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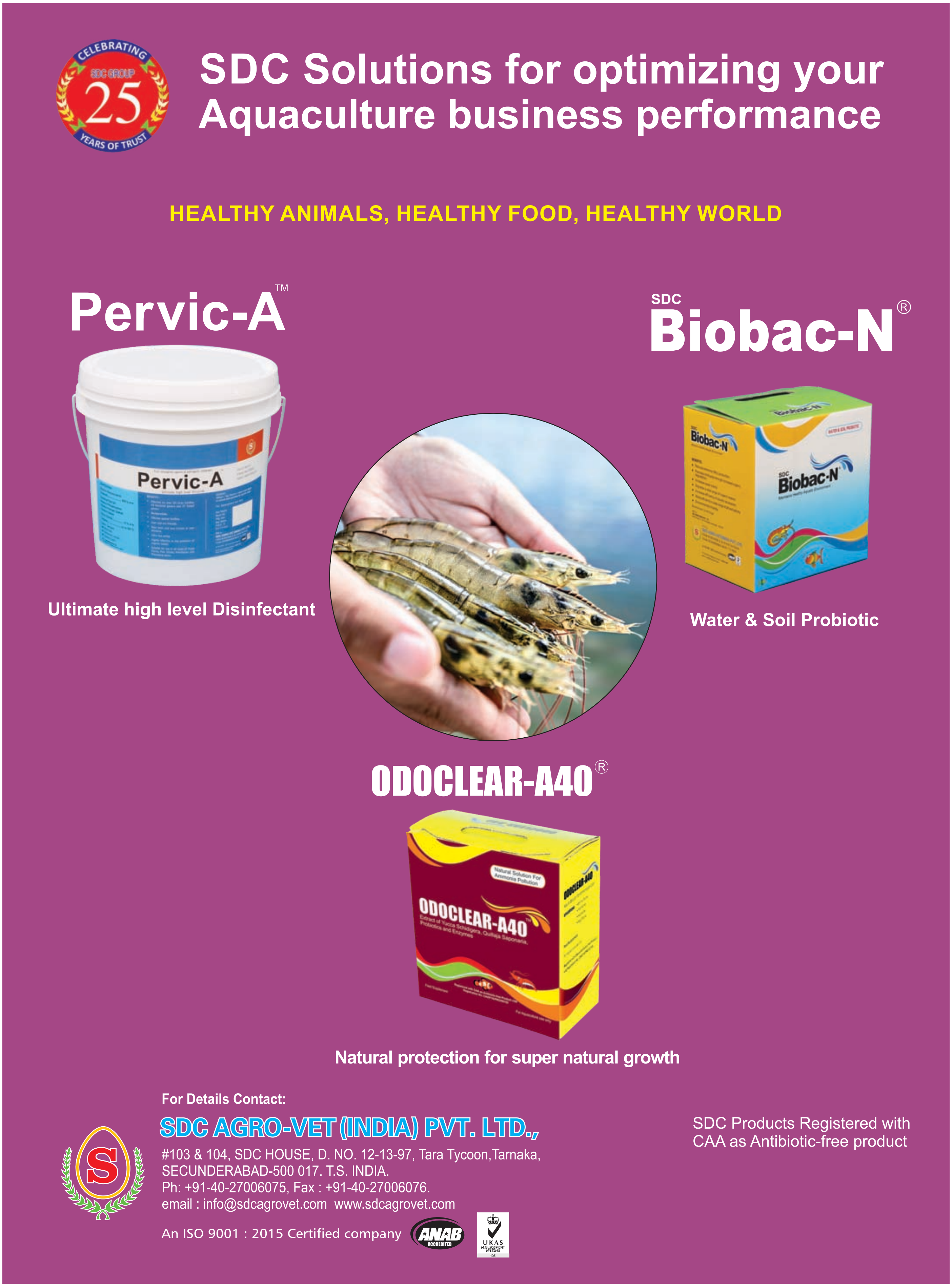

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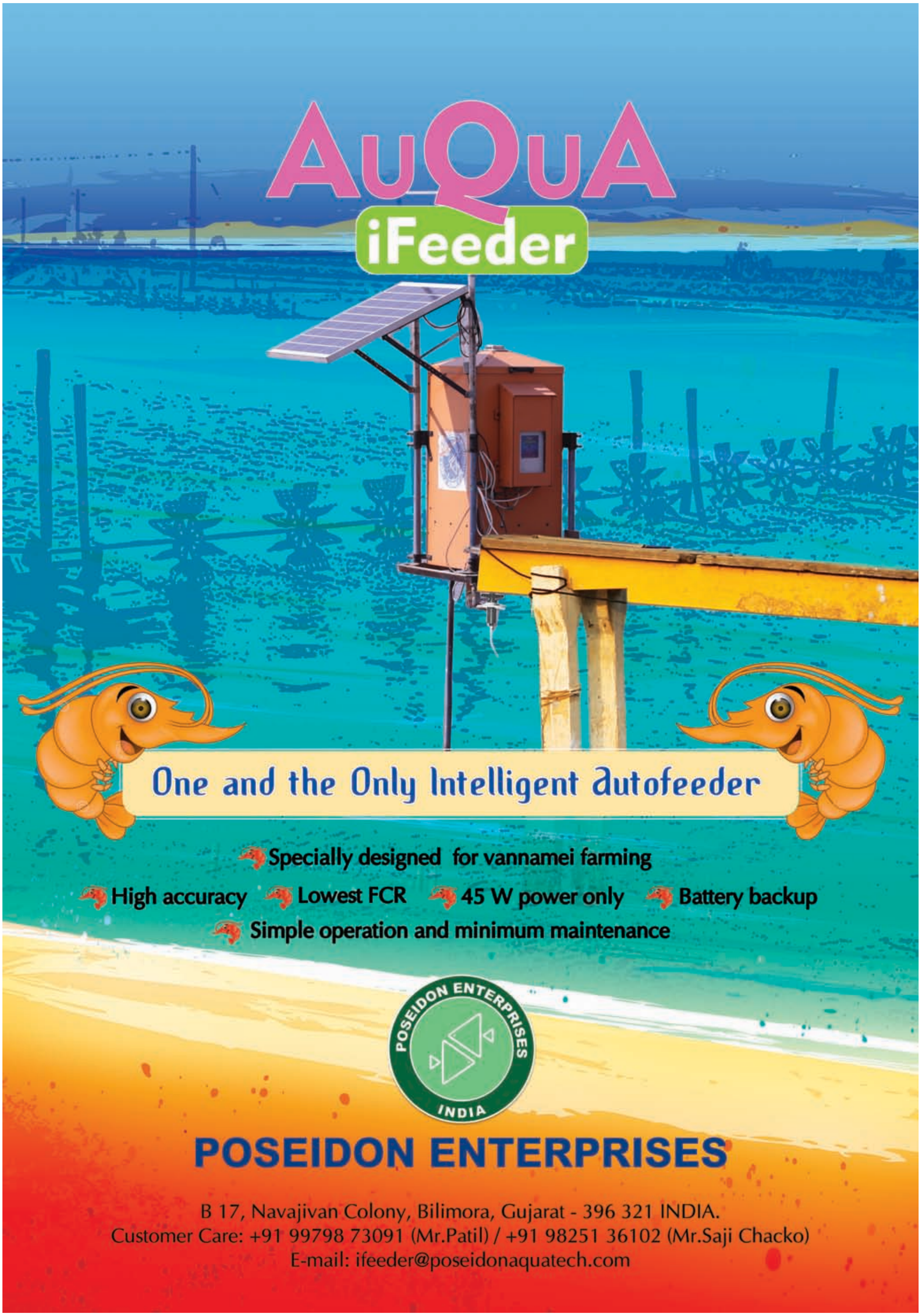

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From the Editor...

Work with long term perspective for the industry and for yourself !

Build Amaravati as the pride Capital of A.P in India

Dear Readers,

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

I have been observing Aquaculture industry and its Stakeholders for the past 27 years, but I am sorry to say that many of the stakeholders and promoters of companies do not seem to be giving needed emphasis on long term perspective. If you have long term perspective, you will invest money and time for proper infrastructure facilities with the maintenance of quality standards, and to brand both Shrimp and Fish products besides Crabs. If you are really serious about the future of this industry, you also would have done sufficient work and make investment for the promotion of Shrimp and Fish products consumption in the country.

As I said in my Editorial in July 2020 issue of AI, even if Covid-19 pandemic continues, I do not see any problem to aquaculture sector as this sector produces and provides nutritious food such as fish, shrimp, crabs etc for the people and people need these food items all the time to live and to live healthy.

There is a similar kind of industry – Poultry, which is advanced in putting efforts in branding and promotion of Egg and Chicken products consumption in the country. The stakeholders in aquaculture should put concerted efforts for the promotion of aquaculture and its products consumption.

I appeal to the Farmers, Hatcheries, Feed companies, Processors, Health & Nutrition products manufacturers and suppliers, Dealers, Intellectuals and all others in aquaculture sector to respond and come forward to work together for the promotion of consumption of shrimp and fish products domestically, and also to attend to resolve other issues of this sector and its stakeholders.

If you all wish, I can take initiative to have a meeting of the above mentioned segments to discuss and to do the needful soon.

****

After the bifurcation of united Andhra Pradesh into two states – Andhra Pradesh and Telangana, the way Mr N. Chandrababu Naidu started working to develop a world class state headquarter, AMARAVATI for Andhra Pradesh state, people with in Andhra Pradesh and all over the country commended him for his initiative.

People had faith that a wonderful city will be developed on the name of Amaravati as the head quarter of A.P, as the project was planned and taken up by Mr Chandrababu Naidu who had the good record of developing Hyderabad as the delightful city with wide and clean roads, Hitech City, Outer Ring Road, International Airport etc.

The proposed Amaravati city is located on the banks of river Krishna in Guntur district and the primary city of the state's capital region and the land for Amaravati is selected close to the geographical center of the state.

Amaravati was founded by former Andhra Pradesh Chief Minister N. Chandrababu Naidu in 2014 as the Greenfield administrative capital city of Andhra Pradesh state, and its foundation stone was laid at Uddandarayunipalem by the Prime Minister of India, Narendra Modi on 22 October 2015. Narendra Modi promised to help in developing Amaravati as the Capital of A.P, but he never showed any interest on it after that. May be Narendra Modi does not want the development of Amaravati as it will make Chandrababu Naidu to emerge as a strong leader and administrator in the country, and Modi has to face competition from Chandrababu Naidu at national level. Ego and Jealousness are harming the development of a good capital for the people of Andhra Pradesh.

Y. S. Jaganmohan Reddy who is facing many criminal cases in the court should realize that people of the state voted him to come into power as he pleaded the people “to give him a chance”, but not that he will pull down whatever Chandrababu Naidu took up for the state like developing Amaravati as the state capital.

With the way the Governor of A.P gave his assent on 31 July 2020 paving the way for the formation of three capitals for Andhra Pradesh is a sorrowful thing for the region, and it shows the double standards of the Central Government. Whether Visakhapatnam is made the Capital of the state or not, it will naturally become a nice city and commercial capital of Andhra Pradesh looking at the facilities Vizag has already got.

Late Dr Y. S. Rajasekhar Reddy during his tenure as the Chief Minister of united Andhra Pradesh made a mark with good work which was left behind by his predecessor Chandrababu and Jaganmohan Reddy should follow his father’s foot steps by continuing to develop Amaravati better than what his predecessor Chandrababu Naidu planned and get people’s appreciation instead of destroying it.

Let us hope that the High Court will do justice for the Amaravati to come into true as the capital city of Andhra Pradesh, which is No.1 in Aquaculture development in the country.

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

M.A.Nazeer
Editor & Publisher
Aqua International

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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Centre targets scaling up the fisheries sector to help India achieve $ 5 trillion economy

Fisheries Secretary, Mr Rajeev Ranjan unveils comprehensive plan to usher in Blue Revolution through start-ups, infrastructure modernization, quality assurance, species diversification, etc.

Chennai: The Centre has come up with a comprehensive plan to revamp and accelerate the growth of the fisheries sector in India through various schemes, including the recently launched 'Pradhan Mantri Matsya Sampada Yojana (PMMSY). Explaining the proposed plans of the Union government, the Fisheries Secretary **Mr Rajeev Ranjan** said the government targets scaling up the fisheries to help India achieve $ 5 trillion economy.

Citing the latest data, he claimed that India's fisheries is on a trajectory of progress with an average annual growth rate of close to 11% in the last fiver years. "The growth rate of fish production of the country in the last five years is 7.53% while it is nearly 10% in exports", he added.

He was speaking after inaugurating a digital conference on 'emerging technologies in brackiswater aquaculture' hosted by the Chennai-based ICAR-Central Institute of Brackishwater Aquaculture (CIBA). "The government is eying a total fish production of 220 lakh tonnes in the next five years. The latest estimates of the fish production during the period of 2019-20 in India is close to 15 million tonnes", he said.

In a bid to boost the pace of initiatives to usher in the Blue Revolution, the government has unveiled a comprehensive plan which aim to address infrastructure modernisation, critical gap in value chain, post-harvest management, traceability and quality control under the PMMSY scheme, he said adding that the scheme was cleared by the union cabinet recently. "Under various schemes, the government is looking forward a total investment of 9 billion dollars in the next five years from the government sector," he said.

Start-ups in aquaculture

The government would focus on developing entrepreneurial initiatives and promotion of start-up ecosystems in aquaculture, which has immense potential in India's highly prospective brackish water resources, Ranjan added. For making this happen in a viable means, he suggested popularising adequate technologies in the farming. "Promoting start-ups in aquaculture by adopting the latest technologies in the field will help boost the production", he said.

Aquaculture is one of the technology-driven sectors where technologies are adopted at a faster rate on a global scale. Ranjan sought the support of the CIBA in providing the required technological backstopping and handholding the start-ups to play an important role in taking forward the highly prospective sector of brackishwater aquaculture in the country, which is the fourth largest seafood exporter and the second largest producer in aquaculture. The latest statistics show that 28 million fishers and fish farmers in the country are directly dependent on fisheries at the primary level", he said.

Doubling Exports

He further said that the union government is looking for doubling the exports of aquaculture production from India, which is the fourth largest seafood exporter and the second largest producer in aquaculture. "Presently, the country's export from aquaculture production in terms of value is almost $ 7 billion of which the majority share comes from the shrimp export", he added.

