative opportunities that are present in the ever-growing market. Additionally, insights into market expert's opinions have been taken to understand the market better.

The major players in the market include Aqua fine, Pentair Aquatic, Veolia, Xylem, ATG, Blue Ridge Technology, Spartan, WMT, etc.

Global Water Treatment for Aquaculture Market: Regional Analysis

The report offers in-depth assessment of the growth and other aspects of the Water Treatment for Aquaculture market in important regions, including the U.S., Canada, Germany, France, U.K., Italy, Russia, China, Japan, South Korea, Taiwan, Southeast Asia, Mexico, and Brazil, etc. Key regions covered in the report are North America, Europe, Asia-Pacific and Latin America.

The report has been curated after observing and studying various factors that determine regional growth such as economic, environmental, social, technological, and political status of the particular region. Analysts have studied the data of revenue, production, and manufacturers of each region. This section analyses region-wise revenue and volume for the forecast period of 2015 to 2026. These analyses will help the reader to understand the potential worth of investment in a particular region.

Global Water Treatment for Aquaculture Market: Competitive Landscape

This section of the report identifies various key manufacturers of the market. It helps the reader understand the strategies and collaborations that players are focusing on combat competition in the market. The comprehensive report provides a significant microscopic look at the market. The reader can identify the footprints of the manufacturers by knowing about the global revenue of manufacturers, the global price of manufacturers, and production by manufacturers during the forecast period of 2015 to 2019.

UP best performer in inland fisheries, Odisha is best Marine state

Uttar Pradesh was awarded as the best performing state in inland fisheries sector while Odisha got the award of the best Marine state on the occasion of 'World Fisheries Day'

Uttar Pradesh was awarded as best performing state in inland fisheries sector while Odisha got the award of the best Marine state on the occasion of 'World Fisheries Day' observed on Saturday by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

The Minister of State for Fisheries, Animal Husbandry and Dairying, Pratap Chandra Sarangi, was the chief guest at the occasion. Laxmi Narayan Chaudhary, Minister for Dairy Development, Animal Husbandry and Fisheries, Government of Uttar Pradesh also graced the occasion and received the award on behalf of the State of Uttar Pradesh, awarded as best performing State in inland fisheries sector. The fishers, fish farmers, entrepreneurs, stakeholders, professionals, officials and Scientist from across the nation also participated in the grand event.

Addressing the gathering, the Minister of State, Sarangi said, "World Fisheries Day is our way of thinking globally and acting locally as we reach out to our fisher communities through local events. He said that through this event we send a message to our fishers, to our nation and to the world that fisheries is an important sector that contributes immensely to

the socio-economic growth of the country."

Sarangi said that the marine capture fisheries in the country have become stagnant and there is a paradigm shift from capture to culture-based fisheries.

Aquaculture activities have to be taken up in India as the alternative way of meeting the growing demand of nutritional security. He also said that Pradhan Mantri Matsya Sampada at a total estimated investment of Rs. 20,050 crores intends to address critical gaps in fish production and productivity, quality, technology, post-harvest infrastructure and management, modernisation and strengthening of value chain, traceability, establishing a robust fisheries management framework and fishers' welfare.

Sarangi said that the Fisheries sector is extremely diverse and quite dynamic. There is a need to streamline policies and programs to take R&D benefits to the farmers and fishers for orderly and sustainable utilisation of all potential resources with focus on increasing efficiency and reducing environmental footprint. He said, "We need to diligently explore the resources available in the country such as waterlogged area, wetlands, lakes, reservoirs, canals, ponds, tanks, floodplains, backwaters, lagoons, low saline inland areas for increasing the fish production."

During the event, for the first time in the Fisheries Sector, the Government of India awarded best performing States for 2019-20 namely, Odisha (amongst Marine states), Uttar Pradesh (amongst Inland states) and Assam (amongst Hilly and NE states).

The Govt. also awarded best Organisations for 2019-20 (Tamil Nadu Fisheries Development Corporation Ltd. (for Marine); Telangana State Fishermen Cooperative Societies Federation Ltd (for Inland), and Assam Apex Cooperative Fish Marketing and Processing Federation Ltd. (for Hilly region); Krishna District, Andhra Pradesh as best Marine District; Kalahandi, Odisha as best Inland District; Nagaon, Assam as Best Hilly and NE District.

Andhra Pradesh CM YS Jagan Mohan Reddy to lay stone for four fishing harbours, 25 aqua hubs

These four fishing harbours will come up at JuvvalaDinne in Nellore, Uppada in East Godavari district, Nizampatnam in Guntur district and Machilipatnam in Krishna district.

21 November 2020, Vijayawada: Chief Minister YS Jagan Mohan Reddy will lay the foundation stone for four fishing harbours in the State on the occasion of the World Fisheries Day on Saturday. These four fishing harbours will come up at JuvvalaDinne in Nellore, Uppada in East Godavari district, Nizampatnam in Guntur district and Machilipatnam in Krishna district.

The Chief Minister will also lay the foundation stone for 25 aqua hubs in the State. The State government had decided to set up eight fishing harbours in the State at an estimated cost of Rs 3,000 crore.

Works for the remaining four fishing harbours will also be taken at the earliest, government sources said. It may be recalled that Jagan, who interacted with many fishermen during his padayatra taken out before the 2019 elections, had promised to set up more fishing harbours in the State.

The total cost of the four fishing harbours to be constructed in the first phase is Rs 1,510 crore and in the second phase, fishing harbours will come up at Budagatlapalem in Srikakulam district, Pudimadaka in Visakhapatnam district, Biyyapu Tippa in West Godavari district and Kothapatnam in Prakasam district.

In the first phase, tenders have been called for the

Andhra Pradesh CM YS Jagan Mohan Reddy

four fishing harbours at Juvvaladinne, Nizampatnam, Machilipatnam and Uppada costing around Rs 1,510 crore and the government aims at completing them in the next two years. The tenders will be finalized in the second week of December.

Although Andhra Pradesh has the second longest coastline of about 974km in the country, the previous government allegedly neglected the maritime activity and established only small fishing harbours.

Through the new fishing harbours, it is expected that an additional 2.37 lakh tonnes of fish and prawns worth nearly Rs 500 crore will be added as GVA (Gross Value Addition) to the State and 85,000 direct and indirect employment will be generated.

The state government will be developing these green energy harbours with modern facilities such as cold storage units, fish processing units, chill centres, boat handling, and repair facilities. It is also planned to provide one or two coastal cargo berths in the fishing harbours, wherever feasible, to facilitate export operations.

Along with the eight fishing harbours, the state government has decided to develop one aqua hub each in every assembly constituency, depending on feasibility.

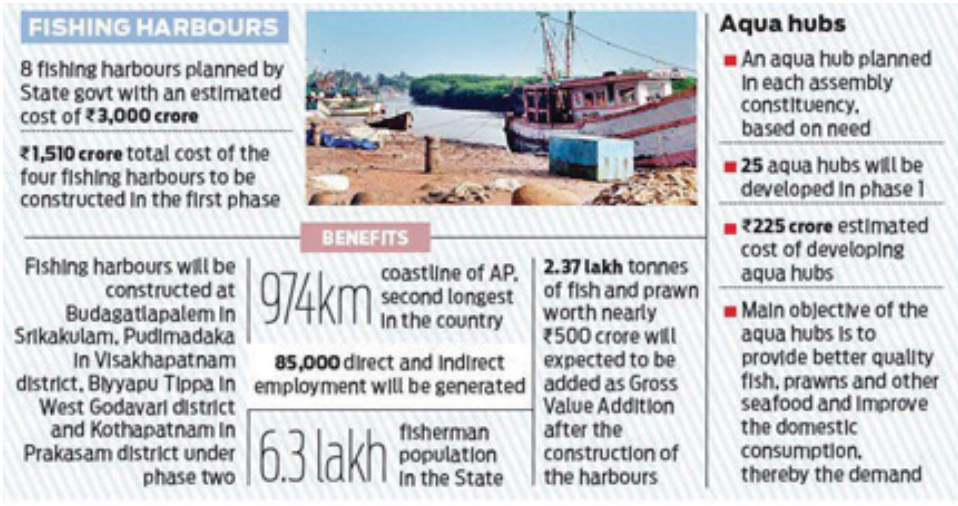
In the first phase, 25 aqua hubs will be developed. The total estimated cost of the developing aqua hubs is Rs 225 crore. Main objective of the aqua hubs is to provide better quality fish, prawns and other seafood and improve the domestic consumption, thereby the demand.

Fish and other sea foods are rich in nutrients and recommended for consumption to improve immunity. Further, to ensure optimum remunerative price for the aqua farmers, the aqua hubs, which will be managed by Aqua Farmers Societies, will be interlinked with the proposed Janata Bazaars.

Amul milk project

Earlier, speaking to media persons, Minister for Fisheries and Animal Husbandry S. Appalaraju said the Chief Minister will also launch AP Government-Amul Milk project on 26 November 2020. On the same day, milch animals will be distributed to the beneficiaries under the YSR Aasara and YSR Cheyutha.

