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Inside...

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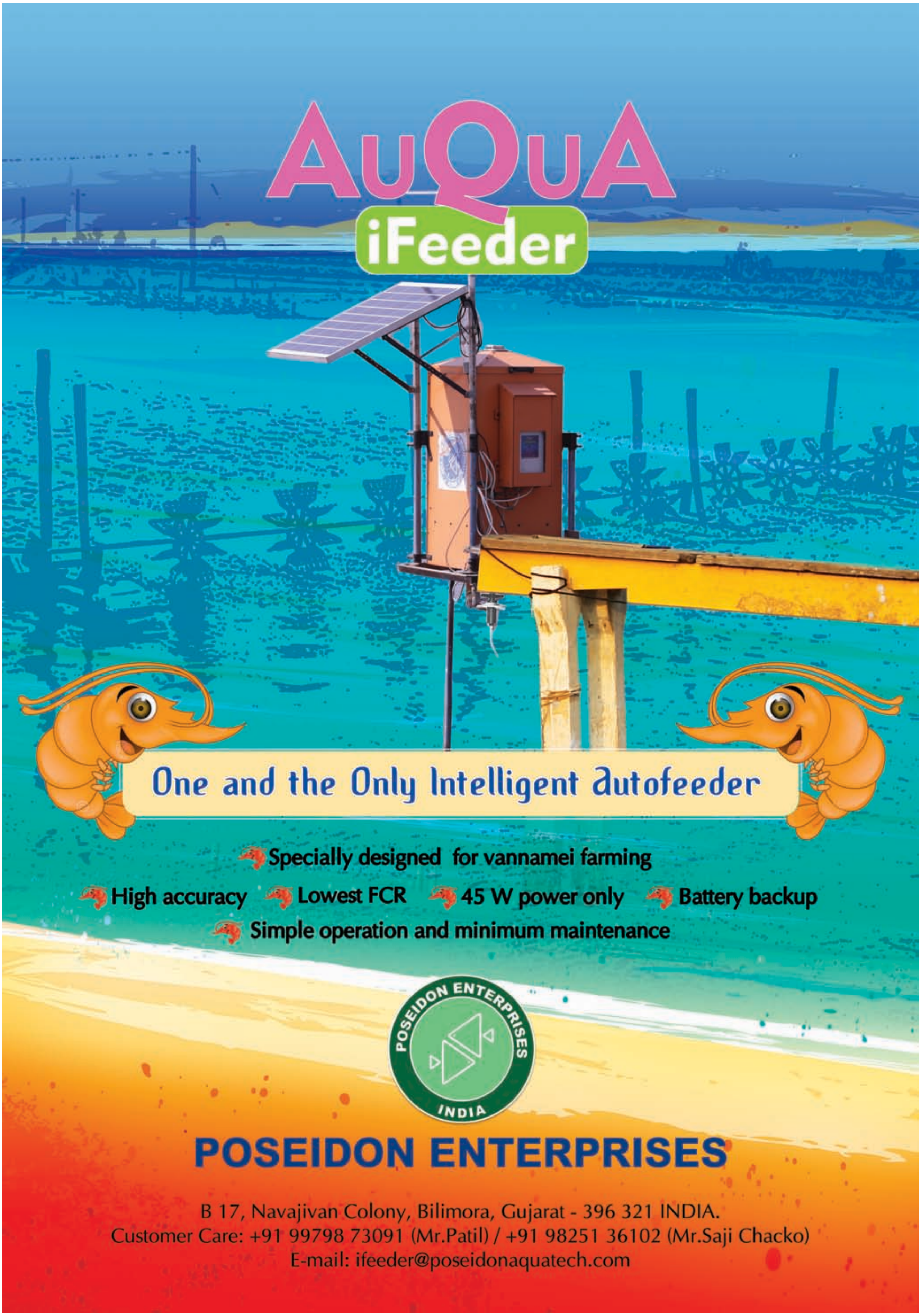
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From the Editor...

China, the largest producer of Tilapa - Washington to impose tariffs on its imports from Beijing

Dear Readers,

The October 2019 issue of ***Aqua International*** is in your hands.

In the News section, you may find news about, India can cash in on Washington's decision to impose tariffs on tilapia imports from Beijing, replacing its northern neighbour as an alternative supplier of the world's fourth most-consumed fish species that generates $13 billion in global sales annually. China is currently the largest producer of tilapia with 1.6 million tonnes of global output of 6 million tonnes. It is also the biggest supplier of tilapia to the US.