Species diversification

Stressing the need for improving the quality other than focusing on increasing quantity, Rajan opined that the government is in favour of producing diversified aquaculture species, especially indigenous shrimp varieties. He signalled shifting of the trend from single focus on vannamei to diversified shrimp species, including native species such as indicus, the Indian white shrimp, adding that the CIBA could take leadership in taking up a flagship programme enabling the commercial production of such shrimp varieties.

The conference was organised by the Institute Technology Management and Agricultural Business Incubator Unit of ICAR-CIBA. Dr K.K. Vijayan, Director, ICAR-CIBA, who made introductory remarks, stressed the need of partnership between the governments, research institutions, private sector and the farming communities, on a P-P-P mode.

PMMSY Scheme will give a upthrust to the Fisheries and Aquaculture Industry in India: MoS Union Minister for Fisheries

New Delhi: MoS, Fisheries, Animal Husbandry and Dairying, Govt. of India, Mr Pratap Chandra Sarangi addressed the fisheries and aquaculture industry on the current scenario of the fisheries industry. He further highlighted the best practices involved and executed by the Union Government in the revival of the economy in this sector. Mr Sarangi said, "The package of 20,000 crores, covered under the scheme PMMSY of Union Govt will help the Industry of Fisheries and Aquaculture, inside-out. A lot of sub schemes are covered under the umbrella of PMMSY Scheme. This scheme will make the fisheries industry self reliant, matching the idea of Prime Minister, Mr Narendra modi." He further added that not only the sector will experience an upthrust but also willl generate employment to more than 50 lac people across the nation.

This discussion was held in a webinar was organised by the ASSOCHAM on "Fisheries and Aquaculture Industry in COVID Times: Challenges and a Roadmap Ahead on July 16, 2020. Along with the presence of MoS, Fisheries, Mr Pratap Chandra Sarangi as the Chief Guest. The digital session has gained more value and insights with the presence of Minister, Environment and Forests, Excise and Fisheries, Govt of Assam, Mr Parimal Suklabaidya and Minister of Fisheries, Govt of Mizoram Mr K. Lalrinliana as a Guest of Honour.

On behalf of ASSOCHAM, Mr Deepak Sood, Secretary-General, ASSOCHAM, welcomed the panelists which were present from across the nation and outside. In the presence of the Union MoS Fisheries Minister, Fisheries, Govt of Assam, Mr Parimal Suklabaidya and Minister of Fisheries, Govt of Mizoram, Mr K. Lalrinliana, Mr Deepak launched a knowledge report prepared by ASSOCHAM with the help of the financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD).

Minister of Fisheries, Govt of Mizoram, Mr K. Lalrinliana said that state of Mizoram welcomes the scheme by Union government and is keen to start implementation. Further, adding to this, he said "Mizoram is lacking certain inputs to increase per area production such as fingerlings and fish feed, which are mostly imported from other states. Mizoram is producing around 50% of its fish requirement and the state has been importing from neighbouring states as well as from neighbouring countries – Myanmar and Bangladesh. The state is also slowly moving in exploring innovative practices such as Crab Farming, Ornamental fish farming, breeding of indigenous aquatic species etc". Commenting on PMMSY he said, "The supply of inputs in the PMMSY Scheme leans towards first year inputs for the new ponds and new rearing area construction. He would like to propose supply of inputs for already existing fish pond. Majority of the farmers are poor and are Below Poverty Line (BPL) families who cannot afford to purchase the necessary inputs from their own pockets. Therefore, special consideration for supply of inputs to the existing water area, will greatly increase the fish production of the state."

Representing Assam, Minister for Fisheries, Govt of Assam, Mr Parimal Suklabaidya said that state has taken aggressive implementation of various schemes to support the sector to provide the livelihood. He said there is no shortage of water bodies and spaces in Assam however until few years back, 1/3 of fish were brought from outside before our govt. He further stated that "under leadership of the CM started a scheme : 'Ghare Ghare Pukhuri Ghare Ghare Maach', which translates every house to have a pond, state took on this mission. The loan was arranged from NABARD and as of today state has developed 12000 ponds and production has begun. The scheme supported meeting the demand for the local consumption of the state during Covid times as well as neighouring states of Meghalaya and Mizoram were supplied the stocks." He concluded his message with conveying thanks to Union Government for launching PMMSY scheme.

Giving more technical insight about the PMMSY scheme, the Secretary, Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Govt of India, Dr Rajeev Ranjan, IAS said, "The scheme was started in May 2020 with an array of 100 diverse activities. With the budget of Rs. 20,050 crore, it is by far the largest investment in the fisheries sector. The strategy along with the concerted and collaborative efforts between the stakeholders and government is required in order to achieve ambitious targets under the

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scheme. These targets are Rs. 1,00,000 crore fisheries export, additional 70 lakh tonnes fish production, and generation of 55 lakh employment in the next five years among the others."

The state partners of this digital session are Government of Karnataka and Government of Andhra Pradesh. Further, the session is supported by NABARD and Gujarat State Biotechnology Mission and MPEDA.

"The Marine Products Exports Development Authority, is also helping to revive the sector by taking various timely measures. In such a difficult time, it is the prime concern of MPEDA to provide unique solutions to the problems faced by the Marine Industry bodies, ensuring smooth and proper operation of the sector along with maintaining quality and implemented various programs to meet the required concerns regarding food safety." said Chairman, MPEDA, Mr K S Srinivas, IAS

Mr Subrata Mandal, Chief General Manager, NABARD, West Bengal, said "The Fisheries and Aquaculture sector is moderately impacted in COVID time, majorly due to the migration of the labour and the other problems faced by the fishers at individual level. I am sure that the sector will rise again and more growth will be seen this time from past. The Govt of India is constantly putting a lot of efforts in coping up with such difficult situation. Further, at NABARD, we are also dedicated to help each and every fisher by supporting them financially.

On the panelist Dr Worawit Wanchana, Policy and Program Coordinator, The Southeast Asian Fisheries Development Center (SEAFDEC), Bangkok, Thailand, thanked the ASSOCHAM for inviting him in this webinar, he shared the role of SEAFDEC which is an internal governmental organization established since 1967. According to Dr Wanchana, "There is moderate impact in the fresh food products, the domestic consumption is reduced, demand from the factories were decreased and regarding the ready to eat products the impact is low as it also impacted the chilled and frozen products like salmon and Mrmps. The orders from the importing countries cancelled or postponed. Also commercial fisheries being unable to conduct fishing activities due to social distancing measures and prohibition of foreign crew to enter other countries due to lockdown measures."

The other speakers in the session were from a diverse background across the nation, they discussed and bring out all the possible ways to cope up with the current situation faced by the fisheries and aquaculture industry inside the nation. The other eminent speakers of the session, representing the interest of industry bodies were Mr Jagdish Fofandi, National President, Seafood Exporters Association of India & MD Deepmala Marine Exports, Mr Rajamanohar Somasundaram, Co-founder & CEO, Aqua Connect, Dr Manoj M Sharma, Director, Mayank Aquaculture, Pvt. Ltd., Prof Baskaran Manimaran, Founder Vice-Chancellor (Retd.), Tamil Nadu Fisheries University and Dr PE Vijay Anand, Senior Consultant, Global Emerging, Markets Development US Soybean Export Council.

The session was be attended by major industry bodies of Fisheries and Aquaculture Industry/ leading industrialists, exporters, educationists, bureaucrats, FPOs, and other industry professionals across the nation.

CMFRI adjudged as best research institute under ICAR

CMFRI wins ICAR's highest award

Kochi : The Central Marine Fisheries Research Institute (CMFRI) has been adjudged as the best research institute of the Indian Council of Agricultural Research (ICAR). The CMFRI won the Sardar Patel Outstanding ICAR institutions award, the highest award of the ICAR with a cash prize of Rs one lakh, in the category of the large institutions. This is in recognition of CMFRI's excellent performance in marine fisheries research during the period from 2014 to 2019.

This is the second time CMFRI bagging this prestigious award. Research works for the development of mariculture activities such as open sea cage fish farming, seaweed farming, integrated multi-trophic aquaculture (IMTA) which were aimed to enhance the income of fishermen helped CMFRI achieving the highest ranking among more than 150 agricultural and allied research institutes in the country. Its research initiatives in developing nutraceutical prdocuts from marine organisms to treat type 2 diabetes, arthritis, obesity, thyroid and hypertension also played a major role in winning the award. In addition, CMFRI's efforts on preparing a range of policy briefs, including the works on minimum legal size (MLS), ecosystem-based management and light fishing, towards the sustainable utilization of marine fisheries resources were appreciated.

Earlier, the CMFRI received this award in 2007. The Central Institute for Research on Cotton Technology, Mumbai won the award in the category of small institutes, while Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand was selected as the best agricultural university under ICAR.


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Aquaculture farmers of Andhra Pradesh stare at heavy losses despite rise in production

Vijayawada: The months from April to June is the harvesting season for fish and prawn in the State as the temperatures are conducive for processing, packing and export. But unfortunately, with the COVID-19 crisis, the aquaculture sector was badly hit and the damage is yet to be assessed, but experts say that significant losses could not be ruled out.

Aqua farmers say though they are producing enough, there is a lack of market for their produce due to COVID-19 crisis and subsequent worker shortage. Further, market transactions across the country have slowed down, which has resulted in price drop.

Shrimp and fish farming is extensively taken up in twin-Godavari districts (East and West), Krishna, Prakasam, Nellore and to an extent in Guntur districts. Situation is not so good in any of the districts and all the aqua farmers are doing now is to pray for the return of normalcy.

Of the fish produced in Andhra Pradesh, 75 to 80 per cent of Indian major carps (Catla, Rohu and Mrigal) are consumed in Eastern India and in North India, while 90 per cent of Pangasius is consumed in North India. A majority of the shrimp produced is exported to the US, European Union, China and Japan. Local consumption of the fish and shrimp is less. In other other words, the domestic market is not the main income generation avenue for the aqua farmers.

In Nellore district, aquaculture is taken up in 11,400 hectares in all 12 coastal mandals. Mostly it is shrimp, which is marketed to other countries. However, during the first half of the lockdown -- from the last week of March to June first week — aqua exporters are facing twin-pronged problems, shipping to other countries has been restricted and lack of manpower for packing. Exports of aqua products to other countries have dropped in April and May by 30 per cent this year when compared to last year.

In Prakasam, shrimp/ pisciculture is taken up in 29,000 acres and the harvest was good this year. Though the farmers supplied shrimp to processing plants, shortage of workers has proved to be a stumbling block.

“Since lockdown restrictions are in force, we are facing shortage of skilled labourers as most of the aquafarm caretakers are from Srikakulam, Vizianagaram, Odisha, West Bengal and other places. They went to their native places in April-end and haven’t returned yet. Somehow we are pulling through. Usually, we sell our produce to the local processing unit agents and they, in turn, export it to China, UK, America and the like. But due to ongoing stand-off between India and China, exports to that country were hit and taking it as pretext, export agents are not offering a good price for our produce,” K Suresh Kumar, an aqua farmer from Ongole said.

Speaking to TNIE, Suryamitra Group of Companies managing director Surya Rao Irrinki said, shortage of workers is the major problem. “ Due to shortage of workers, 300 tonnes of produce in the company unprocessed. It is perishable and if it is not processed in time, we will suffer heavy losses,” he said. Only 150 out of 1,000 workers are coming to the company, though it is taking all protective measures. Owing to huge demand from Tamil Nadu, Karnataka and other places, fish farmers in Nellore harvested the crop, but owing to restrictions, the prices have dropped.

Krishna district fisheries department joint director Sk Lal Mohamed said due to dip in the demand, there has been a fall in fish exports. About 350 to 400 truck loads of fish used to be exported to other States earlier; it has reduced to 150 and 200 trucks now, according to Express News Service.


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Shrimp giants urged to take action over increased disease risks

The governments of the five largest shrimp producing nations have been urged to take increased and immediate action to address the continued outbreak and emergence of new diseases in shrimp farms.

More than 25 major retailers and seafood companies and the Sustainable Fisheries Partnership (SFP) have signed the letter, which was sent to the governments of China, India, Indonesia, Thailand and Vietnam.

“Governments need to take action now to stop disease outbreaks in shrimp farms,” said Anton Immink, aquaculture director at SFP. “Disease disrupts the reliability of supply chains, threatens seafood sustainability and jobs, and continually costs the industry billions of dollars each year.”

Retailers are concerned that disease outbreaks in the shrimp sector, such as took place in 2012-2013 across much of Asia, could easily return

The companies and trade associations signing the letter include: AquaStar, Beaver Street Fisheries, Chicken of the Sea, Fortune International, HighLiner Foods, Hilton Seafood UK, IDH the Sustainable Trade Initiative, Labeyrie Fine Foods, Lyons Seafoods, Marks and Spencer, Sainsbury’s, Seafresh Group, Sunnyvale Seafood, Sustainable Fisheries Partnership, Tesco, The Co-op, The Fishin’ Company, Waitrose & Partners, and the UK Seafood Industry Alliance.

Given the major supply chain disruptions and massive economic losses caused by diseases that spread rapidly across Asia in 2012 and 2013, the companies strongly appealed to governments to get ahead of the situation this time. All major shrimp producing countries have already committed to follow international guidelines for necessary controls issued by the UN Food and Agriculture Organization (FAO) and the World Animal Health Organization (OIE).

“Acting now will help to prevent a repeat of the chronic economic impacts associated with established diseases and ultimately lead to a more resilient and robust shrimp industry,” wrote the companies. “The economic costs of investing in good health control systems, best management practices in farms and hatcheries, epidemiological analysis, and emergency response planning is minimal when compared to the tens of billions of dollars that diseases cost the industry every year.”

Retailers are concerned that disease outbreaks in the shrimp sector, such as took place in 2012-2013 across much of Asia, could easily return

The risks to shrimp farms are also magnified by the COVID-19 pandemic, according to SFP. International supplies of good quality broodstock to hatcheries have been limited by transportation disruptions. As the international market for shrimp picks up, increased demand for juvenile shrimp may overshadow proper inspection and controls.

There is no direct danger to consumers from these diseases, but the loss of income impacts millions of farmers’ livelihoods.

More than five million tonnes of shrimp are farmed around the world. It is America’s favourite seafood and is consistently among the top five seafood imports in Europe. The FAO and WorldFish estimate that five million people are employed directly on shrimp farms and an additional five million in related supply chains.