He said out of 400 lakh liters of milk produced per day in the state, the dairies are able to procure only 1.6 lakh liters and with the tie-up over 200 lakh liters of milk will be procured. In order to help the women dairy farmers, 7,125 bulk milk chilling units will be established near the existing Rythu Bharosa Kendras in three phases at a cost of Rs 1,362 crore.



CMFRI extends support to troubled fish farmers, opens live fish counter

Varieties such as seabass, red snapper, pearl spot and tilapia farmed in cages are available live

Kochi: In a move to create a market avenue for fish farmers, the Central Marine Fisheries Research Institute (CMFRI) has opened a 'Live Fish Counter' at its campus that also offers an opportunity to fish lovers in the city to purchase quality live fishes farmed in cages.The facility is aimed at supporting the cage fish farmers who toil hard to reach to consumers owing to the COVID-19 pandemic. The counter is selling varieties such as seabass; red snapper, pearl spot and tilapia live on all working days. The facility is meant for the cage fish farmers who use the technical support of CMFRI's Agricultural Technology Information Centre (ATIC) and KrishiVigyan Kendra, Ernakulam(KVK).

The initiative assumes significance in the wake of the crisis being faced by the fish farmers owing to the COVID-19 pandemic. This will help farmers reach out to the consumers without the help of middlemen

"Fish farmers find it hard to sell their produce as marketing of farmed fish was disrupted by the COVID-induced circumstances. By depending on middlemen, fish farmers' profit is slashed by around 35 per cent. They cannot survive in the field further, unless the farmers are able to sell the yield immediately after the harvest. The facility given at CMFRI's Live Fish Counter where fish tanks are equipped in a way ensuring the adequate oxygen supply to the fish will be of much help to them to sell the fish live and fresh", said Dr Vipin kumar V P, Principal Scientist and Manager of ATIC.

He also said that Counter would be helpful to consumers as well to purchase the fish in good quality and condition. "CMFRI also aims to promote a trade culture of selling fish live which has immense scope in urban areas these days. The sector will be benefitted by diversifying the trade and marketing so as to attract consumers", Dr Vipin kumar said.

Operated by the ATIC and KVK, the Fish Counter will be open from 10 am to 7 pm on all working days.

A Farm Shoppe which offers fresh, hygienic and packed food products, including vegetables is also functional along with a Farm Store where various seeds, plants,

feed and organic manure among many other varieties exclusively for farmers are available. Quality-ensured branded food products directly procured from farmers, farmer collectives and self-help groups, including the items such as cut vegetables, fruits, pokkali rice, country eggs, milk, cooking oil, pulses, spices, ghee, etc are available at the Farm Shoppe.

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Shrimp / Fish performs all their body functions and growth in water. Good quality water and proper D.O. levels determines the success or failure. Good quality water, optimum D.O. level is of prime importance for health and growth of Shrimp / Fish.

Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions triggers the release of toxic gasses like Ammonia, H_2S, Methane, etc, The toxicity of Ammonia, Hydrogen Sulphide, Methane attributed mainly due to unionized form. As the concentration in water increases, ammonia excretion by aquatic organism diminishes and the level of ammonia in blood and in other tissues increases. Ammonia increases oxygen consumption by tissues, damage gills and reduces the ability of blood to transport oxygen, and increases the disease susceptibility. To eliminate / overcome the above problems 'GASSEN PLUS' Yucca Schidigera, it contains Steroidal"Saponin" which help to reduce ammonia and other noxious gasses such as H_2S, Methane, etc., Microbial enzyme "Urease' Production inhibited by Saponin which leads to an increases D.O. and reduction of BODand COD levels.

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

COMPOSITION:
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BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
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Fresh water Pearl production: a futuristic approach for empowering women in northeastern state of India

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Highlight Points

▶Household women of northeast can easily involve in culture of pearl. ▶The main advantage of pearl farming or pearl culture is the high market value. ▶The final product i.e. Pearl is non lightweight and nonperishable.

Abstract: Pearls are precious, biological gem having smooth, lustrous deposit nacre around the foreign particle. Fresh water pearls have been successfully produced in three species of bivalves which are found to possess high potential for pearl formation compared with the other species, viz., *Lamellidens marginalis*, *L. corrianus* and *Parreysia corrugata* (Janaki Ram 1989). Pearl culture may offer livelihood opportunities to northeastern women. However, the major limitations for adoption of pearl culture are non-availability of skilled manpower for performing implantations and absence of an established marketing network. These potential livelihood opportunities may be recognized in northeastern India through the active introduction of pearl farming where they support local populations.

Key words: *Lamellidens marginalis*, women empowerment, Pearl.

Introduction:

Pearl is known as "Queen of Gems" and considered as symbol of beauty, love, purity and good wealth. Pearls were considered as an exclusive privilege of royalty and throughout history held presence within wealthy and powerful people. According to our Indian system of gemology, of nine maharatnas (Heera, Mukta, Manikya, Pravala/Munga, Gomeda, Indra-neela, Vaidurya, Pushyaraga and Panna) the pearl (Mukta) is only next to diamond (Heera). Pearls are among the oldest and most universal of gems being admired and adored as symbols of beauty, wealth and love all over the world. Glittery, lustrous and colorful pearls have been called the queen of the jewels. Pearls are produced by only selected species of bivalves and a few gastropods. A natural pearl is formed when a foreign particle, such as a piece of sand or parasite, makes its way into particular species of mollusc and cannot be expelled. As a defense mechanism, the animal secretes a substance, known as nacre, to coat the foreign body. Layer upon layer of this coating is deposited on the irritant, resulting in a shimmering and iridescent creation of a gem. Cultured pearls are produced both in marine and freshwater environments. The cultured pearl undergo the same process of formation as that of natural pearl. The only difference is that an irritant of foreign particle, otherwise called as 'nucleus', of desired shape and size is surgically implanted into the body of bivalve mollusc where it cannot be expelled. The animal does the rest, creating the precious biological gem, the pearl. A pearl is more or less similar to the inner shining layer called 'mother of pearl layer' or nacre of shells. The composition of a pearl is about 82-86 per cent aragonite crystals of calcium carbonate; 10 to 14 per cent organic matrix, a scleroprotein termed as conchiolin; and 2 to 4 per cent water. A pearl has 3.5 to 4.5 hardness on Moh's scale with a specific gravity of 2.7. Pearl culture is a billion dollar business and one of the world's largest aquaculture activities in terms of value. The world trade in cultured pearls is reported to be more than US$2 billion per annum, contributed mainly by freshwater pearls. It was also reported that India imports around US$0.2 billion worth of pearls each year, mainly from China and Japan. The demand for pearls in the Indian market is increasing every year (Ninawe, 2006).

India has more than 50 species of mussels distributed in various freshwater resources. Among these, *Lamellidens marginalis, L. corrianus* and *Parreysia* corrugate have been shown to produce quality pearls (Raje et al. 2004). The genus Lamellidens is represented by nine species and two sub-species, while the genus Parreysia includes 35 species and six sub-species in two sub-genera (Subba Rao 1989). Species in the genus *Lamellidens* are normally distributed in stagnant to slow flowing habitats such as ponds, lakes and reservoirs at a depth of 0.5 m and deeper (Misra 2005). Generally, pH neutral to slightly alkaline waters are conducive for mussel colonization. Mussels are filter feeders and juveniles filter single celled algae, such as diatoms, gold algae (*Chrysophyceae*), green algae (*Chlorophyceae*) and Euglena sp. Adult mussels filter some colonial types of algae, organic matter and tiny zooplankton along with single-celled algae. Therefore, effective management of natural food sources in the water body is very important in the cultivation of

mussels. Dissolved oxygen (DO), pH and other parameters are very important to the mussel (Dan and Ruobo 2000). In India, marine pearl culture had its beginning in the early 1970s by the Central Marine Fisheries Research Institute, Cochin and the technique is now fairly established (Mishra and Mukhapadhyay, 2008). In contrast, freshwater pearl culture remained as an unexplored area despite vast freshwater resources and abundant natural stocks of freshwater mussels in the country. Realizing the scope and importance of inland pearl culture, an indigenous system of culturing pearls from common freshwater mussels, *Lamellidens marginalis, L. corrianus* and *Parreysia corrugata* has evolved (Janakiram 1989), producing traditional regular round, maybe (half round), small round, oval to irregular pearls of assorted color and luster.

Steps for the Operating of Pearl Mussels:

The best season for operating depends on the water temperature. When the water temperature is between 15-25° C, mussels have an active metabolism with high survival rate of mantle cells, recover rapidly from the operation wound and quickly form the pearl sac and secrete nacre. These are important factors in producing good quality pearls.

The technology of pearl production is broadly divided into 6 principle steps described as follows:

1. Collection of mussels:

Mussels usually live partly buried in the sand or mud in shallow marginal areas of stagnant to slow-flowing habitats. Healthy mussels are collected manually and kept in containers with water. The ideal mussel size used for pearl culture is over 8 cm in anteriorposterior length.