In a major attempt to protect coastal wetlands in the wake of climate crisis, a mobile app has been developed to collect the complete datasets on smaller wetlands across the coastal region of the country. The app was developed by the Space Applications Centre (SAC) of the ISRO upon the request of the Central Marine Fisheries Research Institute (CMFRI) in line with a memorandum of understanding between them.

The Rajiv Gandhi Centre for Aquaculture (RGCA) has developed a live feed that can help in reducing India's dependence on imports from China and the US. Artemia, the main live feed for shrimp as well as fish hatcheries, has been introduced by RGCA, which is the research wing of the Marine Products Export Development Authority, popularly known as MPEDA, under the brand name 'Pearl'.

The Union Minister of Fisheries, Animal Husbandry & Dairying Mr Giriraj Singh said that the Union Government will invest Rs 25,000 crores in the next five years to enhance infrastructure and boost production of fishes in India. The minister released the Handbook on Fisheries Statistics - 2018, published by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India. The Handbook on Fisheries Statistics - 2018 is the 13th edition which presents useful statistical information for various aspects of Fisheries sector. The last (12th edition of) Handbook was published in 2014.

India built an enormous shrimp exporting industry when it started vannamei shrimp farming a decade ago. The country could be set to emulate that success with pangasius and tilapia.

Bihar, the poorest state of India, has some of the best conditions on earth for aquaculture. The Ganges River, which extends for 1,569 miles (2,525 kilometers) from the Himalayas to the Bay of Bengal, splits the state in two and creates the so-called Gangetic plains with ideal conditions for pangasius aquaculture. Several other states across northern India are highly prospective for pangasius farming.

In the Article Section, article titled "Status and situation of marine fisheries in India" by Nitin K. Suyani, Mridula Rajesh and S. S. Rathore, discussed about India stands at sixth position with regard to marine fish production in the world. Total marine fish landings of India increased from 2.88 MT to 3.49 MT in the last 12 years registering a growth of 21.1 %. Gujarat stands first in marine fish landings for the Sixth consecutive year. Pelagic fishery dominated in the marine landings with Indian Mackerel contributing the maximum share. Industrial fishing, pollution, destruction of breeding sites like mangroves and poor governance are major stressors impacting marine fishermen. Implementation of strict government laws and awareness programs by involving stakeholders can only way to solve the problems of marine fisheries.

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 industry. Keep reading the magazine regularly and update yourself. Wish you all fruitful results in your efforts.

M.A.Nazeer
Editor & Publisher
Aqua International

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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CMFRI warns of dwindling catch of sharks, suggests self-imposed measures for conservation

Dr P.U. Zacharia speaking at the stakeholders workshop held by CMFRI on conservation and trade of sharks.

Kochi: Scientists of the Central Marine Fisheries Research Institute (CMFRI) have warned of a dwindling catch of sharks compared to previous years and suggested that self-imposed measures are required to conserve this threatened fish group. The production of elasmobranchs (sharks and rays) is experiencing a sharp fall while analysing the catch data of the last 20 years, they said.

They were speaking at a stakeholders workshop on conservation and trade of sharks held by CMFRI. Lack of regulatory measures and overfishing may even lead to the extinction of some shark stocks, said Dr P U Zacharia, Head of the Demersal Fisheries Division of the CMFRI. Hence, it is high time the stakeholders gave thrust to conserve these species, he said.

"However, unlike some other countries India has a good model of shark fishing that no practice of fishing for the lone purpose of shark fins is existing in the country. The meat and other parts of sharks except fins have huge demand within the country", he said, adding that CMFRI submitted a National Plan of Action on Sharks to the Centre regarding the management of the sharks.

Fishermen and those involving in the shark trade attended the workshop. During the discussion, representatives of the shark traders asked to lift the ban of exporting shark fins flagging the concern that the fishermen community and traders were suffering a huge financial loss by abandoning the fins due to the ban. "The fin has a huge demand in overseas markets, and neighbouring countries including Sri Lanka exports it. India loses a good amount of foreign currency in this regard", they said.