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Webinar Talk on Status, Diversity and Trade Prospects of Marine Ornamentals

The National Webinar on Legal Framework for Coastal and Marine Biodiversity Conservation was organized by Centre for Climate Change Studies, Sathyabama Institute of Science and Technology, Chennai during July 27-29, 2020. As a part of it, Dr S. Prakash, Scientist-C and Fullbright-Nehru Fellow of this Centre spoke on coastal and marine biodiversity with emphasis on ornamental (Orn) trade, with the title 'Reef to aquarium: status, diversity and trade prospects of marine ornamentals'.

Animals like sea anemones, both Orn fishes and shrimps collected from coral reef environment cover hundreds of miles to reach aquarium at homes, airports and other buildings. Mostly collected from Indo-Pacific, Red Sea and Caribbean Sea, nearly 35 lakh people worldwide are involved in this trade. Dr Prakash further discussed about how Orn fishes, both cultured and wild-ones reach to hobbyists from producers/collectors; eco-friendly collection of marine ornamentals practiced in Gulf of Mannar (GoM) and Palk Bay by native Tamil Nadu fishermen; explained biological features of trade-important Orn fishes viz., clownfishes, damsels, sergeants, angelfish, butterflyfish, cardinalfish, surgeonfish, triggerfish; family Pomacentridae constituting most of marine aquarium trade of Orn fishes; marine Orn biodiversity and trade flow worldwide; 'Nemo' effect of clownfishes and breeding protocol of 30 species of clownfishes developed in India and abroad; Amphiprion ocellaris and A. percula as top 2 species in clownfishes; films Finding Nemo and Finding Dory released in 2003 (that influenced and increased sales of marine ornamentals by 3 times) and 2016 (Dory parrot surgeon bred in captivity for 1st time in Florida in 2016) respectively. Total trade value in 2014 was US$ 10 billion with 10% annual increase.

Extensive study was done by this institute during 2014-2015 on marine aquarium trade in Indian perspective. Mostly restricted to GoM area, almost 87 sp of fishes and 21 sp of invertebrates involved in trade.

Clownfishes and damsels are captive-bred, NBFGR and other institutes started producing marine Orn shrimps in captive condition. A. sebae ranks 1st among top 10 fishes in Indian trade, 16sp under family Labridae which is maxm, 12 sp under Pomacentridae and 11 sp under Chaetodontidae.

Dr Prakash stated that proper infrastructure is not there after collecting fishes from wild waters. Mandapam, Keezhakarai and Tuticorin are major hubs of marine Orn fishes in GoM (mostly fish wholesalers present in Tuticorin). Invertebrates mostly caught are Stichodactyla haddoni, Periclimenes brevicarpalis, Ophidiaster confertus, Rhynchocinetes durbanensis. Export value from India during 2014-2015 was US$ 10,605; Bangalore (52.9%) and Mumbai (47.1%) are points of export. Govt of India in 2000 included 24 sp of marine molluscs along with all reef-building corals under Sch-I and Sch-IV of Wildlife Protection Act, 1972. CITES, Global Marine Aquarium Database and Law Enforcement Management Inf Sys (LEMIS) are taking care and regulating marine Orn trade.

Dr Prakash discussed about recommendations like prioritizing existing policies WPA, CRZ, Biological Diversity and Fishery Regulation Acts; strengthening research on species-based taxonomy, natural stock/population assessment data and species biology; destructive fishing practices to be banned; understanding knowledge of elderly Indian fishermen can be considered and should be educated and let know the exact fishes supplied in trade; enforcing of licensing methods for Orn fish collection, 150-200nos Orn fish collectors exist in between Mandapam and Tuticorin; establishing size-based limitations: brooders and newly-recruited juveniles can be avoided; labeling of Orn species as captive-bred or eco-friendly collected particularly during transportation and sale; creating SHGs in this sector for income/livelihood development for women entrepreneurs. In the end, he emphasized about participatory approach for sustainable utilization of resources and proper management in India; top authorities like MPEDA, MoEFCC, NBA can help stakeholders (fishermen, collectors, wholesalers, retailers, exporters, hobbyists, researchers, conservationists, NGOs) in regularizing the Orn trade and utilizing it sustainably. Livelihood development and conservation must always move in parallel.

In this Webinar, Ms P. M. Vatsala, Advocate, Madras High Court spoke on 'Legal framework policy for the conservation of marine biodiversity in India' and Dr Amit Kumar, Scientist-C of this Centre spoke on 'Indian patent scenarios for the microorganisms and their products'. News communicator Subrato Ghosh participated in it entirely.


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Dr Sam Dupont speaks on Ocean Acidification

Marine Ecology Laboratory at Department of Life Sciences, Presidency University, Kolkata, WB in collaboration with Aquaphile organized a two-day International Webinar on 'Aquatic Ecosystem: Prospect and Future Challenges' during July 18-19, 2020. As a part of it, Dr Sam Dupont, Associate Professor, Department of Biological and Environmental Sciences, University of Gothenburg, Sweden spoke on the topic 'Get ready for ocean acidification (OA)'. Dr Dupont discussed about the kind of science we need to address the issue of increasing CO_2 emission in atmosphere. OA is not climate change issue (unlike global warming, ice melting, sea level rise, hypoxia, salinity change) but is a consequence of CO_2 emission. OA is happening as evident from classic CO_2 record monitoring station at Mauna Loa in Hawaii. He discussed about formation of carbonic acid in ocean; decrease in ocean pH by 0.4-0.5 by year 2100 if we keep emitting CO_2 as today (doubling of acidity); its adverse impact upon oceanic life forms particularly those with exposed $CaCo_3$ structure; increase in bicarbonate ion and CO_2 and decrease in carbonate ion and pH in course of time; seawater will turn more corrosive; negative impact observed upon marine calcifiers (sea urchins, oysters, phytoplankton coccolithophores); coral reefs will not be maintained as polyps have been found unable to maintain healthy skeleton. Brittle stars larvae in Atlantic Ocean could not survive in 0.2 pH decrease (8.1 to 7.9) and died in seven days.

OA created a positive impact to sea star Crossaster papposus with increase in growth rate of its juveniles. The pH 5.4 is not stressful for deep-sea mussels but mussels near coast get super-stressed at pH 5.0. With formation of Centre for Collective Action Research, Dr Dupont emphasized on the kind of scientific information that will drive changes in citizens and policies. As Mitigation and Adaptation strategies to reduce CO_2 emissions, he spoke about changing our ways to do science to have impact on society and citizens and targeting them; importance of effective scientific communication; information obtained from research done in chemistry and biology of OA is shared with stakeholders. His experiments on impact of OA on taste of northern shrimp, a seafood of high demand in Swedish meal, had good scientific and popular impact as shrimps of future (experimentally exposed to low pH) have been found not to taste as good as of today's shrimps. He experienced that people are willing to change with science bringing emotional response and his goal is to drive societal change and science targeting local values, people will care about it. 'Mitigation' requires coordinated action from all around the world at same time. As a local challenge, oyster farmers in Hong Kong must produce this resource, thus management and adaptation as local options should be developed from local data.

In a case study on impact of OA on oysters of aquaculture importance in west coast of USA in 2007, scientists observed that oyster farmers could not produce spats in hatcheries, leading to neither production nor income. They collect oysters from open sea and produce baby ones in controlled conditions; the juveniles/spats produced are stocked in nearshore cages and reared till marketable size. Due to OA, pH of ocean water was too low for oysters to produce normal larvae that can turn to juveniles. It was observed that these oysters cope up with OA well except 24 hours in their development, when stage trochophore larvae advance to D-shaped larvae. Former start precipitating $CaCO_3$ skeleton but at low pH (experimentally exposed to it), they cannot do it and die. As means of changing culture method, farmers thought that this 24-hour period must be optimized, to ensure optimal condition for precipitation of their skeleton/shell and then they can resume as usual. This is 'Changing the way to do aquaculture', an 'Adaptation' strategy to OA. Companies attributing to CO_2 production and OA in that coast were identified; policy makers talked with oyster farmers about the issue but it will take years to check CO_2 emission. So alternative action is Adaptation. Dr Dupont emphasized on having adaptive laboratory, knowledge, required capability, capacity building. Since 2014, he is giving basic trainings on OA research in countries in Latin America, parts of Africa and Asia (which are poor in data, its collection, with no laboratory nor equipments) to increase capability of getting the needed data to adapt to and/or mitigate OA. We need to measure pH and other parameters at site and have right data and measure response of OA on marine ecosystem, understand local problems/challenges. He adopted simplified methodology in teaching, focuses on developing lab and doing science with little infrastructure. In Level-III, biological OA experiments designed and OA measurements in western Indian Ocean done in 2018 and as Level-IV of capacity building training, global collaborative research undertaken (2018-2022) to evaluate the impacts of OA on seafoods.

According to Dr Dupont, local solutions can be developed but often data are lacking and capacity building is the key. We need both Mitigation and Adaptation; focus, identify and understand science priorities for doing something useful; understand the science that is needed for driving global and local changes and actions; motivate policy makers about leading to a change in CO_2 emission and about best science we can do locally to implement a change in ways of people. UN Decade for Ocean Science will start and there will be more opportunity for OA research. Dr Dupont ended by saying that there is enough evidence to be virtually certain that OA will have drastic consequences for marine species, ecosystem and associated services. We will choose to protect and rescue the ocean in this decade, which are facing wide range of global stressors today. News communicator Subrato Ghosh was a careful listener in Dr Dupont's talk and participated in this Webinar.

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Japan lifts inspection order for Black Tiger shrimps from India

Kochi: Japan has lifted inspection order for Indian Black Tiger shrimps (Penaeus monodon) after the export consignments of this shrimp were found free from any residue of synthetic anti-bacterial drug furazolidone.

This has been conveyed by Food Inspection and Safety Division of Japan's Ministry of Health, Labour and Welfare (MHLW) to the Embassy of India in Japan, Export Inspection Council of India and the Marine Products Export Development Authority (MPEDA).

The MHLW has also reduced import inspection sampling frequency for Black Tiger shrimp to 30 per cent from the current 100 percent. Order related with furazolidone was implemented in accordance with Section 3, Article 26 of the Food Sanitation Act of Japan. Black Tiger shrimp, commonly known as the giant tiger prawn or Asian Tiger shrimp, is a popular seafood delicacy the world over and also forms an important segment of India's marine products export basket. Japan consumes nearly 40% of India's Black Tiger shrimp exports, while it enjoys niche markets in EU and USA also.

The MHLW, in a communication to its chiefs of Quarantine Station, has also conveyed that due to lift of Inspection Order related with furazolidone on Indian cultured Black Tiger shrimp, the frequency of monitoring inspection will be revised to 30% based on Imported Foods Monitoring and Guidance Plan FY2019 and it is added to Schedule-2 of monitoring notification.

A 2 –member expert team had surveyed the Black Tiger shrimp hatcheries, and farms, and processing units that export the variety during March 2020 ahead of this order.

Welcoming the lifting of inspection order by Japan, Mr K S Srinivas IAS, Chairman, MPEDA said it is a validation of the relentless efforts undertaken by MPEDA in raising the request at various platforms and through its Trade promotion Office in Tokyo.

He added that MPEDA through its field offices and society named National Centre for Sustainable Aquaculture, had been constantly educating the farmers on Better Management Practices (BMPs) and the ill-effects on usage of unknown inputs which may contain residues of antimicrobial substances like furazolidone.

Mr Srinivas said the MPEDA has also been making sustained efforts to revive the production of Black Tiger shrimps by supplying high health seeds of the variety from its new Multispecies Aquaculture Complex (MAC) at Vallarpadam in Kochi. The seeds supplied by MAC have shown a rapidly growing interest among the farmers to raise the disease-free variety, he pointed out.

The present decision by Japan will give an impetus to the farming and export of Black Tiger variety which has been shadowed by the mass production of exotic vannamei variety during the last 10 years.

Mr Srinivas has also mentioned about the recently launched antibiotic-free certification system, called Shaphari, which guarantees quality shrimp post larvae (PL) and authenticates their quality in the competitive international market. It is an end-to-end solution that enables MPEDA to audit the post larvae shrimps offered by hatcheries across the country."

He said the rigorous certification would enable aqua farmers to freely validate online that the post larvae shrimp offered by hatcheries across the country are antibiotic-free. The entire process has been designed to guarantee the cent per cent healthy products so as to boost marine products exports as well.

Haryana to give 10% subsidy for fisheries

CHANDIGARH: In a bid to promote fisheries, Haryana government has decided to provide a subsidy up to 40% to people belonging to general category and up to 60% to women and scheduled castes to start their business, a spokesperson of the department said.

Unemployed youth can also earn a better livelihood by adopting fisheries as a business option, the spokesperson said, adding that no qualification is required to start this business. Any person starting this business needs only one acre of land. Any interested person can start fish farming on his own land or by taking land on lease.

He said that on one acre of land, a special pond needs to be constructed for fish farming. After this, the cost of construction is subsidized directly through DBT to the bank account of the beneficiary.

Sharing details about recirculating aquaculture system, he said earlier, fish farming was done in ponds, which used to yield about 5 to 7 tonnes of fish only. But now, by setting up a fixed overhead tank, the cultivation will increase to 30 to 35 tonnes through the recirculating aquaculture systems. With this, the profits of fishermen will also increase manifold. He said this cultivation can be done in both sweet and salt water.

Mainly, fish species including rohu, catla, mrigal, common carp, grass carp and Indian major carp are cultivated in fresh water. Similarly, white shrimp can be cultivated in saltwater. Shrimp is sold in the market at around Rs 300 to 350 per kg.

Approximately 30 tonnes of fisheries per hectare can be cultivated, which can be a good profitable business, he informed.