2. Pre-operative conditioning:

The mussels are kept crowded in aged tap water for 2-3 days. Such preoperative conditioning helps in relaxation of adductor muscles, which increases ease of handling during tissue grafting and insertion of nuclear beads.

3. Mussel surgery:

The materials required for surgical implementation include specially designed surgical kits, nuclear beads of various size and shape and the mussel species to be implanted. The nuclear materials used the world over are primarily made from hard molluscan shells. Beads made from mussel shell powder or eggshell powders blended with suitable adhesives are also ideal nuclear materials that produce gem quality pearls. Beads can be manufactured in various shapes to produce different shaped pearls. Three types of surgical operation techniques, viz. mantle cavity, mantle tissue or gonadal implementations are followed depending on the type of pearl to be produced.

a. Mantle cavity implantation:

Mantle cavity implantation is the simplest technique, which often results in a high rate of success. The products are generally self-attached, half round pearls, depending on the shape of the nucleus implanted. The shells are carefully opened by means of a speculum up to a maximum of 1 cm wide without causing injury to the adductor muscle. A small area of the mantle from the anterior side is carefully detached from the upper shell valve and a nucleus of desired size and shape (up to 1 cm) is slowly inserted into the mantle cavity. Subsequently, a gap created during implantation is closed by pressing the mantle gently. The mussel is then turned over and a similar implantation is carried out in the other mantle cavity.

Mantle cavity implantation

b. Mantle tissue implantation:

This operation has two steps: making a slice of mantle tissue and transplanting the slice. Both steps should be performed at the same time. The mantle tissue slice should be made from the edge of the mantle tissue near the pallial line. The nacre secretion capacity of this part of the mantle is the strongest. There are several ways to prepare the mantle tissue; by tearing, splitting and peeling, in which the mantle tissue is separated into two parts from a cut mussel and the epidermis is prepared for making a tissue slice. The next step is to cut the epidermis of the mantle tissue strip into square slices 3 x 3 mm in size (Dan and Ruobo 2000). The mantle tissue slice is then transplanted into the mantle tissue of a living mussel between the outer edge of the mantle and posterior part of the central mantle. The number of transplanted mantle slices used depends on the size of mussel to be implanted. About 25-30 slices can be transplanted into a mussel 10 cm long with 12-15 slices in each side.

c. Gonadal implantation:

The slices are prepared from the mussel as stated earlier. The recipient mussels are carefully opened 1 cm wide with the shell opener and positioned on the clamp of the operating stand. The labial pulps and gills of the clamps recipient mussels are gently pushed up with a spatula and the operating gonad area exposed. A small incision is made by a specially designed knife along the outer membrane of the gonad for inserting the slice and nucleus. Care is taken so the nucleus touches the outer epithelial layer of the slices and the intestine is not cut during the surgery.

4. Post-operative care:

The implanted mussels are placed immediately after surgery in specially made nylon bags at two per bag with the ventral side up. The bags are placed at 0.2 m depth for 10 days. Ferro-cement or FRP tanks filled with aged tap water are used for this purpose. Water in the post-operative care unit is treated with the broad spectrum antibiotic, Choramphenicol at 1-2 ppm as a prophylactic measure, ensuring better survival and wound healing of the implanted mussels (Anonymous 2009). It is desirable to add algae-rich water into the units after 3-4 days. The units are examined daily and dead mussels are removed.

5. Pond culture:

After post-harvest care, the nylon bags containing implanted mussels are hung at 1 m depth from bamboo or PVC pipes placed in ponds. Mussels can also be kept in perforated plastic crates and a specially designed frame with net pockets. The mussels are cultured at a stocking density of 61,750/ha. Since mussels are filter feeders, the ponds are

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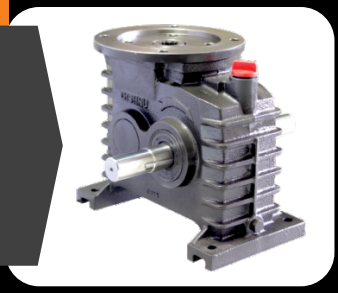

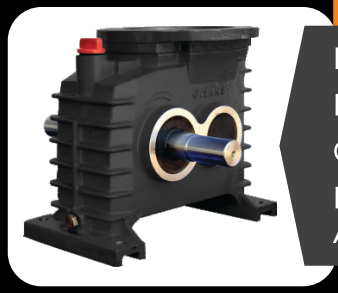

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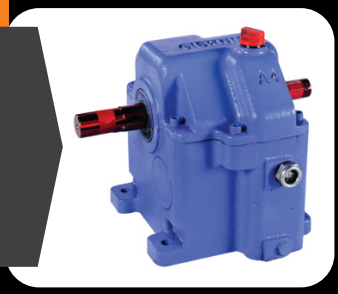

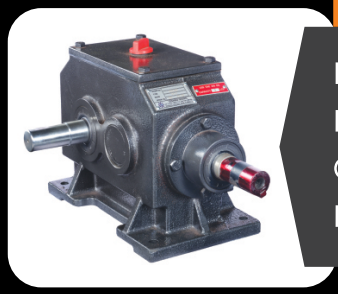

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fertilized with organic and inorganic fertilizers periodically to sustain plankton productivity. Periodic checking of the mussels with removal of dead ones and bag cleaning are required throughout the culture period.

6. Harvest:

Mussels are harvested after a culture period of 12- 18 months. While pearls can be removed from the mantle tissue or gonad of live mussels, the mussels are sacrificed in case of mantle cavity method. The harvested pearls are cleaned and further processed before marketing. Producing Image Pearls Image or mabe or blister pearls get their shape from the sculpted nuclei used to create them and are grown against the inside shell rather than in the animal's soft tissue. The sculpted nuclei become covered by the nacre-forming highly attractive pieces. The original sculpture can be made from wax, shell, plastic, steel or other materials with a distinct convex surface design. These sculpted nuclei are inserted into the cavity between the shell and mantle of the operated mussel, producing an image pearl.

7. Conclusion

Careful management is very important during the culture period, in as much as it affects the quality and quantity of pearls produced, particularly in terms of water quality and management of natural food production through fertilization or manuring. Surgical implantation, being a specialized technique, requires skilled operating hands for successful pearl culture. However, the disadvantages of this technology are: 1) pond water is often heavily loaded with high concentration of nutrients (e.g., N and P) and high Chemical Oxygen Demand (COD) that resulted from frequent fertilization, which are potential pollution sources to the surrounding environment; 2) high loading of nutrients often leads to the frequent occurrence of algal blooms (especially cyanobacterial blooms), which further causes a high pH and a violent fluctuation of Dissolved Oxygen (DO) in mussel ponds; 3) the phytoplankton assemblage is often dominated by mussel inedible cyanobacteria (such as microsystis etc.) due to the enrichment of nutrients, and 4) poor water quality and unpalatable algae impact the growth of mussels, which further impact the quality of pearls, etc. Therefore, with good management practices survival of implanted mussels can be increased. Pearl culture can be integrated with carp polyculture system as the implanted mussels are kept in nylon bags suspended in an earthen pond from a bamboo frame. The major limitations for adoption of pearl culture are non-availability of skilled manpower for performing implantations and absence of an established marketing network. There is a vast scope of pearl culture in North eastern states of India and the farmers/small entrepreneurs can harness its commercial potentials. Thus, commercial adoption of this technology requires a well planned strategy.

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More reference can be provided on request

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Impacts of fishing gear and Reduction of by-catch along West coast of India

Dr Jaya Naik
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Highlight Points

This study reveals that the fishing gear will have a impact on various fish species to be caught in the Indian Ocean and also various by-catches to be reduced during fishing season, which will plays a vital role in conserving the endangered species along the coastal states of India. And these could play an important role in reducing by-catch and focusing on targeted fish species during trawling and purse-seining, which could benefit the fishermen of our country.

INTRODUCTION: Fishing and seafood are vital to our economy and coastal communities. We use data collection, assessments, and research to evaluate the benefits and costs of how we manage fisheries, to help us prioritize management needs, and to facilitate policy that maximizes societal benefits from ocean and coastal resources.

Fishermen sometimes catch and discard animals they do not want, cannot sell, or are not allowed to keep, creating what we know as by-catch. By-catch can be fish, but also includes marine mammals, sea turtles, and seabirds that become hooked or entangled in fishing gear. By-catch is a complex, global issue that threatens the sustainability and resiliency of our fishing communities, economies, and ocean ecosystems. By-catch of protected species, such as sea turtles and marine mammals, remains a significant threat to recovering dwindling populations. We are committed to minimizing by-catch in Indian fisheries to ensure our fisheries are sustainable and protected species are given the best chance to recover.

Impacts of Fishing Gear

Fishing industry and other partners to develop regulations and technology-based fishing gear modifications to reduce by-catch of non-target species. Our ability to reduce by-catch depends on data collected by our National Observer Program. Fisheries observers track where, when and how many protected species become hooked or entangled in fishing gear. Once by-catch reduction measures are implemented, observers also help to monitor their effectiveness.