"Moreover, the dwindling return from the fishing activity, fishermen are moving away from the occupation and younger generation are no longer fascinated to the profession", they added. The representatives of Thothoor fishermen said the government failed to support them during the time natural disasters.

The workshop was part of a collaborative research project of the CMFRI and the FAO of the UN. The workshop was also aimed to create awareness among the stakeholders about the suggestions of the recently concluded CMFRI-FAO joint global meet on shark trade.

Dr T M Najmudeen, Principal Scientist, B Hamza, M Majeed and Dr Rekha J Nair spoke during the workshop.

Aquaculture, a vehicle for rural development: Venkaiah Naidu

Naidu said it was a fact that globally, aquaculture was being looked upon as the best alternative to boost fish production, as the production from the traditional sector had been stagnating

Hyderabad: Vice-President M.Venkaiah Naidu recently said it was a matter of great concern that India was able to exploit only a fraction of the aquaculture potential that was available in the country, and called for a boost to fish production in the country to ensure food security for the billion-strong population.

Inaugurating the 5th Aqua Aquaria India, an International aquaculture show, organised by the Marine Products Export Development Authority (MPEDA) here, Naidu said it was a fact that globally, aquaculture was being looked upon as the best alternative to boost fish production, as the production from the traditional sector had been stagnating.

"India utilises only about 40 per cent of the available 2.36 million hectare of ponds and tanks for freshwater aquaculture and about 15 per cent of

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Dr Shinn speaks on fish parasites at Aqua Show 2019

Dr Andy Shinn makng presentation

Highlighted as 'Eastern India's Biggest Integrated Techno-Commercial Expo for Aquaculture and Fisheries', the Aqua Show 2019 was organized at West Bengal University of Animal and Fishery Sciences (WBUAFS), Kolkata during September 19-21, 2019. This 3-days Expo along with technical discussion (lecture) sessions was organized by Aqua Farm India (publisher of Indian Poultry Review) and Aqua Vet Consulting LLP (a leading aqua-consulting firm), Kolkata in association with WBUAFS; Department of Fisheries, Govt of WB and US Soya bean Export Council (USSEC; Knowledge Partner). Eastern India is an important production and consumption centre of different commercially-important finfishes and shellfishes; this programme aimed to expose visiting aqua farmers from different parts of WB and other eastern and NE states to latest developments in the field of aquaculture and to bridge the gap between professional aqua farmers, buyers and suppliers of different aquaculture products, academia and industry professionals.

In addition to beautifully set-up exhibition stalls in indoor hall where different reputed companies exhibited their high-quality aquaculture products, the Knowledge Conclave was organized concurrently at Vivek Bhaban of WBUAFS. On the first two days, eminent persons like Mr Tarun Shridhar IAS, Former Secretary, DADF, Govt of India; Dr B. K. Das, Director, ICAR-CIFRI, Barrackpore; Dr S. N. Biswas, Retd. Joint Director of Fisheries, WB; Dr B. K. Chand, Dy. Director (Research), WBUAFS; Dr Y. Basavaraju, Former Dean, Mangalore Fisheries College; Prof. M. M. Rahaman, Dept of Fisheries Biology and Genetics, Bangladesh Agricultural University; Dr M. K. Das, Retd. Principal Scientist (PS), ICAR-CIFRI; Sri Umakanth R., Scientist, USSEC and Dr B. K. Mahapatra, PS, ICAR-CIFE Kolkata Centre made scientific presentations on important topics pertaining to aquaculture and fisheries and interacted with participants. On third day, Dr A. Shinn, Senior Scientist, Fish Vet Group Asia Ltd., Thailand and fish parasite specialist spoke on 'Treatment considerations in aquaculture: Does history inform our future?'.

Dr Shinn discussed about Chinese and Egyptian culture of fish farming long back, Streptococcus sp infection in Tilapia and related symptoms (fluid deposition in abdomen); establishment of fish parasites in a different environment along with fishes as we have brought (moved) them as alien species to new place for trade; some fish farmers using anti-parasitic drugs non-judiciously and building up of resistance; introduction of stellate sturgeon in Aral Sea leading to establishment of parasite Nitzschia sp and devastation of endemic population of sturgeon; features of fish parasites Aphanomyces invadans, Gyrodactylus salaris, Ergasilus sieboldi, Schyzocotyle acheilognathi (tapeworm infection heavily blocking gut of carps); unprocessed and uncooked marine trash fishes as source of parasites and infection when fed to growing fish stock under culture. Before treating a parasite, we should identify it, have clear understanding of its life cycle, we must help fish farmers to resolve the parasite-infected situation and help to prevent losses.