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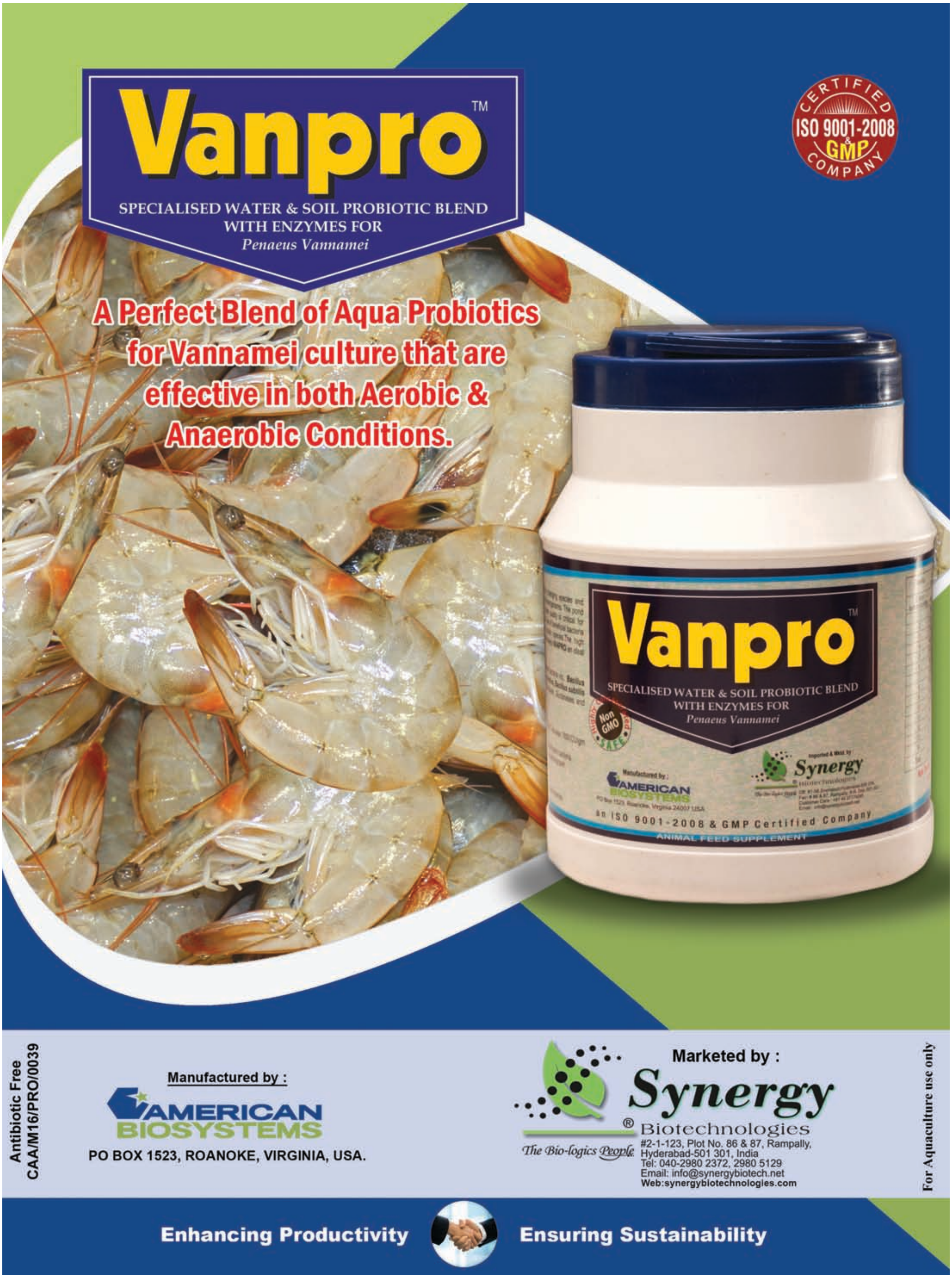
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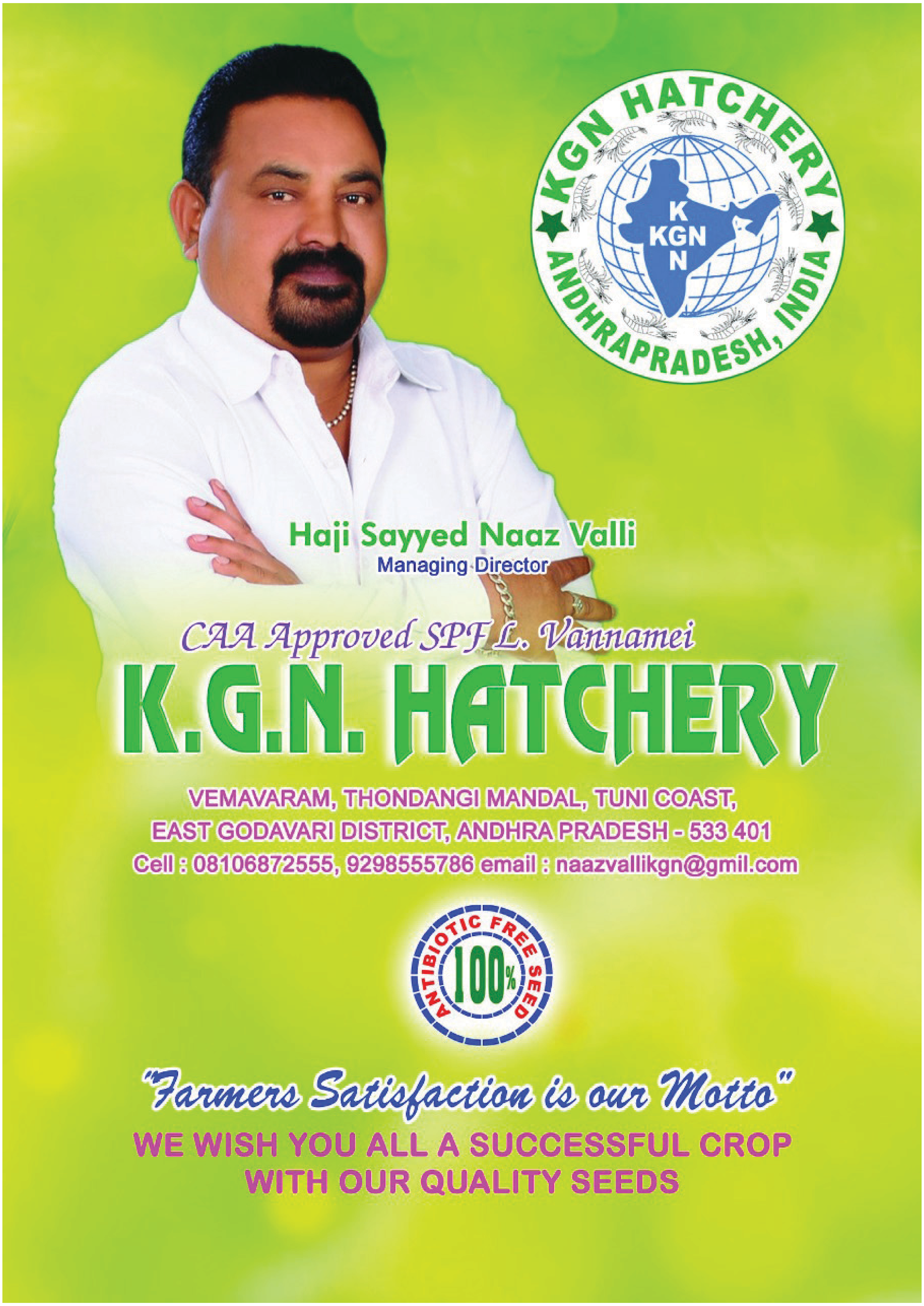
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Aquaculture in perspective of Corona virus with emphasis on production optimization and supply

Highlight Points

▶ Aquaculture production has been reduced somehow for some restrictions due to present pandemic. ▶ It is explained details for fish & shrimp farming in India. ▶ Logistics and seed availability are the major troubles for both. ▶ Proper strategy and correct measures will reduce the impacts & maintain productivity. ▶ Shift from traditional unfed polyculture to productive fed system will gain the production. ▶ Shrimp ponds with cost control, nursery, barramundi culture & biosecurity will be beneficial.

Dr B.M. Hasan
General Manager, Anmol Feeds Pvt Ltd, New Town, Kolkata, W.B

Indian aquaculture and worldwide in general is facing tremendous pressure on the business stability and its sustainability. India is 2nd top producer of aquaculture products with huge potential of high production, and export. Although Covid-19 does not affect fish or shrimp but the sector is still subject to indirect impacts of the pandemic through market access, production and customer demands related to boarder and transportation which disrupts the production and prospects. It directly affects the farmers' plan of harvest or stocking in right time with poor income generation. For poor availability, public in general deprive of animal protein related to nutrition or high price of the food items as supply chain has come to almost standstill.

Confusing and misleading information on seafood caused declining consumption and price fall, less stocking with fears amongst farmers as less movement of seeds from one place to another, and uncertainty about the future selling price during harvest primarily for shrimp. Airlifting of SPF vannamei broodstock from other countries struck up resulting unavailability of good quality seeds. The decline in feed production was caused by the COVID-19 regulations, which resulted by manpower shortage, issues with raw materials' logistics and fluctuating demand in the market. Export has been hampered for low capacity of buying globally, limited shipping facility or lacking of products. Below schematic graphs are presented predicting the market scenario in the supply chain in the current year primarily for low production:

IMPACTS OF THE LOCKDOWN:

In India impacts on aquaculture and supply is tremendous since February. One in 10 persons in India directly or indirectly involved in aquaculture business. Restrictions of Covid caused significant manpower scarce in the industry making the factory or farms functioning with less capacity. Recent outbreak in June and surge of Covid-19 further cause great concern for logistics and production for both fish and shrimp. Export was halted and started with small sizes for China & bigger sizes for USA.

FISH FARMING:

- Fry production & supply was hampered in hatcheries since Feb-March
- For Log down transportation was not smooth even though there was exemption
- Stocking is delaying by 3-4 months thus affecting production, supply and sale
- Unable to harvest in time for low demand & logistics issue, FCR & production cost increased
- Pangus harvest is still seriously affected as maximum is supplied in restaurants and it's closed till date
- FCR is getting high for inability to harvest; cost of production increases
- Overall production & cycle goes beyond target (70% culture is ongoing)

SHRIMP FARMING:

- The COVID-19 lockdown at the end of March significantly impacted the supply of seeds and the subsequent stocking of ponds and stocking was only 25-30% average including AP. Now it improves only 40-50% till June.
- Due to uncertainty in international markets, farmers carried out emergency harvests of ponds even in smaller sizes, and farm gate price started to fall during the second week of March and continued declining regardless of shrimp size – might be for dynamic export markets and caution on the part of buyers
- Availability of labor and logistics for proper functioning of the industry (farm, hatchery, feedmill, processing, and shipping) remains a key challenge across different segments of integrated aquaculture
- 50-60% of productive ponds are not stocked for the dilemma & uncertainty; moreover good SPF fry has the acute shortage, and white spot disease has started in rainy season


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- Export is affected a lot for logistics issue & market dilemma. Demand has been generated but materials (shrimp) are not available in the ponds or processing plants.

STRATEGY & INTEGRATED APPROACH:

Managing aquaculture operations in challenging times is of Prime importance. Industry needs to keep updated for the farmers for its sustainable fish production. Little has been regularized since February and still needs to do more. Even in Covid outbreak, following measures could be taken to maintain its production volume and supply to markets. A promising action plan to consider in this crisis ridden period:

- High value fish culture to practice (pabda, koi, singhi, bhetki) besides IMC, Pangus, Tilapia
- SPF shrimp broodstock started to imported to catch up stocking plan; farm gate prices at par at present
- Low stocking density with simple culture within carrying capacity of the ponds emphasizing clear focus on medium count (50-60) or size (18-20 g) for the international and domestic markets
- Increasing awareness of shrimp in the domestic market would help support the industry where Govt has a role to promote it with subsidy towards more sustainable production and benefits
- Innovative approaches (low density low DOC, only SPF fry stocking and usage of nursery , Maintaining low production cost by optimizing growth, survival, pond management, stress reduction, health management & biosecurity, marketing)
- Use of Auto feeder (reducing dependency on work force & accuracy)
- Better pond and feed management practices to improve for responsible yields, and for successful and profitable production- farmers has to be updated on market dynamics and technology
- India's shrimp exports may increase due to possible global shortages by major producing countries
- Keeping records by monitoring water quality, FCR & costs
- With expertise only-Biofloc, RAS, Aquaponics can be tried to produce in intensive way
- Shrimp ponds can be stocked alternately with Barramundi (bhetki), tilapia to compensate the production rather than keeping empty ponds
- Sanitary measures (facial mask, social distance, gloves) need to use for all activities from pond feeding to processing

LOOKING FORWARD:

- Interventions from Govt are required more to make good policies to support the farmers. Insurance for the crop loss or zero production for some crisis is of prime importance.
- Subsidy to the farmers for feed and seed will be helpful to optimize production efficiency.
- Resurgence of black tiger shrimp (P. monodon) or alternate species as blue shrimp (P. stylirostris) can be introduced as back up shrimp species. Sea bass, sea bream culture has to initiate as this is expensive marine fishes, and we don't have enough hatcheries to supply the seeds.
- Conversion from traditional unfed

Contd on Page 44

Introduction to Hormone-Induced Reproduction of Fish

Highlight Points

▶ Fish in captivity exhibit different forms of reproductive dysfunction. Reproductive dysfunction occur at different levels of reproductive brain-pituitary-gonad (BPG) axis. Natural and synthetic hormone analogue can be used to stimulate the gonadal growth, maturation and spawning in captivity.

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Introduction

Among the most significant advancements in the field of aquaculture during recent decades is the development of techniques to induce reproduction in fish. These techniques have allowed farmers to profitably breed and raise species that do not naturally reproduce in captivity, and to manipulate the timing of reproduction to suit production cycles. Some species will not readily breed in captivity due to environmental or culture conditions that are different from those found in nature, such as water temperature or substrate type. These conditions may cause stress or may not provide the cues needed to complete the reproductive process.

Fish in captivity may not always reproduce at the most advantageous time, and alteration of the spawning cycle may be desirable. This allows a farmer to:

1. Obtain fish outside of the normal spawning season either to lengthen time for grow-out or to produce hybrids with other species;
2. Improve efficiency by getting fish to spawn on a predetermined date; and
3. Maximize survival by fertilizing and incubating eggs under hatchery conditions. Where successful, techniques for altering the spawning cycle of fish have become a valuable tool.

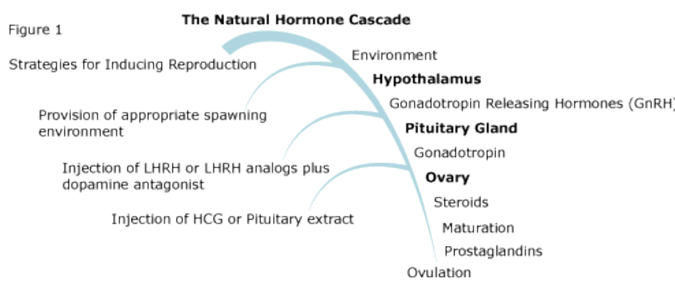
Background: Reproduction in Nature

In fish, the reproductive process involves three basic steps:

1. Maturation - the development of the gametes (eggs and sperm) to a point where fertilization can occur;
2. Ovulation - the release of eggs from the ovary; and
3. Spawning - the deposition of eggs and sperm so that they can unite.