Sea Turtle By-catch

By-catch is one of the most serious threats to the recovery and conservation of sea turtles. Most of the Indian fisheries have rules in place to reduce sea turtle by-catch, and cooperative fishing gear research with fishermen is necessary. In the Southwest, we have to work closely with the trawl fishing industry to develop turtle excluder devices that reduce sea turtle deaths from shrimp trawl nets.

Marine Mammal By-catch

The Marine Mammal Protection Act requires us to develop and implement plans to prevent the depletion of certain marine mammals that are seriously injured or killed in commercial fisheries and assist in their recovery. Teams of stakeholders recommend measures for reducing marine mammal by-catch through regulatory and voluntary measures.

Seabird By-catch

Seabirds can tell us a lot about the marine ecosystems they inhabit. They travel long distances, are near the top of the food chain, and are relatively easy to study compared to underwater animals. However, they can also be caught incidentally by some types of fishing gear, a problem that state fisheries and partners around the nation to be work to address properly.

Dolphin Safe Tuna

Protection of dolphins is a unique concern for the purse seine tuna fishery of the Indian Ocean, where tuna and dolphins are known to closely associate, leading to incidental catch of dolphins. The Dolphin Protection Consumer Information Act of 1990 and other international agreements mandate tuna tracking programs and other dolphin conservation efforts for this region.

Global By-catch

Several studies have been conducted to reduce by-catch in fishing operations and address illegal fishing practices to reduce the incidental catch and mortality of fish and other animals including marine mammals, sea turtles, seabirds, and sharks. Our study has been built on our domestic efforts and includes participation in international agreements, training and education of foreign fisheries, development of international standards and best practices for fishing operations, and enforcement of international laws.

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Technology for Voluntary Captive Spawning of Magur

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[2]ICAR Research Complex for NEH Region, Tripura Regional Centre, Agartala, Tripura, India

Highlight Points

Efforts have been made for 50 years to breed Clarias magur in captivity without sacrificing male. This is the first report of voluntary spawning of C. magur in captivity through hormonal manipulation. This technology will enable hatchery operators to produce sufficient quantity of C. magur seed, suitable for aquaculture diversification due to its hardy nature, high market price, delicacy and medicinal value. The species is also suitable for aquaculture in large number of water bodies such as marshy area, weed chocked pond and paddy fields.

Introduction

Catfishes, belonging to the family Siluridae, Clariidae and Ictaluridae, have great aquaculture significance across the globe. One of the major hurdles, realised in catfish propagation, was the requirement of artificial fertilisation of eggs using sperm suspension from testes of killed male. In absence of achieving voluntary spawning and poor strip ability in male catfish, male are being sacrificed to collect testis for fertilising eggs and seed production of catfish. Across the globe this process is being followed for several catfish species belonging to family Siluridae, Clariidae and Ictaluridae. This process is not only cumbersome but also inflicts certain economic drawback, like loss of valued brooder and implementation of genetic improvement programmes. Several efforts have been made to avoid this cumbersome process. In *Clarias magur*, a high value Asian catfish, we demonstrated that hormonal manipulation promotes sustained gonadal maturation in males, and induces mating and voluntary spawning with high fertilisation and hatching rate.

Present process & status of *Clarias magur* seed production

Pituitary gland extract (PGE) and LinPe method-based GnRH formulations (Salmon gonadotropin releasing hormone analogue/sGnRhA and a dopamine antagonist), have been very successful in inducing captive spawning and hatchery operation of carp, but produced limited success in catfish species. In catfish, major barrier was from male partner, since these hormonal treatments bring final gonadal maturation and free oozing of eggs in female. PGE and GnRH formulations injection while bring some positive changes in gonad of male catfishes, do not induce behavioural responses required for mating and voluntary spawning in captivity. This has been a key obstacle and seed production has been facilitated by artificial fertilisation of stripped eggs, using sperm suspension from testis, obtained after sacrificing males. This technology evolved during late 1980's and still being followed world-wide for several catfish species including *Clarias magur* (Figure1). In terms of economics, this does not appear to be a major issue, limitationsimposed on genetic improvement programmes and poor adaptability by farmers due to cumbersome nature of the technology, are amongst the few factors that does not allow harnessing full potential of the species for aquaculture despite of the fact that the fish has a high value. To overcome this reproductive dysfunction and understand associated molecular underplay, substantial efforts comprising hormonal augmentation to transcriptome analysis has been made across the globe with special emphasis on male catfish.

Technology to induce voluntary captive spawning in *Clarias magur:*

Considering the fact that the PGE and LinPe method-based GnRH formulation were able to bring final gonadal maturation & free oozing of ripe eggs in female and some positive changes in male gonad in *Clarias magur,* we hypothesised that an additional augmentation of hormone capable of inducing mating and spawning reflex will be would produce positive response in terms of voluntary response. Oxytocin, a mammalian nona-peptide neuro hormone and its analogue, present across the animal kingdom, affects several reproduction related physiological and behavioural attributes via egg laying, mating, spawning, lactation, contraction of muscle, trust adaptation, social interaction. In our experiments, while Ovatide (commercial inducing agents consisting of sGnRhA and domperidone) was administered uniformly at dose of 0.5 ml per kilogram body weight, several doses and time frame for oxytocin augmentation in brooders (both male and female) of *C. magur* were tested(Figure 2).Optimal dose for oxytocin was found to be 40 milli International Units per kilogram body weight of brooder and most suitable time gap between Ovatide and oxytocin injection was 12 hours. Briefly, after injecting Ovatide, male and female brooders were kept together in simple polystyrene box with feeble water flow and after 12 hours of time gap oxytocin was injected. This resulted in voluntary spawning in more than 80% of breeding

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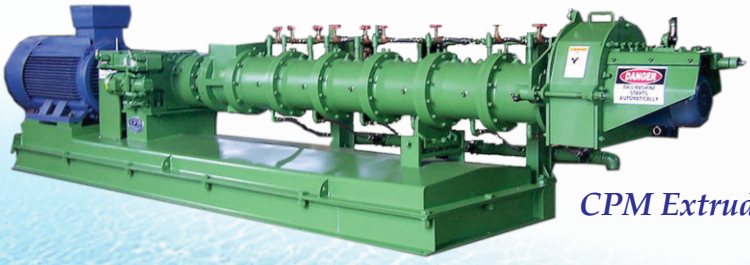

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trials with fertilisation and hatching rate of about 80% and 70%, respectively. The dose and time combination of Ovatide and oxytocin injection were equally effective in other breeding facilities like plastic tub and FRP tanks (Figure3).Interestingly, low dose of Oxytocin injection resulted in voluntary spawning in fewer breeding sets with only partial spawning of eggs. On contrary, higher dose of Oxytocin injection resulted in aggressive fight between brooders.

Oxytocin administration results in sustained gametic maturation in males, induced by the Ovatide injection and facilitate synchronised maturity status in both the sexes, required for voluntary spawning in captivity. This technology will bring a sea of change in the seed production scenario of *C. magur*, one of the most important aquaculture species in Asia.

The aquatic resources such as marshy areas, wetlands, weed chocked ponds & tanks, seasonal water bodies and paddy fields can be utilised for aquaculture of magur, which have huge potential to enhance fish production.

Figure1. Conventional method of seed production of C. magur: Males are scarified to collect testis to prepare sperm suspension and fertilize stripped eggs

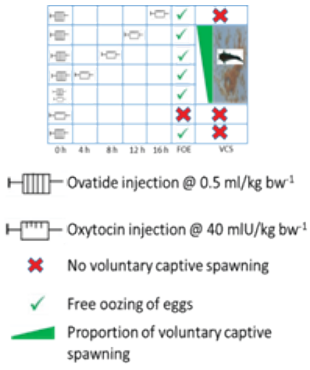

Figure2. Schematic of hormonal manipulation for voluntary captive spawning in C. magur

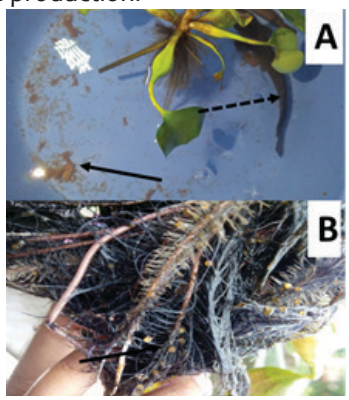

Figure 3: Voluntary captive spawning in C. magur through hormonal manipulation

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Small-Scale Inland Fisheries: New studies, strategies and ideas

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Highlight Points

ICAR-Central Inland Fisheries Research Institute, Barrackpore published the leaflet 'Small Scale Inland Fisheries in India' where concept, characteristics, advantages of small-scale fisheries, factors affecting and suggestive measures for development written comprehensively. CIFRI organized an informative Webinar 'Understanding and managing small-scale fisheries in inland open waters - status and opportunity' on September 9-10, 2020 where listeners were informed about new studies, concepts and strategies for way forward in this field. Aspects of scientific presentations of invited scientists in two sessions on 1st day are revisited and presented here.