Dr Shinn also spoke about happenings from misdiagnosis and inaccurate identification; careful consideration of each situation in farms; consideration of fish biomass in ponds, water quality, gill condition while treating parasites; vertically-placed floating PVC pipes or smooth bamboo used to destroy eggs of fish parasites deposited over it by turning it upside down and drying in sun once in 3-4 days; infected snails serving as intermediate host for parasites; Digenea Diplostomum sp inside snail body; removing pond vegetation; bath and in-feed treatments for parasitic infection; decision about right regime of treatment; reducing organic loading and managing water quality to eradicate Epistylis sp and Apiosoma sp; a single Ichthyophthirius sp can produce hundreds of infective stages and features of white spot disease; no harm caused in salmon industry by tapeworm Eubothrium sp; infection of parasite Diplectanum aequans in gill filaments of sea bass Dicentrarchus labrax.

Dr Shinn stated that Trichodina sp and Gyrodactylus sp causes heavy loss in aquaculture farms. He described the link between application of formalin to kill parasites, biomass in pond and oxygen depletion, it should be applied in varied dosage depending on water hardness, DO; fish gill condition, organic loading. Potassium permanganate should not be used with formalin; NaCl solution may be used first and


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formalin thereafter to treat fish parasites in gills. Parasites can switch host very quickly (like different species of Gyrodactylus). He spoke about importance of strict biosecurity measures in farms, tight quarantining system for new stock, fish health surveillance (screening) on regular basis for parasite control; emergence of Enterocytozoon hepatopenaei in shrimp intestine in commercial farms; judicious use of chemicals Trichlorfon and malachite green. In the end, he stated that we can become strong in sustaining aquaculture industry via cooperation between progressive aquafarmers, scientists and sharing knowledge. He interacted with fish farmers about identification and knowing the presence of internal parasites in cultivable freshwater fishes.

In the end, Dr M. Chowdhury, Asst. Professor, Dept of Food Science and Nutrition, Assam Agricultural University made a presentation on 'Fish nutrition: a boon to human health'. News communicator Subrato Ghosh was present on the last day of Aqua Show 2019.

Acewin Agriteck plansto raise ₹ 300 Cr

Acewin Agriteck Ltd, a listed company that is into software and aqua culture trading, plans to raise nearly ₹300 crore through equity or debt or a mix of both to fund an integrated project for aquaculture and agriculture farming and processing.

The project planned on nearly 300 acres at Ponneri in North Chennai will have freshwater fish; prawn farming and processing; fruits and vegetable farming; poultry and goat farming and dairy farming. The project is expected to be launched next year, said Jesudas Premkumar, Managing Director, Acewin Agriteck, which reported revenue of nearly ₹22 crore last financial year.

At present, the promoters hold nearly 70 per cent of shares in the company, and the balance is with the public. The company will dilute dilute promoters' without giving up the majority. "We have just started talks with potential investors," he told newspersons.

The company plans to take on lease an existing hatchery with a capacity to produce annually nearly 750 million prawn and fish seeds, he said.

India looks to cast its net wider as China's fish exports face US curbs

China is currently the largest producer of tilapia, with 1.6 million tonnes of the global output of 6 million tonnes. It is also the biggest supplier of tilapia to the US.

KOCHI: India can cash in on Washington's decision to impose tariffs on tilapia imports from Beijing, replacing its northern neighbour as an alternative supplier of the world's fourth most-consumed fish species that generates $13 billion in global sales annually.

China is currently the largest producer of tilapia, with 1.6 million tonnes of the global output of 6 million tonnes. It is also the biggest supplier of tilapia to the US.

"The Trump government has imposed 30% tariffs on tilapia imported from China," said aquaculture expert Kevin Fitzsimmons.

The tariffs may lead the US, which imports 6 lakh tonnes of tilapia annually, to increase purchases from other suppliers in Asia and Latin America. Besides, Chinese production is also hit by problems. "China's tilapia cultivation is concentrated in Guangdong and Hainan provinces where it is facing labour, land and environmental issues," Fitzsimmons told ET on the sidelines of Aqua Aquaria, the aquaculture event organised by Marine Products Export Development Authority.