In fish, as with all higher animals, hormones play a critical role in the reproductive process. Hormones are chemical messengers released into the blood by specific tissues, such as the pituitary gland. The hormones travel through the bloodstream to other tissues, which respond in a variety of ways. One response is to release another hormone, which elicits a response in yet another tissue. The primary tissues involved in this hormonal cascade are the hypothalamus, pituitary gland, and gonads (Fig. 1).

Fish have evolved to reproduce under environmental conditions that are favorable to the survival of the young.



Long before spawning, seasonal cues begin the process of maturation. In many fish, this can take up to a year. When the gametes have matured, an environmental stimulus may signal the arrival of optimal conditions for the fry, triggering ovulation and spawning. Examples of environmental stimuli are changes in photoperiod, temperature, rainfall, and food availability. A variety of sensory receptors detect these cues, including the eye, pineal gland (an organ in the dorsal part of the forebrain that is sensitive to light), olfactory organs, taste buds, and thermo receptors.

The hypothalamus, located at the base of the brain, is sensitive to signals from sensory receptors and releases hormones in response to environmental cues. Principal among these hormones are gonadotropin releasing hormones (GnRH), which travel from the hypothalamus to the pituitary gland. The pituitary is responsible for a wide variety of functions, including growth and reproduction. Certain cells of the pituitary receive GnRH and release gonadotropic hormones into the bloodstream. The gonadotropic hormones travel to the gonads, which synthesize steroids responsible for final maturation of the gametes.

Maturation of the egg is a long process that involves complex physiological and biochemical changes. One important step, vitellogenesis, is a process in which yolk proteins are produced in the liver, transported to the ovary, and stored in the egg, resulting in tremendous egg enlargement. The yolk is important as a source of nutrition for the developing embryo.

Also critical are germinal vesicle migration and germinal vesicle breakdown (GVBD). Before it migrates, the germinal vesicle, or nucleus, is located at the center of the egg in an arrested stage of development. At this stage, the egg is physiologically and genetically incapable of being fertilized, even though it has the outward appearance of a fully mature egg. When conditions are appropriate for final maturation, nuclear development resumes, and the germinal vesicle migrates to one side. Finally, the walls of the germinal vesicle break down, releasing the chromosomes into the cell.

The maturity of eggs can be determined using biopsy techniques. Eggs are removed from the ovaries, cleared with a prepared solution, and viewed under a microscope. In mature eggs, the migration of the germinal vesicle to the side of the cell will be complete.

After the egg has matured, classes of compounds called prostaglandins are synthesized. These stimulate ovulation, which is the rupture of the follicle cells that hold the egg. The egg is then released into the body cavity or ovarian lumen, where it may subsequently be released to the outside environment. Following ovulation, the viability of the eggs can decrease rapidly.

Fish with gametes that have not yet been released by the gonads are called "green." The term "ripe" is used to describe fish with gametes that have been released from the ovary into the ovarian lumen. Ripe fish can be stripped, green fish cannot.

Inducing Reproduction

There are two main strategies used to induce reproduction. The first is to provide an environment similar to that in which spawning occurs naturally. Catfish, for example, like to spawn in enclosed spaces such as hollow logs. A farmer can simulate this by putting milk cans in a pond. The presence of vegetation and an increase in temperature will usually work for goldfish. Changing the photoperiod in a hatchery can accelerate or delay maturation and ovulation in many salmon and trout species.

The second strategy is to inject the fish with one or more naturally occurring reproductive hormones or their synthetic analogs. This is only effective in fish that are already in breeding condition and have mature eggs in which the germinal vesicle has migrated. Often the two strategies are used sequentially: the first to manipulate maturation, then the second to induce ovulation.

Numerous hormones have been used to induce reproduction. Two methods have emerged over the past few years that seem to offer the best chance for success at the least expense. They are injection of a GnRH analog with dopamine antagonist, and injection of gonadotropin.

GnRH Analog with Dopamine Antagonist

Luteinizing Hormone Releasing Hormone (LHRH) is the name of a mammalian hormone that has been employed successfully to induce the reproductive hormonal cascade. In recent years, synthetic analogues of LHRH, referred to as LHRHa, have been developed that are far more effective. Because they are purer and are not rapidly metabolized by fish, they remain active for longer periods.

Under natural conditions, there is a feedback mechanism in the fish that limits the release of gonadotropin. This mechanism uses a chemical called dopamine, which inhibits the action of LHRH. When dopamine is present in the fish, even LHRHa will have only limited success. A dopamine antagonist is often used to limit the effects of dopamine. When LHRHa and a dopamine antagonist are used in conjunction, reproductive success dramatically increases.

Gonadotropin

Two types of Gonadotropin extracts have been used to induce ovulation in fish: Human Chorionic Gonadotropin (HCG) and fish pituitary extract. Pituitary extracts are made by removing the pituitary from a fish and extracting the hormones, which may then be injected into another fish. Carp, catfish, salmon, and other fish have been used for this. HCG offers three major advantages over the pituitary extract: 1) it is much less expensive, 2) it is more stable and thus has a longer shelf life, and 3) it comes in a purified form.

Methods

The details of inducing spawning differ from species to species. They will also differ according to the goals and means of the farmer. It must be emphasized that the following techniques do not apply to all situations. Farmers should always thoroughly research the techniques that have been developed for their species of fish and select those that best fit the circumstances.

Broodstock

Brooders should be fast growing, disease free, and sexually ripe. There are several indicators of ripeness:

Females:

- The abdomen is rounded and soft.
- The genital opening is swollen, protruding, and reddish.
- The anus is often also swollen and reddish.
- Secondary sexual characteristics are evident.

Males:

- Milt is released when the abdomen is pressed gently.
- Secondary sexual characteristics are evident.

Brooders must be handled with extreme gentleness. They are physically very vulnerable during spawning and may die if dropped or roughly handled. Often, a good deal of the farmer's resources has gone into developing the Broodstock line and keeping the fish healthy. The potential return from this investment can easily be eliminated through sloppy handling.

When the brooders are kept in ponds or pens, all water quality parameters, such as temperature and oxygen, should be kept at optimal levels. A satisfactory amount of high quality, well balanced feed should be provided. If the fish are moved from one set of conditions to another, time must be allowed for acclimation. When handling the fish, gentle firmness should be the rule. Covering the fish with wet burlap or cloth, or covering their container to cut off light, will help to keep them calm. Tranquilizers may be used when fish are to be injected or stripped.

Preparation of hormones

The hormones must be mixed and stored properly to prevent contamination and preserve potency. The proper dosage must be calculated for the brood fish, and the optimum injection schedule must be used for best results. To calculate the proper dosage, (1) the recommended dose, (2) approximate weight of the brood fish, and (3) the desired volume of the injection must be determined. The quantity of hormone to be injected can then be calculated from the weight of each individual brood fish and the appropriate injection schedule.

Injecting the Fish

There are two common places to inject hormones into a fish. An intraperitoneal (within the body cavity) injection is given through the ventral (bottom) part of the fish behind either the pelvic or pectoral fin (Fig. 2). Intramuscular (within the muscle) injections are commonly done on the dorsal (upper) part of the fish above the lateral line and below the anterior part of the dorsal fin (Fig. 3). In either case, it is important to place the needle so that it slides under the scale rather than through it.

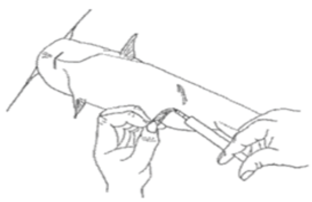


Figure 2

Figure 3

Two dosage levels are commonly used: a preparatory dose and a decisive, or final, dose with a time gap generally of 12 to 24 hours between the two injections. The preparatory dose brings the fish to the brink of spawning, and the decisive dose induces ovulation. In general, the preparatory dose is about 10 percent of the total dose. For some fish, several preparatory doses may be necessary.

Stripping

Stripping should be carried out as soon after ovulation as possible. Fish should be anesthetized and examined 6 to 12 hours after the final injection. Before stripping, both the male and female should be cleaned and dried around the vent with a soft towel because residual anesthetic will kill sperm. Water, fish "slime", feces, and blood should not be allowed to mix with the gametes as they are stripped.

To strip the fish, the female should be held around the caudal fin with one hand, while applying slight pressure to the abdomen with the other hand. If ovulation has occurred, a stream of eggs will emerge. If only a few appear, the female is still "green" and should be returned to the holding tank. If there is a stream of eggs, the abdomen should be messaged from front to back to strip out all the eggs.

Conclusions

Many species of fish will not readily reproduce under certain culture conditions. Others will, but not necessarily when the farmer desires. In these cases, induction of spawning can be of great value. Two techniques are commonly used, sometimes in conjunction with one another. The first is manipulation of the culture environment to mimic some important quality in the fish's natural environment. The second is injection of hormones to stimulate spawning. The hormones may be natural hormones taken from fish or other animals, genetically engineered from bacteria, or synthetic analogs of naturally-occurring hormones.

Methods vary from species to species and situation to situation. However, at least two generalizations can be drawn. First, brooders are very vulnerable to rough handling. Care should always be used to avoid damaging these valuable animals. Second, a fish that does not have mature gametes will not produce viable eggs or sperm no matter how many times it is injected with hormones. Ripeness is the result of environmental factors working over a period of time, leading to maturation of the gonads and production of viable eggs.

Many procedures have been developed for inducing fish to undergo the last steps of spawning. Farmers should thoroughly research the procedures that have been developed for their species of fish through experimentation, and select those that best suit the circumstances. In addition, once the fish have spawned, there are many techniques involved in incubating and caring for the eggs, and caring for the hatched fry. These too must be thoroughly researched.

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

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Aquaculture in perspective of Corona virus with emphasis on production optimization and supply

Contn from Page 38

polyculture to move Productive fed systems will definitely help for blue revolution.
- Feed companies have a responsible role to develop and explore the market.
- Greater awareness of biosecurity, high health high growth variety seeds for both fish and shrimp will be top priority for augmenting harvest yield, national food security and profits.
- Good coordination and exchange of information amongst stakeholders (Govt agency, aqua society, institutions, and farmer groups) can sustain the fish & shrimp production even in corona period, and manage the income generation as prime economy & building the nation.
- Empowering aqua farmers to make data driven decisions that increase production, new tech culture, reduce costs & sustainable yield.

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Importance of Larval Nutrition in Freshwater Fish Hatchery Industry at West Bengal

Highlight Points

▶ West Bengal, leading freshwater fish hatchery industry possessed 495 hatcheries and 70 seed supply farms. ▶ The hatchery market has varieties of seedlings which meets the domestic requirement, but attempts need to be made to reach its international market. ▶ The main problem for not reaching its international status due to traditional method which is still not updated. ▶No proper or nutritionally balance diets during larval rearing. ▶ International and domestic concerns like De Heus Animal Nutrition, Netherlands and Aquatic International, Chennai, India made effort to provide such balanced larval diet.

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SUMMARY

Larval feeding and nutrition are one of the important criteria for a successful aquaculture practice. West Bengal is one the leading market for freshwater fish hatchery industry. In the state, nearly 495 freshwater fish hatchery and 70 seed supply farms, however it's not reached its international market. Initially, the breeding and hatching techniques was started with Indian major carps and tilpia followed by catfishes like singi and pangasius and now recently rupchanda in West Bengal. Though, it is a potential market, but the market is still not reaching outside of the country. The main reason is that still the many farmers are following the traditional method and not updated their breeding and hatching techniques. Another main issue in the larval rearing sector is not providing nutritionally balance diets. Hence, the feed industries like De Heus Animal Nutrition, the Netherlands and Aquatic International, Chennai, India understand the fish hatchery requirement and developed special and nutritionally balanced fish hatchery feeds. De Heus is importing its hatchery feed to India through its Vietnam outlet; similarly, Aquatic International is preparing its juvenile fish feed under a brand name of 'Joven' in India with the collaboration of Scientists from Israel and there are few more like these. These kind of hatchery diets contained necessary protein levels which meet the metabolic and physiological function of the larvae and also the feed comes in different pellet size that suits from hatchlings to fingerlings. This nutritional balanced hatchery diet produced better yield in terms of profitability and counts per Kg fish. After the arrival of these kinds of hatchery diets in the market, the farmers also realised the nutritional importance during larval rearing period. Overall, most of the farmers now understand the need of good larval diets for their young ones, hence they started using these kinds of readymade feed in which De Heus fish hatchery feed and Joven from Aquatic International are considered as best products among the available hatchery diets due to their cost effective, growth and survival performance and high profitability.

Introduction

Fish hatchery is one of important the accessory in the promising aquaculture industry. The whole culture is depending on the seeds produced from the hatchery. The seeds should be healthy and disease free or in other words should be disease resistance individuals. Mostly, seeds depend on the brooders, in terms of possessing good inheritance characters including growth and survival rate, quality flesh, muscle protein, etc. Simply, seed is the major criteria for the culture practice; based on the quality seed only the farmers receive their potential and progressive yield in the form of growth and survival. Hence, the place where the hatchery is present also a notable parameter especially on hygienic aspect, that lead to pathogen free seed production. So far, the value of freshwater aquaculture hatchery and nursery production has not been estimated worldwide like the culture production statistics [1-4]. This data is required and it is also essential for the measurement of the ratio between the hatchery production and culture production, so a prediction on growth and survival rate is possible from larval to grow-out.

Considering a fish hatchery, there are several factors included, but mainly breeding and nursery rearing are the critical factors. The hatchery farmers from West Bengal produced various freshwater fish seeds from their hatcheries. Initially, the farmers focused on breeding Indian major carps such as Catla, Rohu and Mrigal, followed by common carp and tilapia. Later, once they establish the artificial breeding


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(Fig. 1A) techniques in the Indian major carps, they included Calbasu, Bata, Silver Carp, Grass Carp, Japan Puti, Black Carp, Common Carp and Koi Carp (Fig. 1B). The farmers obtained more experience eon these caprs species, then they tried in singi, pangasius, magur, murrels and ompak (Fig. 1C) breeding and succeeded in their attempts. Recently, the farmers succeeded in breeding attempts on Pacu or Roopchand (Fig. 1D), Sea Bass, Anabass (Fig. 1E) and Notopterus (Fig. 1F). Later, the farmers struggled in proper larval rearing techniques especially on the non-availability of nutritionally balanced hatchery diets.