The beginning

On-line meetings organized by different colleges, universities and research institutes in India since 3rd week of March 2020 in different disciplines of basic and applied science are very valuable to improve one's knowledge base, opportunity to learn much from newer avenues of research, progress and newer technologies. The Webinar 'Understanding and managing small-scale fisheries (SSF) in inland open waters - status and opportunity', organized by ICAR-CIFRI on September 9-10, 2020, was such a kind. Enlightening presentations were made successively by eminent invitees in this 2-days programme. First day was divided into two technical sessions, with the themes namely 'Drivers of SSF in inland open waters' (Session-1) and 'Approaches and framework for management of SSF – an illuminate hidden harvest of SSF' (Session-2).

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Virtual webinars have no less impact than physical seminars/ meetings. Respected Dr J. K. Jena, DDG of Fisheries Science, ICAR, New Delhi stated this in Presidential address. Details of Dr Jena's talk on formulating strategies for SSF published in October 2020 issue of this magazine. Highlighting the available open water resource that exists for inland fisheries, Dr Dilip Kumar, Former Director, ICAR-CIFE, Mumbai opined that much scope exists in India for taking up SSF to business mode. Disadvantaged poor fishing communities should be brought out of poverty *via* business-oriented fisheries development. If organizations of small holders are strengthened, they will be able to contribute towards such fisheries development. We learnt that 70-80% of inland fisheries sector in India is contributed by SSF sector. It was felt by Dr C. V. Mohan, Principal Scientist at WorldFish, Malaysia in introductory note that inland SSF contribute largely towards livelihood, food and nutritional security but is often invisible, hidden and less-understood, goes unreported. Women contribute in this sector significantly; their role and livelihood benefits of small fishes harvested from this system are hidden.

Improved Hilsa fishery in Meghna

In the field-based ECOFISH Project of 2014 on Hilsa fish in 136 villages in 11 districts of Bangladesh, great impact could be created within 3 years of implementation. In the talk 'Revival of Hilsa shad in Bangladesh waters', Dr M. A. Wahab from Dept of Fisheries Management, Bangladesh Agricultural University informed in detail about Hilsa Fisheries Management Action Plan, ban on use of current jaal (monofilament net) and Behundi net, juvenile Hilsa 'Jatka' fishing ban during November to June of next year, ban on brood Hilsa catch in autumn full moon. Optimum brood Hilsa fishing ban period had been enforced; care was taken so that Jatka Hilsa goes back to sea and not caught by trawlers.

It resulted in improved resilience of Meghna river ecosystem and communities reliant on coastal fisheries, enhanced coastal fisheries in Bangladesh. Life cycle of Hilsa fish, estimated MSY of Hilsa, its catch and stock assessment were explained by Dr Wahab. Racial separation of Hilsa done through DNA analysis with SNP technique led to our understanding that Hilsa of Padma, Meghna and marine habitats are genetically isolated. Hilsa fishers and 20000nos fisherwomen were empowered, women mobilized in co-management. Fishing communities and boat owners compelled not to fish during ban period. Increased women participation observed in SSF management and decision making. With interventions, av weight of Hilsa increased from 510gm in 2014 to 915gm in 2019, production also increased.

Good tenure governance for SSF

SSF encompass half of global fish catches, employs more than 90% of world's fisheries and fish workers (catching, processing, trading, marketing fish). It was informed by Dr V. V. Sugunan, Former ADG (Inland Fisheries), ICAR in 'SSF in inland open water bodies: Issues in implementing FAO guidelines'. In India, SSF exists in 3 forms, *viz.*, compliant, intermediate and non-compliant. SSF's main focus is on livelihood equity and sustainability. Certain issues like lack of strong community organizations, access to resources, infrastructure and social facilities to enhance quality of life exist in SSFs. We had idea about ownership conflicts and tenure governance. SSF-compliant include capture fisheries of rivers, lakes, estuaries; culture-based fisheries in open waters and stock enhancement; aquaculture using farm-made feed, in unfertilized drain-in ponds and homestead ponds. Its comparison was made with SSF non-compliant.

We had concept about systems of rights in SSF in pure capture fisheries (rivers and estuaries), enhanced fisheries in reservoirs and small-scale fish culture. It is important to organize and empower community; create enabling environment for open water fisheries and for small-scale aquaculture; in infrastructure, value addition, arrangement for empowering communities for stocking and stock enhancement. Fishing communities should be motivated to follow responsible fishing and aquaculture practices. Along with fishers' right to access, they must recognize their duties to environment. Weak ineffective tenure governance is impediment to livelihood and poverty eradication. Dr Sugunan opined that a tenure governance process in tune with the best interest of fishers is needed to achieve enhancement of contribution of SSF to global food security and nutrition, and equitable and sustainable development. National level efforts needed in form of meaningful and substantive participatory, consultative, multi-level and objective-oriented processes so that voices of both men and women are heard.

Water Framework Bill 2016 and others

Inland capture fisheries in India is rich source of food biodiversity, with 1030nos and fisheries diversity in culture is 37nos. India is global leader in inland capture fisheries production however growth of inland capture fisheries is much lower than inland aquaculture. While emphasizing on these points, Dr Y. S. Yadava, Director of Bay of Bengal-Intergovernmental programme in his talk 'Sustaining small-scale inland capture fisheries in India: some thoughts some approaches' explained governance of inland capture fishery resources. Participants were informed about Govt of India's Water Framework Bill 2016, Draft River Basin Management Bill 2018, Inland Waterways and River Linking Act 2016, National River Linking Project. Rejuvenation of river systems can be achieved by ensuring 'Abiral Dhara, Nirmal Dhara, Swachh Kinara'.

Governance framework for inland fisheries in India was discussed; also problems confronting rivers, tributaries, floodplain lakes (state of resources, water abstraction, eutrophication, pollution, civil structure like dams, embankments); emerging paradigm on use of rivers. Rivers are by and large in bad state of management. Various approaches, ecosystem services provided by fishery; ecosystem-based, societal and economic services provided by fisheries - it is true economic benefit of water for use in fisheries. Dr Yadava emphasized on fishery as non-consumptive use of water, human rights-based approach, upholding customary rights of riparian communities. In the competing scenario of water withdrawal for agricultural, industrial and municipal activities from rivers, sustainable development of inland fisheries has to be planned.

Nutrition sensitive approaches

Dr Philippa Cohen, Programme Leader, WorldFish, Malaysia

published the paper 'Harnessing global fisheries to tackle micronutrient deficiencies' in Nature in 2019. Participants were given overview by her on nutrition-sensitive approaches to fisheries future of India; 194 million people in world are undernourished and fish is global superfood, with all essential fatty acids, vitamins, minerals. India is 2nd largest inland fishery globally, we got idea about nutritional potential of India's inland fisheries; equity, sustainability and nutrition within planetary boundaries, making more of what we have. We have to address food safety, developing safe, culturally-appropriate convenient fish-based foods where women are primarily responsible. Greater inclusion of women needed in productive systems, per heaped tablespoon of fish based chutney contains 60gm of raw fish. Giving attention to trade policy, value chains, distribution and equity, we can address major micronutrient deficiency without producing more or harvesting harder.

For both inland and marine fisheries, India is 2nd most data-rich country in the world. Nutritional data about different fishes have been established in ICAR project 'Nutrient profiling and evaluation of fish as dietary component'. Consumption of fish and fish-based products in world is @ 0.03-22.7kg/capita/year. It is important to maintain diversity and ecological integrity of inland aquaculture resources, nutrition sensitive aquaculture technology, integrated fish-agrifood systems, good water quality, which are opportunities to increase food production.

Fishery Cooperatives and FPOs

Inland capture fisheries (inland capture and inland aquaculture) use much less than 3% water on planet (very limited water resources), and from it, 41% inland fish is produced. In global inland fisheries production, 87-89% comes from SSF and rest 11-13% from commercial SSF, large scale inland fisheries and large scale commercial inland fisheries. While informing about these facts and figures, Dr Dilip Kumar in his talk 'Empowerment of fishing communities to ensure sustainable use of inland fishery resources' discussed extent to which SSF resources contribute to UN Sustainable Development Goals (SDG). Majority working with SSFs are disadvantaged, isolated and poor. Fishermen Cooperatives, like those taking management of reservoir fisheries in Rajasthan, are shield of the weak. Same are FPOs. Some of emerging issues include sustainability concerns, climate change-related challenges, income generation. Inherent weakness of Fishermen Coop institutions is that cooperatives often are not informed about its objectives; it is important to realize its needs, roles and responsibilities of members.

Further it is important to empower communities to become effective and efficient in operating their organizations (consistent efforts for creating awareness and making them exposed to their role and responsibilities in such organizations); developing their capacity to manage. FPOs provide improved access to investments, technology and inputs, markets to small and marginal farmers. One activity expected from FPOs is effective skilling of member fishers, facilitating market information about a produce. Role of facilitator is crucial in initial 4-5 years. FPOs can be strengthened, which can make SSF organizations more effective.