He is a professor of the department of soil, water and environmental science of the University of Arizona, and team leader with Myanmar Sustainable Aquaculture Programme. Rich in proteins and omega-3 fats, tilapia fetches a good price of $6.5 per kg, he said. The US market has different sectors that can absorb fresh and frozen tilapia.

"There are Asian-style restaurants that consume live tilapia sourced from the US. Fresh tilapia fillet goes to grocery stores while frozen ones are bought by hyper markets and lower-end restaurants," Fitzsimmons said.

India is currently the largest shrimp exporter to the US but its tilapia production is a meagre 20,000 tonnes annually. Bangladesh and Myanmar are among the big producers while India's other neighbours Pakistan and Nepal have rapidly growing tilapia production hubs.

According to Fitzsimmons, as India shares the same climatic and geographic characteristics and has sufficient water and land resources, it could enhance the distribution of stocks of genetically improved farmed tilapia (GIFT).

The country should adopt polyculture in tilapia farming by integrating it with carps and shrimps and grow the fish in ponds, cage farms, reservoirs, and irrigation canals to increase output, he said. "India can double the production in the next three years, " Fitzsimmons said. The tilapia skin is used to make several by-products including, caps, belts and wallets, he said.


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CMFRI teams up with ISRO to collect wetlands data

CMFRI Director Dr A Gopalakrishnan checking the provisions in the newly developed mobile app to collect data of wetland.

Kochi: In a major attempt to protect coastal wetlands in the wake of climate crisis, a mobile app has been developed to collect the complete datasets on smaller wetlands across the coastal region of the country. The app was developed by the Space Applications Centre (SAC) of the ISRO upon the request of the Central Marine Fisheries Research Institute (CMFRI) in line with a memorandum of understanding between them.

The mobile app is aimed to generate a centralised digital database of the smaller wetlands (2.2 ha) across the country. Such smaller wetlands cover an area of more than five lakh hectares across the country, while Kerala having as many as 2592 smaller wetlands.The app will be used to collect field level data of the wetlands that include geospatial profile, size, water and soil quality, farmed species, pollution status, illegal construction and other biodiversity specialities.

"The concept is to integrate field-level regional wetland data to geospatial datasets so as to enable comprehensive monitoring system in the wake of climate change and wetland vulnerabilities", said CMFRI Director Dr AGopalakrishnan during the launch of the mobile app on Monday. The app could become a game changer towards national wetland resilience through by bridging the gap between satellite and ground data, he said. "Continuous monitoring will help provide village-level real time advisories for aqua-farmers and alerts on climatic phenomenon in the future", he said.

He also said that the climate related events such as floods and runoffs have changed the physio-chemical profile of several wetlands. "Many fish farmers and fishermen suffered economic loss due to washing away of cages, salinity changes in aquafarms, coastal ecosystem changes and so on. A digital common platform on health status of wetlands of the country may easily help to understand such vulnerable regions", Dr Gopalakrishnan said.

The initiative of monitoring the wetlands is carried out by the National Innovations in Climate Resilient Agriculture (NICRA) project wing of the CMFRI. Thedata collection using the mobile app will be done by registered researchers, farmers and stakeholders while the experts associated with the task will validate the data and will be stored in the central database.

Researchers collecting data on a wetland in Puthuveypu using newly developed mobile app.

Integration of aquaculture in regional wetlands could be made possible with a complete digital data set of the resources in the country, said Dr P U Zacharia, Principal Investigator of NICRA project of CMFRI.

The field-level data collection using the mobile app was also launched on Monday in Puthuveypu. Dr A P Dineshbabu, Dr P Kaladharan and Dr T V Sathianandan spoke on the occasion.


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RGCA develops 'Live Feed' for Shrimp & Ornamental Fishes

The Rajiv Gandhi Centre for Aquaculture (RGCA) has developed a live feed that can help in reducing India's dependence on imports from China and the US.

Artemia, the main live feed for shrimp as well as fish hatcheries, has been introduced by RGCA, which is the research wing of the Marine Products Export Development Agency, popularly known as MPEDA, under the brand name 'Pearl'.