Fig. 1A: Fertilized fish eggs; 1B: Koi carp; 1C: Ompak sp; 1D: Rupchand; 1E: Anbas & 1F: Notopterus

Larval rearing in the early stages of a fish is a crucial process because of the larval sensitive nature or response to varieties of biotic (microbial pathogens) and abiotic conditions (water quality paraments). A successful hatchery process is overcoming or managing all these kinds of issues and producing high quality seeds. Apart from these discussed parameters, feed is one of the essential criteria for a successful larval rearing. Based the quality of the diet only, the larvae exhibit their growth and survival rates and later, the farmers understand the nutritionally balanced diet concept for their high profitability.

Fig. 2A: De Heus (The Netherlands) freshwater fish hatchery diet & 2B: Joven, a fish juvenile diet from Aquatic International, India with Israel collaboration technology

The animal nutrition companies like De Heus Animal Nutrition, the Netherlands and Aquatic International, Chennai, India realised the requirements of the farmers, thus formulated varieties of fish hatchery feed at different protein level as well as different size (mm). All over the world, De Heus is the first in its kind that produced a diet for 7-day old fish larvae, which received a great welcome among the farmers (Fig. 2A). De Heus is a Netherland based company which established during 1911 and extended their business nearly 75 countries that have its own reputation. For its importing business to India, it is using its Vietnam outlet. Likely, Aquatic International is one of the leading fish and shrimp feed producing company in the domestic, which establishes in Chennai during 2000 and specialised in varieties of animal feed business and Joven, the juvenile fish feed (Fig. 2B) is one among them. This company have research collaboration with various countries especially importing animal nutrition technologies from Israel. These animal nutrition concerns studied the farmers requirement and produced high quality diets to increase the profit of the farmers. This article is dealing with the various aspects of West Bengal breeding techniques, hatchery development and larval nutrition.

Different Fish Hatchery Units

Different kinds of hatchery techniques are being used in West Bengal. In which, the notable techniques are being used to hatch the fish eggs in West Bengal are jar hatchery (Fig. 3A), Chinese hatchery (Fig. 3B) and hapa breeding (Fig. 3C). Considering the hatching rate among, these three techniques there won't be much difference except their handling efficiency [5, 6]. However, the jar hatchery and Chinese hatchery are required adequate water flow. The jar hatchery can be run on limited quantity of water and space. The water temperature shoots up over 32 °C during summer; hence the hatching is adversely affected in hapas. But, in jar hatcheries, the temperature is reported within the range even in summer. Also, the developing embryos can be easily observed in jar hatcheries with naked eyes, so if rectification is required, that can be attempted depending on exigencies [7, 8]. The Chinese hatchery system is functioning based on the water flow by gravity, thus eggs hatch. Its construction and operation cost is also less compared to some other system with the same production capacity. In Indian sub-continent, especially in places West Bengal, this Chinese hatchery system has been considered as a highly suitable for the production of quality fish seed [9-11].

Fig. 3A: Jar hatchery; 3B: Chinese hatchery & 3C: Earthen hapa (Courtesy: Biswas Hatchery, W. Bengal)

Breeding Techniques

The hatcheries are producing the seeds through artificial breeding techniques. In brief, the conditioned male and female fishes received breeding hormones through either intra-peritoneal or intra-muscular injection. The dosage of the breeding hormones depending on the weight of the brooders; however, at the concentration of 5-7ml/ kg fish. The breeding set was basically designed at the ratio of either 1 (Female): 3 (Male) or 1 (Female): 2 (Male). The number of male fish has been decided based on the weight of the female or its predicted fecundity rate, so that enough quantity of milt can be attained from the males to fertilize the eggs completely [12-14]. Both the eggs and milt were squeezed out

for the artificial fertilization and then, they were shifted to the respective hatchery units. The incubation period depends the species, usually it takes between 8 and 14 h.

Hatching different Freshwater Fish Species

West Bengal is the top freshwater fish seed producing state (Fig. 4). From the state, the seeds have been transported to all over India by train, road and flight [15-17]. In the West Bengal hatcheries, there are varieties of fish species has been handled for breeding purpose namely, Catla, Rohu, Mrigal, Calbasu, Bata, Silver Carp, Common Carp, Grass Carp, Japan Puti, Black Carp, Pangasius, Koi Carp, Singi, Clarias sp., and Pacu or Roopchand. There are nearly 465 freshwater fish seed hatchery units are available throughout the state, in which 13 hatchery units are belong to the Directorate of Fisheries, West Bengal. Also, there are 70 seed farms are present all-over West Bengal.

Fig. 4: Some clicks from India's biggest live fish seed market, Naihati, West Bengal

Nursery Rearing and Larval Diseases

The larvae were also reared in both cement tanks (Fig. 5A) and earthen ponds (Fig. 5B); in which, the larvae received effective water flow through in the cement tanks. During the rearing period also, the larvae affected by different disease like the grow-out individuals. The infection and disease are due to various microbial pathogen including bacteria, virus, fungus and parasites. They are infectious haematopoitic necrosis, spring viraemia of carp (SVC), viral haemorrhagic septicaemia (VHS), epizootc haematopoitic necrosis, red seabream iridoviral disease (RSID), koi herpesvirus disease (KHV), grouper iridoviral disease, viral encephalopathy and retinopathy, enteric septicaemia of catfish, *Aeromonas hydrophila* infection, *Edwardsiella tarda* infection, *Vibrio anguillarum* infection, *Falvobacterium columnare* infection, *Streptococcus iniae* infection, infectious pancreatic necrosis, *Myxobolous spp* infection, *Ichthyophthirius multifilis* infection, *Saprolegnia parasitica* infection, *Argulus* infection, infestation with *Dactylogyrus* spp., infestation with *Lernoea* spp, infestation with Coligus spp, etc [18].

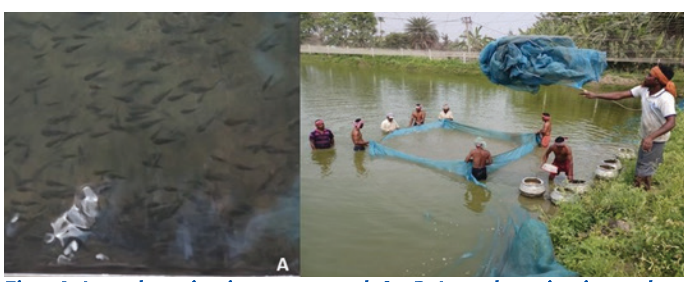

Fig. 5A: Larval rearing in cement tank & 5B: Larval rearing in earthen pond (Courtesy: Biswas Hatchery, W. Bengal)

Larval Feed

In the hatcheries, still there are people following the traditional feed preparation and providing to the larvae. The tradition feed preparation (Fig. 6) includes boiled rice, broken soybean, pea, corn, wheat, etc. Altogether, they were boiled in an iron pot and supplying to the larvae. This is a cost-effective method of feed supply, but it is questionable whether the individuals are receiving enough nutrition for their growth and survival and other metabolic and physiological function [18]. Hence, the commercial feed industries including De Heus Animal Nutrition, The Netherlands and Aquatics International, India understand the fish hatchery requirement, thus developed a special and balanced fish hatchery feeds as supplying them to the hatchery industry as reported above. There are many other companies supplying fish hatchery diet, however based on the farmers satisfaction in terms of profitability and growth and survival performances, these two feeds were considered the best in the hatchery industry.

Fig. 6: Preparation of traditional larval diet in hatchery (Courtesy: Biswas Hatchery, W. Bengal)

The feed or nutrition is not only increasing the production rate, but also helps to produce healthy and quality or disease-free aqua species. Such a complete nutritionally balanced diets from these said brands promotes the growth as well as health of aquaculture organisms, thus feed is playing a major role in the production sector of the aquaculture system. These efficient aqua feed producers mainly focused on preparation of nutritionally balanced and high-quality diet within an affordable cost.

Table 1: List of fish hatchery feed (floating feed) from companies including De Heus, The Netherlands and Joven (Aquatics International, Chennai, India)

Feed Preferred Species	Feed Size (mm)	Nutritional Composition (%)		
		Protein	Fat	Fibre
Catla, Rohu, Mrigal, Calbasu, Bata,	0.3	35 & 40	6 - 8	6
Silver Carp, Grass Carp, Japan Puti, Black Carp, Common Carp,	0.8	35 & 40	6 - 8	6
Koi Capr, Pangasuis sp., Pacu or Roopchand, Ompak, Murrels, Singi, Magur,	1.2	35 & 40	6 - 8	6
Tilapia, Red Tilpia, Sea Bass, Anabass, Notopterus	1.4	35 & 40	6 - 8	6


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Also, these complete commercial feeds from the said banners possessed a balanced nutritional composition such as protein, lipid, carbohydrate, fibre, ash, vitamins and minerals. These are the important nutritional elements of the feed which provide adequate growth and health benefits to the fish larvae. The larval feed contained the following nutritional factors: protein 35 and 40%, lipid 6-8%, fibre 6% and moisture less than 10% and of course a trace amount of vitamins and minerals. Also, these fish larval feed comes in different pellet sizes such as 0.3, 0.8, 1.2 and 1.4 mm (Table 1).

Table 2: Performance of fish larvae in West Bengal hatchery on traditional feed and commercial feed

Traditional Feed	Commercial Feed (De Heus, Netherlands & Joven, Aquatic International, India)
Non or Semi cooked feed	Completely cooked feed
Less than 60% survival	99 % survival
More mortality in Transportation	No mortality in Transportation
More fat / big belly fishes	No fat and good body shape
Unequal size of growth	Equal size of growth
More disease problem	No disease
No resistant to climate change	More resistant due to right baby nutritional feed
Attain per kg 10000 to 5000 line in 7 days	10000 to 5000 line in 4 days only
Attain per kg 5000 to 3000 line in 9 days	5000 to 3000 line in 5 days only
Attain per kg 3000 to 1000 line in 14 days	3000 to 1000 line in 8 days
Attain per kg 1000 to 500 line in 20 days	1000 to 500 line in 12 days
Ammonia accumulation in pond water	Limited amount in water
More Digestion problem	Easy assimilation and digestion
Less growth due to imbalanced nutrition	Higher growth due to balanced diet
No pellet stability and more water pollution	Floating feed supplied until satiation, so no pollution
Feed conversation very high (1:2)	Low feed conversation (1:0.7)
No Feeding protocol at larvae stage	Right Feeding protocol and feed frequency
Antibiotics usage for control diseases	No disease, No antibiotics
Only 50% profitability	92 to 98% profitability
Too much counts in per kg fish (20-25 Nos)	Less counts per kg (7-10 Nos)

It is interesting to note that these commercial feeds producing better performance in all the aspects compared to the traditional feed (Table 2). The best performances of the commercial feed in the larvae due to various beneficial reason such as i. the ingredients or raw materials in the feed are properly cooked, so no pathogenic effect, ii. The nutrition in the feed are evenly and properly distributed in the pellets, so that each and every one of the larvae receive same amount nutrition, thus lead to uniform growth, iii. the amount of necessary essential amino acids, fatty acids, vitamins and minerals present in the feed provide them strong immunity that leads 100% survival, iv. Easy assimilation and good digestibility, v. the pellets did not pollute the water and vi. The feeds are cost effective and high profitability in good number counts per kg fish. Over all, the fish hatchery farmers from West Bengal understand the beneficial effect these commercial feeds such as De Heus and Joven, thus knowing the importance of larval nutrition and changing their larval feeding protocol from traditional to commercial hatchery feeds, which is a good and progressing sign of culture practices.

Problems and Recommendations

In India, West Bengal is the potential market for freshwater fish hatcheries. Though, there are 465 hatcheries and 70 seed farms in the state, the market yet to reach its international level. Hence, frequent meetings or gathering may be recommended among the hatchery farmers for sharing knowledge and ideas. It helps the farmers to updating themselves about the industry. Also, the famers need to be educated or updated more about the breeding techniques, brood stock maintenance, larval rearing protocols, larval nutrition etc., by subject experts as well as technical experts. These experts may educate them by showing videos, photos, elaborating success story of other farmers, etc. Government bodies may take initiative for the farmers international business collaboration in terms of export and import. It is also developed direct or indirect jobs in the field, develop self-employment, socio-economic impact and more earning of foreign exchange. Another important requirement is proper drainage system for the hatcheries, thus avoid infection and produce healthy seeds for the successful culture.

Acknowledgement

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Intelligent Packaging system for Sea food products

Highlight Points

▶ Intelligent packaging provides reliable and correct information about condition and quality. ▶ Intelligent packaging enables the detection of mismanagement through the supply chain from production to ultimate consumer. ▶ Reduce food loss and waste. ▶ Enhance food quality and assurance. ▶ Enhance food safety and biosecurity.

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Introduction

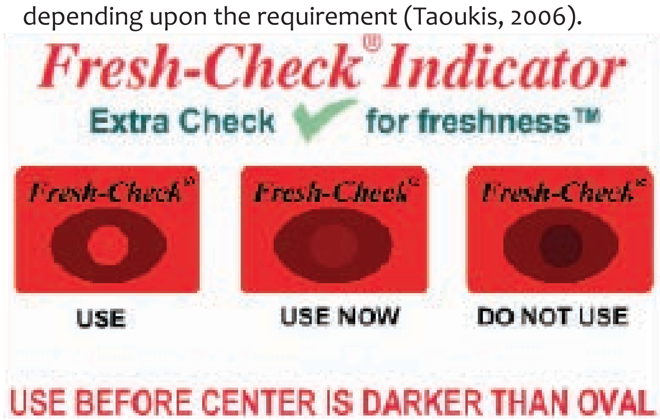
Highly perishable foods are type of food with high active biological systems and higher rates of spoilage (Van Boekel, 2009). As the fish belongs to the highly perishable food commodity, its quality changes as soon as the harvesting starts. In 2016, 88 percent of the total fish production (151 million out of 171 million tons) was utilized for direct human consumption (67 percent in the 1960s). Live, fresh or chilled fishes account for 45 percent direct human consumption, followed by frozen (31 percent), preserved (12 percent) and cured (dried, salted, in brine, fermented smoked-12 percent) FAO, 2018. Highly perishable food commodities lead to the waste of resources and economic loss if storage, processing and packaging are not done properly. Processing, storage and packaging are the most important criteria which extends the shelf life of the highly perishable food commodities. Due to the limited shelf life food processor face difficulties to ensure the quality of perishable foods. If the quality of foods can be monitored during the entire supply chain, quality assurance can be provided to the food that has reached the printed shelf life date but still has an acceptable quality (Heising et al., 2014).