Citizen Science Network

Fishery of Vembanad Lake is very important to life of local inhabitants (fishers); different water characteristics and fishery activities happen here. But fishing communities face problem about formation of unwanted macrovegetation, eutrophication. We got new idea on developing water quality-based risk assessment framework using citizen science and satellite remote sensing in context of SSF of a lake from Dr Grinson George's talk, Senior Programme Specialist at SAARC, Dhaka. We knew about Framework that can be used in management of SSF of a lake. Critically vulnerable coastal areas will be managed by local fisherfolk community, lake to be conserved, increase opportunity for livelihood for local fisherfolk in and around the area. In Citizen Science network (CSN) in Vembanad Lake, observations and analysis of data done by local inhabitants.

Advantages of CSN include long time series data, extended observation that can be obtained in far away place in large spatial area. Results on water quality monitoring and others extrapolated to the scale of entire lake using CS data and satellite data; interesting information was obtained. Water quality monitoring done in CSN using tools like mini Secchi disc, Mobile App 'Turb Aqua', 3D printed Secchi Disc pasted with Forel Ule colour codes and image scale. Common colours of Vembanad Lake determined, floating algal index measured. Ocean colour is useful and used in helping meet the 16 UN SD goals to make better global society. Dr George mentioned importance of framework on how we can work on satellite RS data ad CS data as strong tool for lake fishing activities and for supporting the communities living around the lake.

Ecosystem services of Hail Haor wetland

Bangladesh's wetlands are in crisis, 50% permanent wetlands lost, resulting in fall in fish consumption and fish catch by 38% during 1995-2002. Hail Haor wetland in NE Bangladesh provides wide range of ecosystem services for humans, now suffering from multiple drivers which reduced its capacity to provide ecosystem services. Dr Mokhlesur Rahaman, Executive Director, Centre for Natural Resource Studies, Bangladesh discussed on co-management of wetlands adopting nature-based approaches. Drivers of social ecological vulnerability of this wetland identified through participatory problem census (community consultations). Solution packages identified in participatory planning sessions, *i.e.*, Nature-based Solution interventions.

Habitat restoration in Hail Haor could be done, several degraded and semidegraded wetlands within wetland basin rehabilitated; wetland sanctuary establishment done, managed by CBOs and over 22 small sanctuaries established; reintroduction of rare species, awareness and capacity building; CBOs adopted various conservation measures. Seven locally lost fish species introduced, watershed management done and 3000 nos riparian trees planted along stream banks. Local people trained to monitor the selected project impact. Ultimate result was more fish production (increased by 88% from 1999 baseline), increase in income of fishers, more water birds observed. Three locally rare fish species restored. In 2006, a 24% increase in use value of this wetland noted, that was largely from fish. It is example of

Nature-based solutions meeting societal challenges; NBS interventions have long lasting impact.

Reduction of fish biodiversity

Fisheries benefit ecosystem and humans in form of nutritional security, livelihood support. Strong connection of some Canadian communities exists between inland fish and their culture. But extent of freshwater wetlands declined by about 70% since 1990; one-third of 28000 fish species, dependant on freshwater habitats globally, are threatened with extinction. Freshwater biodiversity index value (fishes, molluscs, amphibians) reduced by 83% in 2016 since 1970. Dr Steven J. Cooke, Canada Research Professor, Carleton University enriched us with this valuable information in his talk 'Freshwater fish biodiversity *wrt* SSF: Status and Future'.

Threats like silt in streams, overharvest, climate change, pollution already exist; emerging threats to freshwater biodiversity are cumulative stressors, shifting climate, infectious diseases, harmful algal blooms, emerging contaminants, expanding hydropower, engineered nanomaterials, microplastic pollution, freshwater salinization. Bending the freshwater biodiversity curve is an emergency recovery plan. We have to accelerate implementation of environmental flows, improve water quality, protect critical habitats, manage exploitation of freshwater species and riverine aggregates. According to Dr Cooke, we foresee a future where there is political will and public desire to properly assess and manage inland fisheries in an integrated water resource management framework to benefit society while balancing needs for biodiversity conservation.

Illuminating hidden harvest

A study was conducted jointly by FAO and World Fish on understanding importance of SSF for food and nutrition security, local economics and poverty eradication. From Dr Nicole Franz's talk, Fishery Analyst, FAO, we got idea about 'illuminating hidden harvest' (IHH) and contribution of SSF to sustainable development. We were informed about interaction of SSF with environment, SSF governance aspects, lack of data and information on SSF that can often contribute to its marginalization, which are invisible and overlooked. In that study, data was collected on key indicators between 2013-2017 in small scale and large scale inland and marine fisheries from 25 countries. It was aimed to have knowledge on employment, dependency, SSF exports, landed value; aiming to generate estimate of catch, efficiency, effort and capacity. In addition to environment and economic clusters, data obtained on domestic fish supply, dietary protein, catch for direct consumption.

Amount of 4.3 million tonne accounted in IHH in inland fishery sector, 500 fish species are caught by SSF, 80% of marine catch comes from 30 pelagic fish species. In typology of SSF, 60% marine and 70% inland catch comes from the category 'Mostly motorized full time fishing'. 1% of catch comes from subsistence fisheries, IHH is an opportunity for SSF in inland open waters in Asia. It is needed to look beyond the fisheries data and bring experts from different disciplines together, to have better understanding of the nutritional value of inland fisheries, number of people deriving livelihood from this sector (including women) and the way this drives local economy.

Vulnerability to viability

SSF supports over 90% of 120 million people engaged in global capture fisheries and are more vulnerable than large scale fisheries. Building resilience to deal with vulnerability and uncertainty associated with vulnerabilities is a strategy to reduce vulnerability. Emphasizing on such points, Dr P. K. Nayak at Faculty of Environment, University of Waterloo, Canada further said that access to capitals can potentially improve a community's economic status, social position and ecological security. We were informed about key dimensions of vulnerability of SSF to global change in Chilika lagoon and areas of vulnerability (ecological problems, economic and social crisis, physical resources, economic dependence).

There had been key dimensions of strength of SSF in Samudram case (coastal habitat conservation, economic development, mobilizing physical resources). SSF communities show coping (short term) and adapting (long term) responses to global change. They engage in transformative responses through creation of locally-driven community science, adaptive co-management, transformative learning, favourable policy environment - which, according to Dr Nayak, can be pathways to reduce vulnerability and build viability. Explaining details of vulnerability to viability Global Partnership, he stated that rebuilding or maintaining viable fishing communities and fish stocks cannot succeed without first dealing vulnerabilities.

End note

Current situation and future perspectives of SSF were explained by eminent speakers in this 2-days programme, few case studies were put up. Presentations of afore-mentioned ten speakers on 1st day are compiled here, 2nd days' proceedings could not be included in this article due to length limit. Author experienced that in West Bengal, primary fishermen cooperative societies are functioning mostly in inland open water sector in beels/wetlands (culture-based fisheries) in different districts and contributing towards development of SSF. There are actively-functioning women-led SHGs in SSF in WB. It is important that we come up with new demonstrable production systems and ideas for them, care and feel for these less-educated but skillful, modest, elderly persons with wealth of ITK in our country, involved in inland SSF and rural small-scale aquaculture and devise fruitful strategies for their socio-economic upliftment.

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Seaweed Importance in Fisheries

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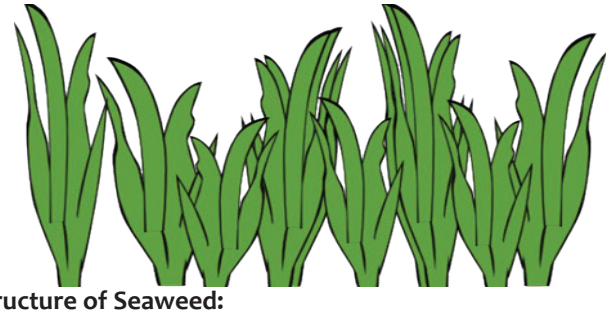
The Indian seaweed resources and subsequently lot of utilization and commercial cultivation has been added. The most recent quantitative estimates for seaweed biomass recorded in the literature for different coastal areas of India are given. An attempt has also been made to provide information on commercial utilization of natural resources, import–export trend for seaweeds and seaweed phycocolloids. Industrial utilization of seaweeds and cultivation of economically important seaweeds in India, socio-economic profile of seaweed collectors, future possible utilization strategies to be adopted for conservation of germplasm and introduction of legislation policies for their controlled harvesting and sustainable utilization are elucidated in detail. When compared with the world scenario, estimates for India do not suggest the existence of rich seaweed resources.

Major seaweed species of commercial importance:

Methods of culture; farming of agar, align, carrageenan yielding species; emerging trends in their farming in open seas and integration with other farming systems. Seaweeds are macrophytic algae, a primitive type of plants lacking true roots, stem and leaves. Photosynthetic, multicellular algae. Sexual or asexual reproduction. Their reproduction stage has two parts the gametophyte stage is sexual and the sporophyte stage is asexual.