Developed under the Make in India programme, the live feed was launched by Indian Vice President M. Venkaiah Naidu at the 5th edition of MPEDA's Aqua Aquaria India (AAI) held in Hyderabad. MPEDA Chairman M K S Srinivas said that "India at present imports around 300 tonnes of Artemia in dried cyst form worth Rs. 300 crore per annum, mainly from China and USA. It is an essential consumable in shrimp & fish hatcheries for the larvae of farmed aquatic organisms".

He further added "Artemia appears only in waters of high salinity. There is a huge potential for artemia live feed in India and its operations can be expanded on a big scale in states like Gujarat and Maharashtra".

It is important to mention that India is looking to increase its seafood exports from $ 7 billion to $ 15 billion till 2024 via introduction of new varieties & expansion of aquaculture cultivation to new regions.

The chairman further said, "Our indigenous artemia Pearl brand is a big step in realizing this ambitious goal".

Dr. S. Kandan, project director, MPEDA-RGCA said, "The University of Kent in Belgium, the authority to test artemia, has certified our product as the best of its kind in the world. "

The cost of imported brands of artemia costs around Rs 5,300 for 450 grams in our country while the Pearl brand artemia developed indigenously is priced much lower at Rs 3,500 (450 grams). He pointed out that "The cost can be brought down further once the production increases".

Aquaculture, a vehicle for rural development: Venkaiah Naidu

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the total potential brackish water resource of 1.2 million hectare. In other words, there is room for both horizontal and vertical expansion of these sectors," the Vice President said.

Pointing out that there was immense potential for development of mariculture which had taken roots only in recent years with culture of mussels and oysters, he said considering the substantial contribution aquaculture makes towards socio-economic development in terms of income and employment through the use of unutilised and underutilised resources in several regions of the country, environmental-friendly aquaculture has been accepted as a vehicle for rural development, food and nutritional security for the rural masses.

The systems of culture at present being adopted by Indian freshwater aquaculturists give yields varying from 1.5 tonnes to 4.5 tonnes per hectare per year, he said, adding that this productivity was much less in comparison with 10-15 tonnes per hectare per year in countries like China and Israel.

"In our country, intensive fish culture with a production of 10-15 tonnes has been carried out only on an experimental basis and its commercial adoption is still a dream, Naidu said.

Government to Invest 25,000 Crores in next 5 years for Fisheries Development:

Union Minister of Fisheries, Animal Husbandry & Dairying

Giriraj Singh, the Union Minister of Fisheries, Animal Husbandry & Dairying, GoI

Addressing the media, the Union Minister of Fisheries, Animal Husbandry & Dairying Giriraj Singh said that the Union Government will invest 25,000 crores in the next five years to enhance infrastructure and boost production of fishes in India. The minister released the Handbook on Fisheries Statistics - 2018, published by the Department of Fisheries of Ministry of Fisheries, Animal Husbandry & Dairying, Government of India. The Handbook on Fisheries Statistics - 2018 is the 13th edition which presents useful statistical information for various aspects of Fisheries sector. The last (12th edition of) Handbook was published in 2014.

He said that Prime Minister Narendra Modi has given the due importance to this sector by creating a separate Ministry for it. Singh said that Fisheries sector will play a crucial role in the doubling of farmers' income. He further said that the Ministry will strive to further increase this 14% growth rate in inland fisheries and are working towards creating more awareness among the State governments and the people.

The latest edition provides information on year wise fish production (Marine & Inland) from 1990-91 to 2017-18, trend of fisheries exports, fisheries resources, fishing craft, pattern of per capita fish consumption in different States/UTs, Grass Value Addition (GVA) from fisheries sector and its contribution to total GVA of the Country, fisheries institutes, fishermen population and various schemes implemented for sustained and responsible development of fisheries sector.

The Fisheries sector is major source of livelihood for over 1.60 Crore people along with double the number in down and upstream. Development of fisheries can ensure nutritional security, food security of India and also provide employment in these regions that are predominately inhabited by rural populace.

The total fish production of 12.59 million metric tonnes was registered during 2017-18 with a contribution of 8.90 million metric tonnes from inland sector and 3.69 million metric tonnes from marine sector. The average growth in fish production during 2017-18 stands at 10.14% when compared to 2016-17 (11.43 million metric tonnes). This is mainly due to 14.05% growth in Inland fisheries when compared to 2016-17 (7.80 million metric tonnes). India is currently world's second largest producers of fish. It is also world number two in aquaculture production as well as in inland capture fisheries.