Packaging prevents the foods from the external environment and has four basic functions: protection, communication, convenience, and containment (Robertson, 1993). Packaging not only contain information like, source, processing, shelf life and most importantly the nutritive value of the food, but also It communicates with the consumer like handling and use of the contained products. Packaging also improves the marketing of the product by maintain the shelf life safe delivery of the product. (Muller and Schmids, 2019). A slight change in the appearance, color and smell of the product can leads to the discard as these changes are very difficult to be assesses by the consumers and the fear of spoilage leads to the discard of the product even if the product is safe for consumption. In view of these intelligent packaging comes into act to provide the information like shelf life of the product. Otles & Yalcin (2008) defined intelligent packaging as "a packaging system that is capable of carrying out intelligent functions (such as sensing, detecting, tracing, recording and communicating) to facilitate decision making to extend shelf life, improve quality, enhance safety, provide information, and warn about possible problems". Intelligent packaging indicates about the quality status of foods and offers the possibility to take decision based on dynamically estimated shelf life, thereby reducing waste of foods (Heising et al., 2014).

An intelligent packaging consists of a continuous interaction system between the product, the package and the environment, which contains a quality indicator or sensors which indicates the quality and shelf life of the product.

Types of Intelligent packaging: In general there are three types of sensors or indicators are used for intelligent packaging (Ghaani et al., 2016):

1. **Environmental conditions:** It assesses the environmental conditions of the food or the kinetics of the quality changes, e.g. time-temperature indicators, gas leakage indicators, and relative humidity sensors. These types of indicators are placed either inside or outside the package, depending upon the requirement (Taoukis, 2006).



2. **Quality indicator compounds:** This type of sensors or indicator compounds directly assess the quality changes of the food product, e.g. biosensors and freshness sensors and indicators, measure quality-related compounds formed in the product and are good direct indicators of food quality attributes. These devices are actually placed inside the package.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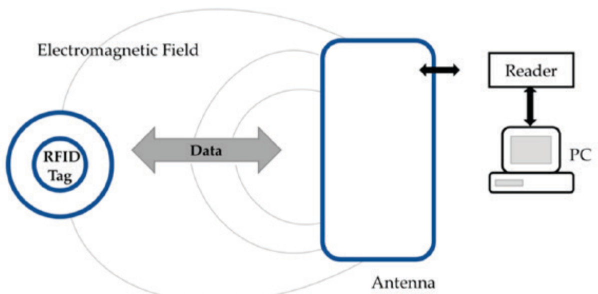
3. **Data carriers:** This type of devices is usually an information device which is used as a medium for communication between the product and the consumer, e.g. include barcode labels and radio frequency identification (RFID) tags and other product traceability, anti-theft, anticounterfeiting and tamperproof devices (Muller & schmid, 2019).



Intelligent packaging used in fishery sector: The various types of intelligent packaging are Temperature indicator, freshness indicator and sensor, leakage indicator, gas indicator, moisture regulators, antioxidant release, O_2 scavenging, CO_2 emitters and antimicrobial packaging etc. some important packaging techniques are discussed below:

1. **Temperature indicator:** A temperature indicator used to predict the remaining shelf life, of the fish product, if the initial quality of individual packages is known at the time of packaging. A time temperature indicator tag which uses a micro-chip to sense and integrate temperature over time (Yam et al., 2005).
2. **Freshness indicators and sensors:** These Sensors or indicators used for estimating the freshness of fish. The basis of these indicators is the chemical kinetics of the food; in case of fish products these are based on mainly TVA or TVB-N, which cause in the change in the pH. Use of electronic nose as a rapid method to detect volatile compounds like H_2S, NO, SO_2 and NH_3 and CO has been studied by Olafsdottir (2005).
3. **Gas Indicator:** The changes in the inside atmosphere of package are mainly based on the enzymatic or chemical reactions of the food and environmental conditions. The changes in the atmosphere due to gas generation by microorganisms or other metabolites detected by the sensor. A sensor detects and reacts to changes in the atmosphere inside the packaging, and most of the indicators monitor the oxygen and carbon dioxide concentrations.
4. **O_2-scavenger:** O_2 scavengers eliminate the oxygen inside the packaging which is left into the headspace. O_2 scavengers prevent the spoilage and rancidity problems of the sea food. It detects the discoloration of fish products, spoilage rancidity, and flavor changes. Generally it is placed inside the packaging in the form of Film, label or sachet form.
5. **CO_2-emitter:** This method is somewhat similar to modified atmosphere packaging, in which a mixture of gases is filled inside the package to inhibit the growth of microbes. The high CO_2-levels (10% to 80%) are most desirable food products like fish, shellfish and meat products which inhibit the microbial growth. The overall effect of CO_2 is to increase both the lag phase and the generation time of microbes. This type of packaging uses sodium bicarbonate, ferrous carbonate, ascorbate and citric acid as medium for CO_2 emitter etc. (Mohan & Ravishankar, 2019).
6. **Antioxidants:** These are mostly used to prevent oxidation of foods which contain high unsaturated fatty acid. Antioxidants are primarily used to extend the shelf life of the food. It is mainly used as additives in the food but also can be incorporated as films in packaging materials. Due to the health concerns of the synthetic antioxidants. Now days the natural additives like vitamin E and C and few natural extract from plants are also used.
7. **Leakage indicator:** Due to the long term storage of the packaged product the atmospheric gases (mainly O_2 or CO_2) changes due to activities of the food, like chemical or enzymatic reaction which leads to the puffiness and leakage in the packaged products. The main concept behind leakage indicator is the change in the colour of the dye placed inside the packaging, as these dyes are sensitive to the change in the chemical or any enzymatic reaction. Any changes in the atmosphere inside the package (gases like O_2 or CO_2) are detected by the dyes.
8. **Moisture regulator:** Fish belongs to the wet food commodity where the moisture content is very high. If proper care is not token during packaging it leads to the spoilage of the product. To control the moisture in the packaging of fish products, high barrier film material with good water vapour permeability. This types of system uses material which is efficient moisture scavenger, such as silica gel, molecular sieves, natural clays, calcium oxide, calcium chloride and modified starch etc. (Mohan & Ravishankar, 2019).
9. **Antimicrobial packaging:** To inhibit the growth of microorganisms antimicrobial such as alcohol, chelators, polysaccharides, acid anhydride, enzymes, organic acids etc. are applied in the form of film to the packaging material. The principle behind antimicrobial agent is release of antimicrobials into the food which extends the lag phase and reduces the growth phase of microorganisms, which extends the shelf life of food. Antimicrobial agents may be coated or incorporated into the packing materials.

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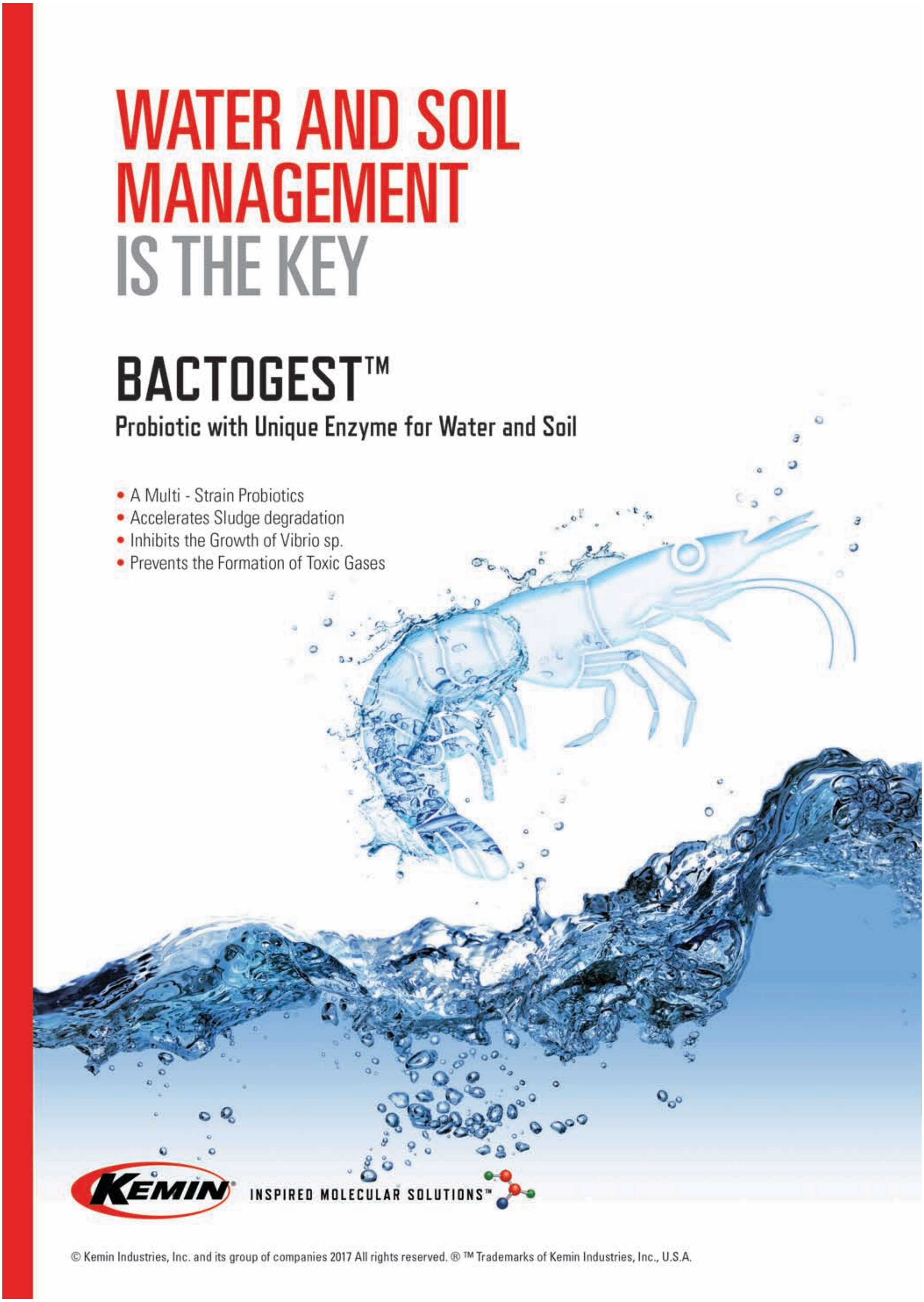
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Stress in aquaculture: a rough guide

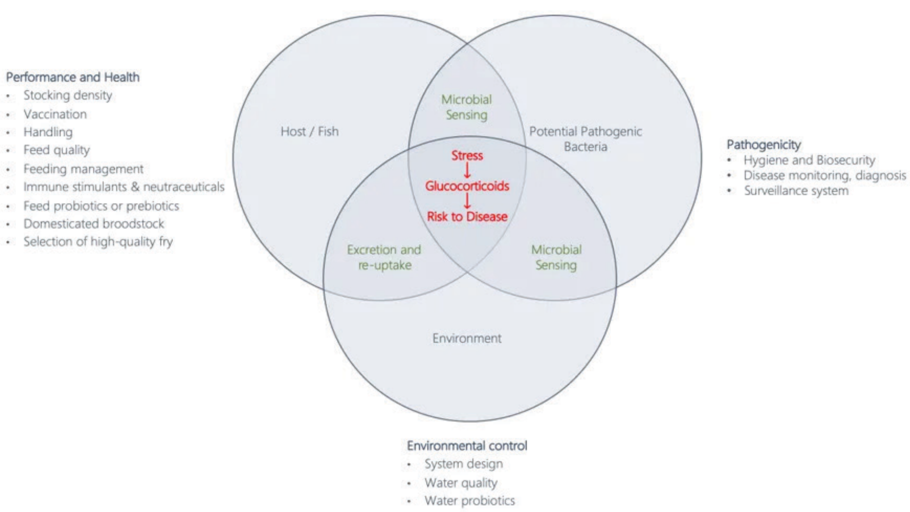
Professor Johan Aerts

Professor Johan Aerts, Head of the Stress Physiology Research Group (StressChron), explains why reducing stress in farmed fish is an essential way to optimise aquaculture sustainability.

For four decades, aquaculture has been the fastest growing animal production sector worldwide and its importance to secure future global food security is well recognised. Fish promote human health and their production has the potential to become highly sustainable. Consumers, in particular in northern Europe, have become more and more critical about fish quality, fish welfare, and the negative effects of the aquaculture production sector on the environment. In the last decade, welfare aspects such as the impacts of chronic stress have gained interest.

A primary concern for a healthy product and a sustainable production process are infectious diseases, which - both directly and indirectly - account for losses of up to 30 percent of the total aquaculture production worldwide. Compared to the husbandry of poultry, pigs and cattle, there are only a limited number of practical, cost-effective and approved therapeutic methods for effective disease treatment in aquaculture. As a result the potential spread of diseases from aquaculture sites and the negative effects of commonly used chemical products which could end up in the environment are a real concern with respect to wild fish populations. Subsequently, disease prevention is one of the most critical elements for successful aquaculture production.

Effective preventive measures applied at the farm level include the use of probiotics (using beneficial living bacteria as feed ingredients or in the culture water), biosecurity measures and, for a limited number of diseases, vaccination. On a national level, monitoring for potential pathogens in a disease surveillance and control system are ongoing.



The actual development and the risk of a disease outbreak is the result of a complex interaction between the host, the environment and the pathogens (Figure 1).

Figure 1. The interaction between the host, (potential) pathogens and the environment (adjusted from Snieszko, 1974) shows that stress-induced higher glucocorticoid levels increase the risk of diseases, hereby affecting various actors represented by the area of the overlapping circles. Some major factors relevant in (chronic) stress reduction are listed for each of these areas

As a consequence, effectively reducing the risk of disease outbreak requires stress reduction in an integrated, multidisciplinary approach at all levels of the production cycle as, during production, fish are subjected to a range of different husbandry practices that may cause chronic stress to the animals – resulting in increased glucocorticoid levels, which render the fish more susceptible to disease. Stressors include, but are not limited to, stocking density, water quality, system design and handling processes such as grading, sampling and transportation.