Structure of Seaweed:

Flattened structure that resembles a leaf. Pneumatocysts, Gas- filled bladders that keep blades close to surface. A stem-like structure used for support, Not present in all. Attaches the thallus to the bottom. Anchors the seaweed to the substrate. "Thallus" – Entire body of a seaweed.

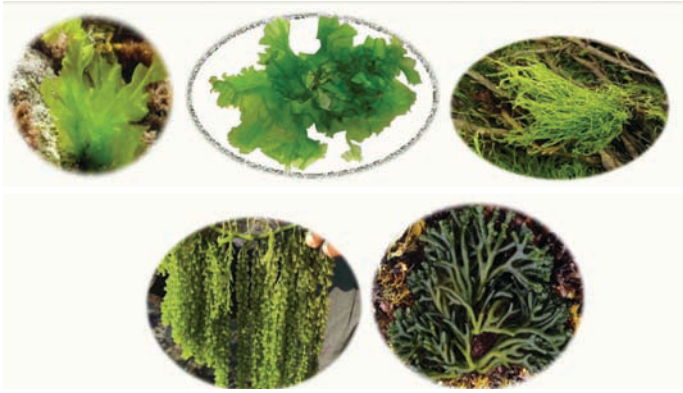
Types of seaweed:

1. Chlorophyta (Green Algae)

Thin flat green algae. Margin is ruffled and often torn. It grows attached to rocks or other algae without a stipe, by a small disc-shaped holdfast. Adult plants usually tubular; more or less compressed, dilated towards the apex, tapering below, giving several branches from the gradually contracted stalk like base. Plastic – looking grape like nodes borne on branches; holdfast penetrates sandy bottom forming a compact cushion. Plants deep green in color, spongy in texture and tubular in appearance. Plants cylindrical and numerous thin branches dividing in two; they form large clusters. *Ulva lactuca Enteromorpha compressa Caulerpa racemosa Codium tomentosum.*

It is found in moderately exposed situations on rocks and quiet shallow waters near the low tide mark . It also thrives in brackish water with organic pollution. Year – round occurrence. Found in the intertidal zone in sheltered to open coastal sites, in shallow water, tide pools, and also on rock pools and sand Year – round occurrence. It is found below the low tide mark, rooted in sandy, muddy bottoms or attached to rocks or dead corals. Grows throughout the year. It is found on sandy bottom in the subtidal area.

Distribution: Gulf of Kutch, Karwar, Kanyakumari, Tuticorin, Mandapam and Lakshadweep. Andaman & Nicobar islands, Bombay Veraval, Goa, Mahabalipuram and Vishakhapatnam, Vizhinjam Okha, Dwarka, Porbandar and Diu.



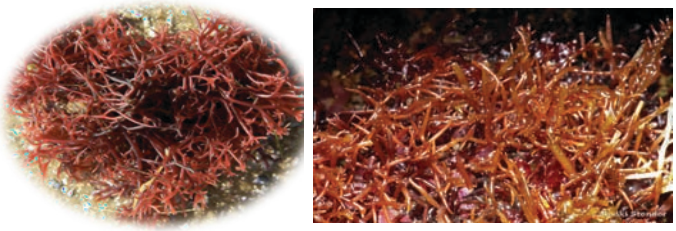
Rhodophyta (Red Algae) - *Gelidiella acerosa Gracilaria edulis Kappaphycus alvarezii .*

Plants brownish-red in colour and 1-6 cm tall. Thallus composed of slender, cylindrical stolons that give rise to erect and decumbent branches above and coarse, short and simply branched rhizoids . Plants erect and grow up to 20 cm or more. Irregularly branched, branches hardly constricted. Morphologically plastic: variable thalli forms, from twisted forms with few small branches in shallow areas to large, intricately tangled, fleshy mats in deeper waters. Habitat: Commonly encountered on rocky inter- tidal areas. Grow throughout the year. It grows abundantly on seagrass beds in shallow lagoons formed between the shore and fringing coral reefs. Reef flat and reef edge, 1 to 17 m deep, Loosely attached to broken coral, or unattached fragments floating in shallow and deep waters.

Distribution:

Okha, Dwarka, Porbandar, Diu, Veraval, Tuticorin, Mandapam,

Lakshadweep and Andaman-Nicobar. Malaysia sea and Southern Philippines

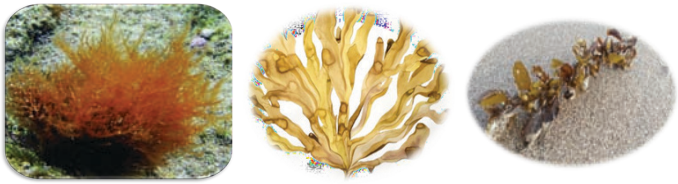


Gelidiella acerosa

2. Phaeophyta (Brown Alage) - *Sargassum wightii Hypnea valentiae*

Description:

Plants dark brown. 20-30 cm in height with a well marked holdfast. Leaves tapering at the base and apex; mid rib inconspicuous; vesicles large & spherical. Plants are erect and laxly branched with distinct cylindrical main axis. They are generally simple and filiform but may be occasionally forked. It grows throughout the year on rocks, dead corals, stones and pebbles in the intertidal and sub tidal regions. Habitat; Grows throughout the year on rocks in the littoral and sublittoral regions. Distribution: Bombay, Goa, Kovalam, Tiruchendur, Tuticorin, Mandapamand Lakshadweep, Madras and Andaman-Nicobar.



Seaweed resources in India:

Grow abundantly along Tamil Nadu, Gujarat and around Lakshadweep and A&N islands. Rich seaweed beds around Mumbai, Ratnagiri, Goa, Karwar, Vizhinjam & Pulicat in Tamil Nadu and Chilka in Orissa. †700 marine algae: Inter-tidal and deep water regions of the Indian coast. Nearly 60 species are commercially important.

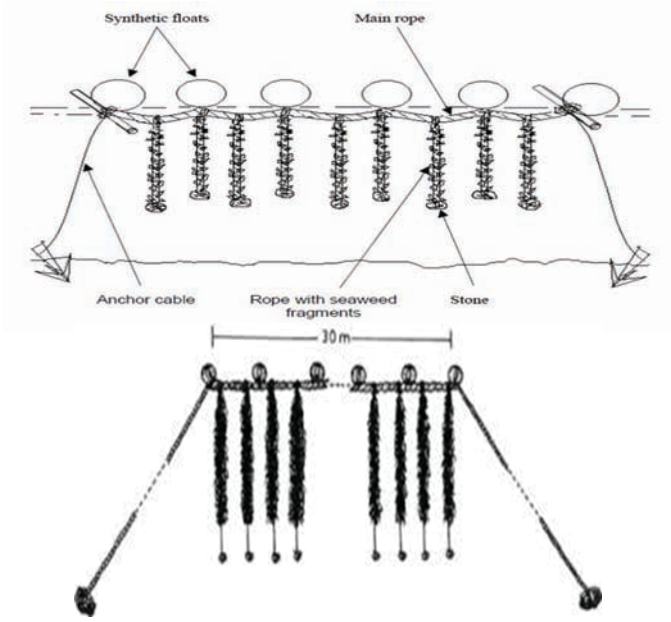
Why Seaweed Farming:

Remedy for non-availability of required quantity of seaweeds for various uses. Provide occupation for the coastal people. Provide continues supply of raw material for seaweed based industry. Provide seaweeds of uniform quality for use in industry. Conserve natural populations of concerned seaweeds. Seaweed farming is an ecofriendly activity. Major tool to treat coastal pollution in the sea and reduce CO_2 in global warming.

Methods of Seaweed Farming:

1) Single Rope Floating Raft method (Coir Rope & Nylon Rope) (SRFR):

Farming of agar and align yielding seaweed. Method developed by CSMCRI. Suitable for culture in wide area and greater depth. It involves either vegetative propagation using fragments from mother plants or by different kinds of spores. Suitable in Kerala coast for agarophyte cultivation and certain areas in the Gulf of Kutch for deep-water seaweed cultivation. A long coir polypropylene rope of 10 mm diameter is attached to 2 wooden stakes with 2 synthetic fiber anchor cables and kept afloat with synthetic floats. The length of the cable is twice the depth of the sea (3 to 4 m). Each raft is kept afloat by means of 25-30 floats. The cultivation rope (1 m long x 6 m diameter polypropylene) is hung with the floating rope. A stone is attached to the lower end of the cultivation rope to keep it in a vertical position. Generally 10 fragments of *Gracilaria edulis* are inserted on each rope. The distance between two rafts is kept at 2 m.



Advantages:

Good use of water space. Simple and easily managed procedure. Floating raft ropes should be installed at right angles to the currents so that hanging kelp ropes sway freely in the currents, enabling plants to receive good illumination.

Disadvantages:

Culture ropes hang vertically downwards from the raft ropes thus illumination decreases with water depth.