The percentage contribution of inland fish production in the total fish production of 29% during the year 1950-51 and has increased to 71% in the year 2017-18. Andhra Pradesh has recorded the highest production of inland fish (34.50 lakh tones) whereas Gujarat is the leading state in Marine fish (7.01 Lakh tonnes) in the country. Total registered fishing vessels and fishing crafts in coastal States/UTs was 2, 69, 047 as on 31.07.2019.

There has been steady growth in the export of fish and fish products over the period. Efforts are being made to boost the export potential through diversification of products for export. During 2017-18 the volume of fish and fish products exported was 13,77,243.70 tonnes worth Rs 45,106.90 crore. The export of Marine Fish products has registered growth of 21.35% (Quantity) and 19.11 % (Value) during the year 2017-18.

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India's pangasius industry next aquaculture segment poised for explosive growth

India built an enormous shrimp exporting industry when it started vannamei shrimp farming a decade ago. The country could be set to emulate that success with pangasius and tilapia.

Bihar, the poorest state of India, has some of the best conditions on earth for aquaculture. The Ganges River, which extends for 1,569 miles (2,525 kilometers) from the Himalayas to the Bay of Bengal, splits the state in two and creates the so-called Gangetic plains with ideal conditions for pangasius aquaculture. Several other states across northern India are highly prospective for pangasius farming.

Bihar's output could rise tenfold in the next two years as farmers switch to this new species from native forms of carp and other types of catfish, according to Rishikesh Kashyap, who heads Cooperative Fisheries Federation (COFFED), a Bihari fishing association. Farmers like pangasius because it can be grown in a shorter period of time and has better survival rates than carp, he said.

"This is the highest income generating aquaculture so it's only going to attract more interest," Kashyap told Undercurrent News. "This is the cheapest source of protein and it will reduce the hunger problem in the world."

Pangasius can grow to 800g in weight after only 140 days from fingerling size and withstands pond-borne diseases better than other fish, Kashyap said.

Carp, a popular Indian fish, takes more than two years to grow to a similar harvest weight when grown with traditional farming methods. It's a no brainer for most farmers, said aquaculture consultant Paramveer Singh.

A retail store for West Coast's Cambay Tiger brand in Mumbai. A worker prepares pangasius fillets.

Pangasius culture only recently became part of India's aquaculture industry.

Andhra Pradesh, the top producer state in India, started farming in the past decade as wealthy consumers grew an appetite for the fish after tasting imported Vietnamese product.

Andhra produced about 80% of India's pangasius output in 2017. This share fell to about 60% in 2018 as Andhra farmers grew more shrimp, and as farming of pangasius started to grow in northern states including Bihar, Tripura, Uttar Pradesh and West Bengal. One constraint is to further growth is the lack of large, professional players in the fingerlings busines s, Kashyap said.

Pangasius compares favorably with other protein prices in India. Farm prices for whole live pangasius increased to INR 74 per kilogram in 2018, compared with INR 61/kg in 2017, according to industry sources. This year, the whole fish prices increased further, enhancing the attractiveness of pangasius versus carp farming.

Carp trades at INR 100, but the fish takes eight months to grow when fed with commercial fish feed, instead of five for pangasius, Singh said. Carp also has inferior survival rate at 70%-80%, versus 90%-95% for pangasius, he said. That said, carp is easier to sell in the Indian market, Singh said.

Pangasius farming costs range between INR 45 to 55 rupees, said Singh, who has plans to start a pangasius hatchery in Uttar Pradesh. The cost is mostly dependent on the cost of commercial feed, which ranged from INR 29 to INR 31/kg for 24-28% protein content, according to industry sources.

A lot depends on the quality of feed pellets to achieve faster growth, Singh said. Using premium feed tends to allow farmers to harvest fish quicker, allowing some to obtain two harvests a year.

India could eventually export pangasius

The surging output might incentivize Indian producers to build an export business. Vietnam, which accounts for more than 90% of exports, sold about $2 billion of pangasius fish in 2018, according to the United Nations' Food & Agriculture Organization. Indonesia and India barely compete in export markets, selling most of their fish domestically.