In such stressful situations, fish launch an endocrine stress response. Catecholamines are released within seconds and glucocorticoids (in particular cortisol or corticosterone depending on the species) within minutes into the plasma. Glucocorticoids are widely used and accepted as biomarker for stress quantification across vertebrates, as they mediate a redistribution of energy in order to restore pre-stress conditions. However, failure to regain homeostasis inevitably leads to chronic stress, making the individual prone to the detrimental effects of glucocorticoid mediated actions (ie decreased growth, decreased reproduction, immune suppression, increased mortality). These detrimental effects from long-term cortisol release are acknowledged across vertebrates. In teleost fish it is also shown that exogenous glucocorticoids in the water trigger similar effects when taken up through the gills or the intestine. As such, fish performance and welfare are affected throughout the life cycle.

So, stress – in particular chronic stress – cannot be ignored when striving for sustainable production. As a result, monitoring and subsequent mitigation of chronic stress levels in order to prevent fish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becoming more susceptible to disease will become pivotal for the sector in the years to come.

Measuring stress

The success of sustainable aquaculture development is also highly dependent on closing the reproductive cycle of fish. Critical stages vary per species but generally include broodstock maturation, first feeding of larvae, controlled juvenile rearing and a predictable grow-out production (Figure 2). Understanding and optimising the stress response by quantification of the stress level at all stages in the production cycle will support disease prevention and improve production performance and efficiency.

of the production cycle – using a single egg, a single larva or fish scales in juvenile and adult fish – is of importance to various sectors in the aquaculture industry. These include, but are not limited to, the production of feed (testing and optimisation of levels and time point of administration of feed constituents), testing and optimisation of probiotics and vaccines, optimisation of aquaculture practices, prevention of disease, reproduction and larval rearing. Furthermore, healthy products produced in a chronic stress-free environment score high for fish welfare in certification standards.

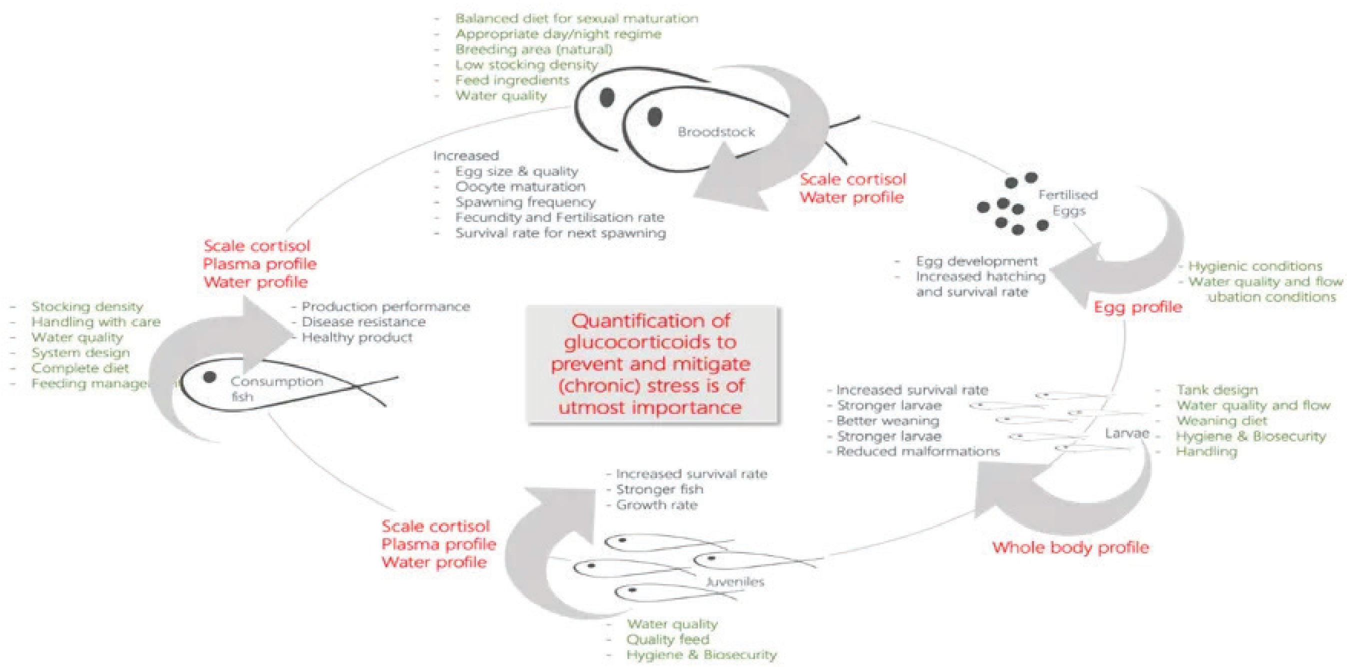


Figure 2. Diagram of the fish production cycle, indicating major management practices (in green), the tissues used to quantify glucocorticoids by the Stress Physiology Research Group (StressChron) (in red) and some of the positive effects encountered after stress mitigation through effective management strategies throughout the complete production cycle (in blue)

Consequently it is important to recognise that periods of increased stress levels (and sub-clinical disease challenge) in the early life stages of fish affect life-long productivity, as the best conditions for broodstock maturation will result in high quality eggs and stronger larvae, subsequently reducing larval mortalities, resulting in stronger juveniles and healthier fish for the consumer.

Conclusion

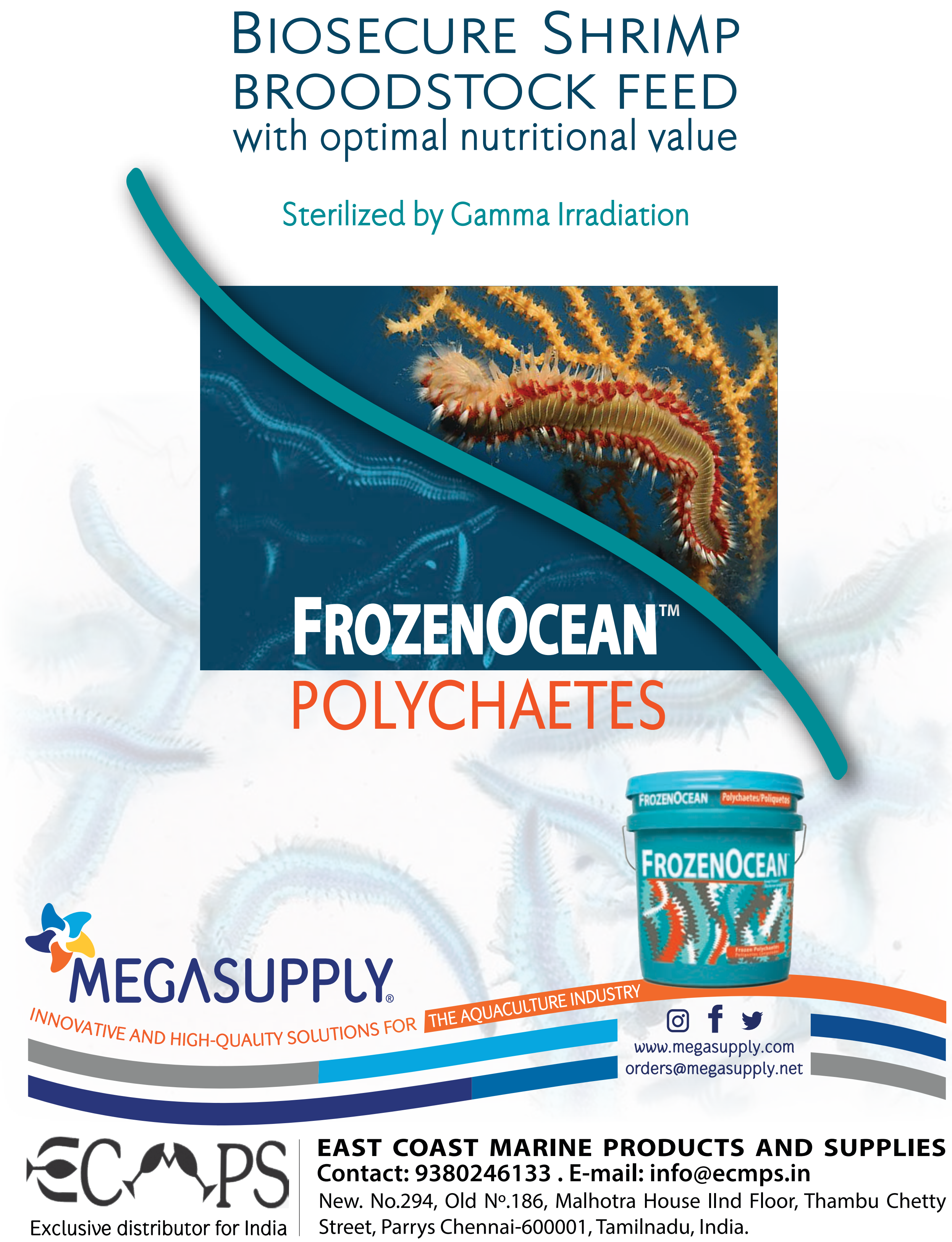
A variety of potential stressfull stimuli will always be present in aquaculture production. However, preventing chronic stress in commonly encountered aquaculture practices and optimising the stress resilience of the fish to these practices are of utmost importance to make aquaculture more sustainable.

Monitoring chronic stress throughout the different stages

About StressChron

StressChron focuses on the neuro-endocrinological and, in particular, physiological research into stress across vertebrates – ranging from fish to humans. One of its key areas of investigation is into the role of glucocorticoids as biomarkers for acute and chronic stress. In this framework, StressChron works according to the criteria of the international standard 5S (Methodology for lab management), ISO 17025 (General requirements for the competence of testing and calibration laboratories), ISO 14001 (environmental management), and ISO 45001 (safety management) in order to guarantee the quality of all results. We provide a full package on stress (acute and chronic) related parameters across vertebrates in our laboratories for mass spectrometry, biochemical, morphometric and molecular analysis, respectively. Glucocorticoid profiling in whole body of a single fish larva, in tank water or in scales as biomarker for chronic stress in fish are just some of the validated (and patented) methods available for the aquaculture industry in the state-of-the-art research facilities in the Science Park of Ghent University. As well as stress quantification, the department helps in translating the results towards a more sustainable and animal-friendly production.

Courtesy: The Fish Site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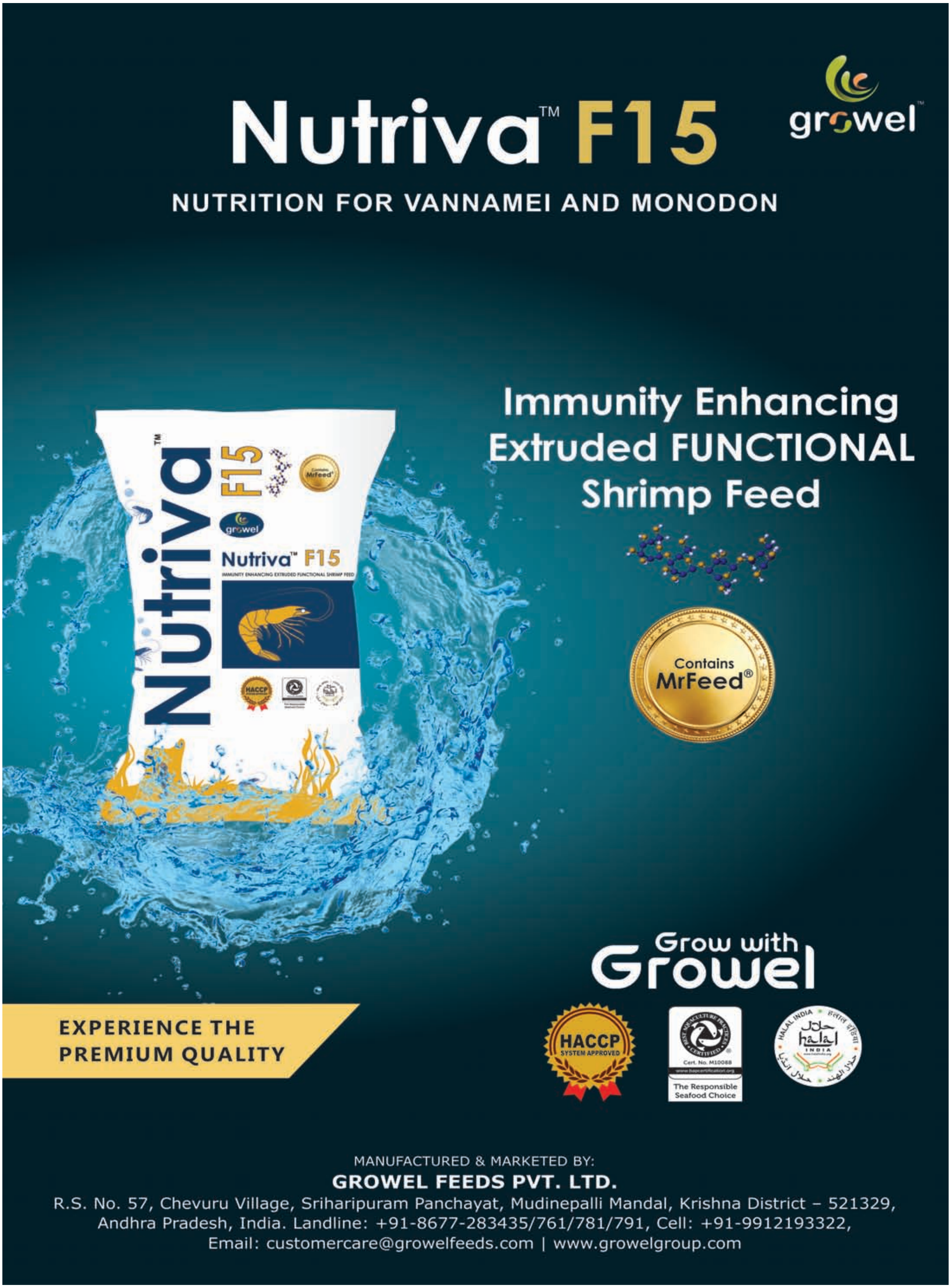

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