2) Floating Bamboo Raft method:

A bamboo raft (12' X 12') is used as the main frame for cultivation. Four bamboo poles (each of 4' length) are tied diagonally in four corners of mainframe. Clusters of rafts are tied with an anchor to secure them and maintain their buoyancy. Bottom netting is provided to avoid drifting of material, as well as to minimize grazing. Seeding is carried out on shore, and seeded rafts are transplanted into the open sea. Harvesting is generally carried out after 45days. This method is recommended where the water movement is gentle. It has been popularly adopted in the Tamil Nadu and Gujarat coastal regions.

3) Fixed Bottom long line method:

Line of up to 50m in length, anchored at each end and with floats attached every 10m or so to support the line. Operated in water of between 4 – 10 m and farmers therefore require access to some sort of boat to access the plots. Farmers can access the plots at all times, except for during bad weather. Seedlings of about 100 – 150g fresh weight are attached to

a rope. Seeded ropes (3mm) are then tied at 10cm intervals. Care needs to be taken to ensure that the seaweed always remains submerged (0.5m below the surface), and receives sufficient sunlight. Generally, seeding in this case is done in the water to avoid seedling loss, which may occur if ropes are seeded on the shore and dragged into the sea. Recommended: Regions that experience moderate wave action, and particularly in areas with a low density of grazers. It is popularly adopted in the South Ramanathapuram, Pudukkottai, and Tuticorin districts of Tamil Nadu.

Seaweed Hydrocolloid Production:

Agar yielding species: Agars are industrially produced from the agarophytes red seaweed genera *Gelidium, Gracilaria, and Gelidiella.* Align yielding species: The main species used for commercial alginate extraction are *Laminaria spp., Macrocystis spp., Ascophyllum spp., Sargassum spp., and Fucales spp.* Carrageenan yielding species: Commercial carrageenans are extracted from the carrageenophyte red seaweed genera *Kappaphycus, Gigartina, Eucheuma, Chondrus, and Hypnea.*

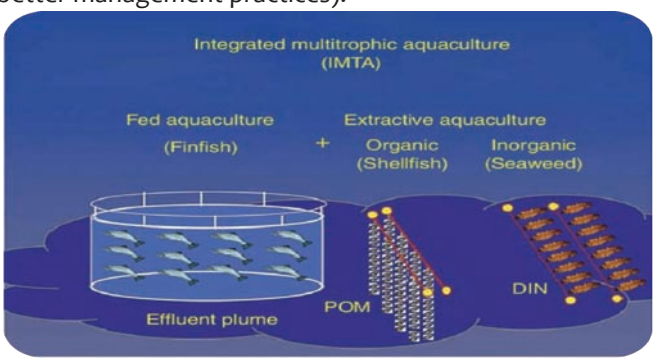
Farming of Carrageenan yielding seaweed:

Eucheuma and *Kappaphycus* are economically important seaweed resources for carrageenan extraction in tropical areas. *Kappaphycus* farming – technology. Could be a source of supplemental income for small fisher folk associations and peoples cooperative. Low-cost venture and profitable one.

Particular	
Annual Seaweed production (260 Kg / raft) (S.D. = 60-80 Kg / raft)	70,200 Kg
Total dried seaweed production from 45 rafts; 6 cycles	7020 Kg
Price of dried seaweed (Rs. Per Kg)	22
Gross Revenue	Rs. 1,54,440
Total cost of production (Rs. 1050 x 45 rafts)	Rs. 47,250
Net Income	Rs. 1,07,190

Integrated Multi Trophic Aquaculture (IMTA):

It involves cultivating fed species with extractive species that utilize the inorganic and organic wastes from aquaculture for their growth. Finfish/Shrimp + Shellfish(Mollusks) + Seaweed, For creating balanced systems for environmental sustainability (biomitigation) economic stability (product diversification and risk reduction) and social acceptability (better management practices).



Status of Seaweed farming in India:

Lakshadweep: *Gracilaria edulis, Hypnea valentiae* and *Acanthophora spicifera*. *Gracilaria edulis*, a 17 – fold increase in yield was obtained for Agar yielding species in 76 days in the first harvest at Minicoy Lagoon, Lakshadweep, India during south west monsoon season by adopting single bottom coir rope method.

Kerala: A maximum of 20.1 fold increase in yield in 80 days and a minimum of 13.2 fold increase in yield in 40 days was obtained for the carrageenan yielding red seaweed *Kappaphycus alverazii* by adopting raft culture method which was carried out as demonstration along with green mussels (*Perna viridis*) – integrated farming – at Vadakkekad, Padane, Kasaragod District, Kerala.

Gujarat: Farming of *Hypneamus ciformis* was carried out during post monsoon period using raft culture method at Chorward near Veraval. A fivefold increase in yield was obtained during August to September period in 62 days. Seaweed culture was integrated with Sea Cage culture. *Kappaphycus alvarezii* was farmed in bags and raft with Sea Cage and the growth was found promising. A maximum of 9 fold increase in weight was obtained by adopting bag culture method in 55 days (January and February) and 11 fold increase in weight by adopting raft method in 64 days (February and March) for *Kappaphycus alvarezii* farming.

Uses:

Seaweeds have been a staple food in Japan and China for a very long time. Green seaweeds *Enteromorpha, Ulva, Caulerpa* and *Codium* are utilized exclusively as source of food. These are often eaten as fresh salads or cooked as vegetables along with rice. *Porphyra* (Nori), *Laminaria* (Kombu) and *Undaria* (Wakame) are used for making fish and meat dishes as well as soups and accompaniments. Seaweeds are also rich in minerals, vitamins, trace elements and bioactive substances, seaweeds are called medical food of the 21st century. Also used for treatment of cancer, bone-replacement therapy, cardiovascular surgery. Edible - Soups, salads, jam preparation, Agar yielding seaweed. Carrageenan yielding seaweed. Algin yielding seaweed. Raw material for production of sodium alignate. Also contains 8 – 10 % mannitol sugar. Carrageenan yielding seaweed. Edible (Salad) etc.

Table 1. Nutrition composition of some seaweed species

Seaweed spp.	Proteion %	Lipid %	Carbohy-drates %	Ash %
Ulva	26.1	2.1	42.0	7.8
Enteromor-pha	19.5	0.3	64.9	15.2
Mosostroma	20.0	1.2	63.9	14.9
Laminaria	16.1	2.4	39.3	19.6
Alaria	17.1	3.6	39.8	14.9
Saragssum	19.0	2.9	33.0	16.2
Padina	18.81	1.7	31.6	10.3
Prophyra	28.4	4.5	45.1	6.9
Rhodyme-nia	21.5	1.7	44.6	5.3
Gracilaria	24.37	1.8	61.75	11.3

Conclusion:

Seaweed farming is a promising opportunity for uplifting the livelihood of the fishermen communities. This low cost occupation involves intensive manual labor and can sustain the entire family, including women, thereby not only helping the families' earning potential, but also supporting the community's holistic economic status. Seaweed farming also has the potential to be part of a coastal zone management strategy, and can be implemented elsewhere, including developing countries.

Biofule:

The carbohydrate content of seaweed, about 50% of dry mass, can be used in biofuel production (Garcia-Casal et al. 2007). Capturing the energy in seaweed can be as simple as microbial anaerobic digestion to produce methane or as complex as microbial breakdown of lignins and other complex carbohydrates into simple sugars for use in ethanol production (Wei et al. 2013).

An annual harvest of 500 million dry tons of seaweeds with 50% carbohydrate content could produce about 1.25 billion megawatt hours' worth of methane or liquid fuel. The world used about 85 billion megawatt-hours of energy from fossil fuels in 2012, so energy production from these seaweed products would equate to roughly 1.5% of current energy use from fossil fuels (IEA 2014). Current biomass prices average about US$50 per dry ton, for a total value of some US$12.5 billion.

Table 2. Place of algal interest along coastal state of India

State	Coastline (Km)	Place of algal Interest
Gujarat	1600 - 1700	Okha (22.15 N, 69.1 E), Dwarka (22.14 N, 69.1 E)
Maharashtra	720	Malvan (16.03 N and 73.30 E)
Goa	160	Panaji (15.03 N & &73.55 E)
Karnataka	320	Karwar (14.48 N & 74.11 E)
Kerala	580	Quilon (8.54 N & 76.38 E), Varkala (8.28 N & 76.55E)
Tamil Nadu (Including Pondicerry)	1121	Krusadai Island (9.14N & 79.13 E), Idinthakarai (8.10 N & 77.43 E)
Andhra Pradesh	975	Visakhapatnam (17.44 N & 83.23 E) Pulicat lake (13.40 N & 80.15 E
Orissa	485	Chilka lake (19.50N & 85.30E)
West Bengal	280	Sundarbans (21.33 - 22.45 N & 88.06 – 89.05E)
Andaman and Nicobar Islands	1900 (approx)	6- 14 N & 92.94E
Lakshadweep Island	132 (approx)	8-12 N & 72 -74E

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