Vietnam produced 1.27m metric tons of pangasius in 2018, compared with 590,000t from India, 524,000t from Bangladesh and 485,000t from Indonesia, according to experts surveyed for the annual Global Outlook for Aquaculture Leadership (GOAL) conference. The GOAL experts predict India's output will increase by 8% to 630,000t by 2020, while Indonesia will rise to 16% to 562,000t over the same timeframe. By contrast, Vietnam's output is expected to rise just 3% over that period to 1.31m metric tons.

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Alexa Reports added Aquaculture Market Report: Assesses Economic Performance, Internal and External Business factors

Aquaculture Market Growth Status and Outlook:

The latest report published by Alexa Reports titled global Aquaculture Market 2019 presents the comprehensive study of the present market based on the research that is being carried out by analysts. The newest developments that are presently affecting the changing scenario and products and services that have high rankings and great feedback are described wisely.

The market report provides a five-year annual trend analysis, with respect to base and previous year analysis, that highlights market size, volume and share for the key regions. The Aquaculture market has been segmented in the regions of North America, Asia-Pacific, Europe, and ROW.

If you are involved in the Global Aquaculture industry or intend to be, then this research study will provide you comprehensive outlook. It's vital you keep your market knowledge up to date segmented by major players. If you have a different set of players/ manufacturers according to geography or needs regional or country segmented reports, we can provide customization according to your requirement.

Some of key competitors or manufacturers included in the study are:

Promarisco, Nireus Aquaculture S.A., Marine Harvest ASA, International Fish Farming Co. – Asmak, Huon Aquaculture Group Pty Ltd., Eastern Fish Co., Cooke Aquaculture Inc., Cermaq ASA, Thai Union Frozen Products Public Company Ltd., Tassal Group Ltd., Stolt Sea Farm, Stehr Group Pty Ltd., SelondaAqaculture S.A., Blue Ridge Aquaculture

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Some of the Points cover in Global Aquaculture Market Research Report is:

The Report gives a brief overview of the market by studying various definitions and classification of the industry. In addition to, the applications of the industry and chain structure are given by thorough market research perspective. Furthermore, prime strategically activities in the market initiated by the key players, which includes product developments, mergers and acquisitions, partnerships, etc., are discussed in this report.

Global Aquaculture Market Report gives answers to following Vital Questions:

1. What are the risks associated with the sourcing of raw material, or holding the line on costs of services?
2. Who are the emerging competitors in the Global Aquaculture industry?
3. Expected percentage of the Global Aquaculture Market Growth over upcoming period?
4. Why does Global Aquaculture Market have high growth potential?
5. How does this Report match with Investment Policy Statement?

To conclude the report summarizes present analysis based on factors which are expected to show positive growth of the market.

The report studies market estimation for 2019 to 2024. Relevantly, the report and company profiles specify the key drivers that are impacting the demand in global Aquaculture markets.

India's pangasius industry next aquaculture segment poised for explosive growth

Contn from Page 26

Much of the fish is sold into domestic wet channels, according to Manoj Sharma, a shrimp industry expert. This contrasts sharply with India's highly developed, export-focused shrimp industry. Some larger players in Andhra Pradesh have built vertically integrated operations and started to sell fillets in India.

India's pangasius output is largely determined by the mood of the shrimp farming industry in eastern Andhra Pradesh state, according to Sharma. When the shrimp market improves, inland farmers switch farming sites to shrimp and create an opportunity for other states to supply the market.

"Pangasius demand and supply largely depends on the mood of Andhra farmers," Sharma told Undercurrent. "When Andhra produces more, nobody can compete with them."

Potential future oversupply, combined with growing competence among farmers, will likely spur efforts for leading farming companies and other investors to build processing plants to export fillets, according to Rishikesh Kashyap. COFFED has received delegations of potential investors from China and Thailand in Patna to discuss a potential export industry.

In theory, there is plenty of demand back home. Bihar is India's third most populous state with 99m people and some 800,000t of fish are consumed in the state, Rishikesh said. About 700,000t of that is produced in the state, of which 100,000t is farmed pangasius. Bihar typically imports about 100,000t of fish each year from Andhra Pradesh.

Pangasius consumption may be restricted by the size of the whole fish, which are typically too large for a small Indian family to eat without a refrigerator to preserve unused portions, said Rahul Kulkarni, a director of West Coast, one of India's leading seafood companies. It's partly for this reason that West Coast switched its focus to tilapia farming instead of pangasius, despite having been involved in the start of the pangasius industry in India.

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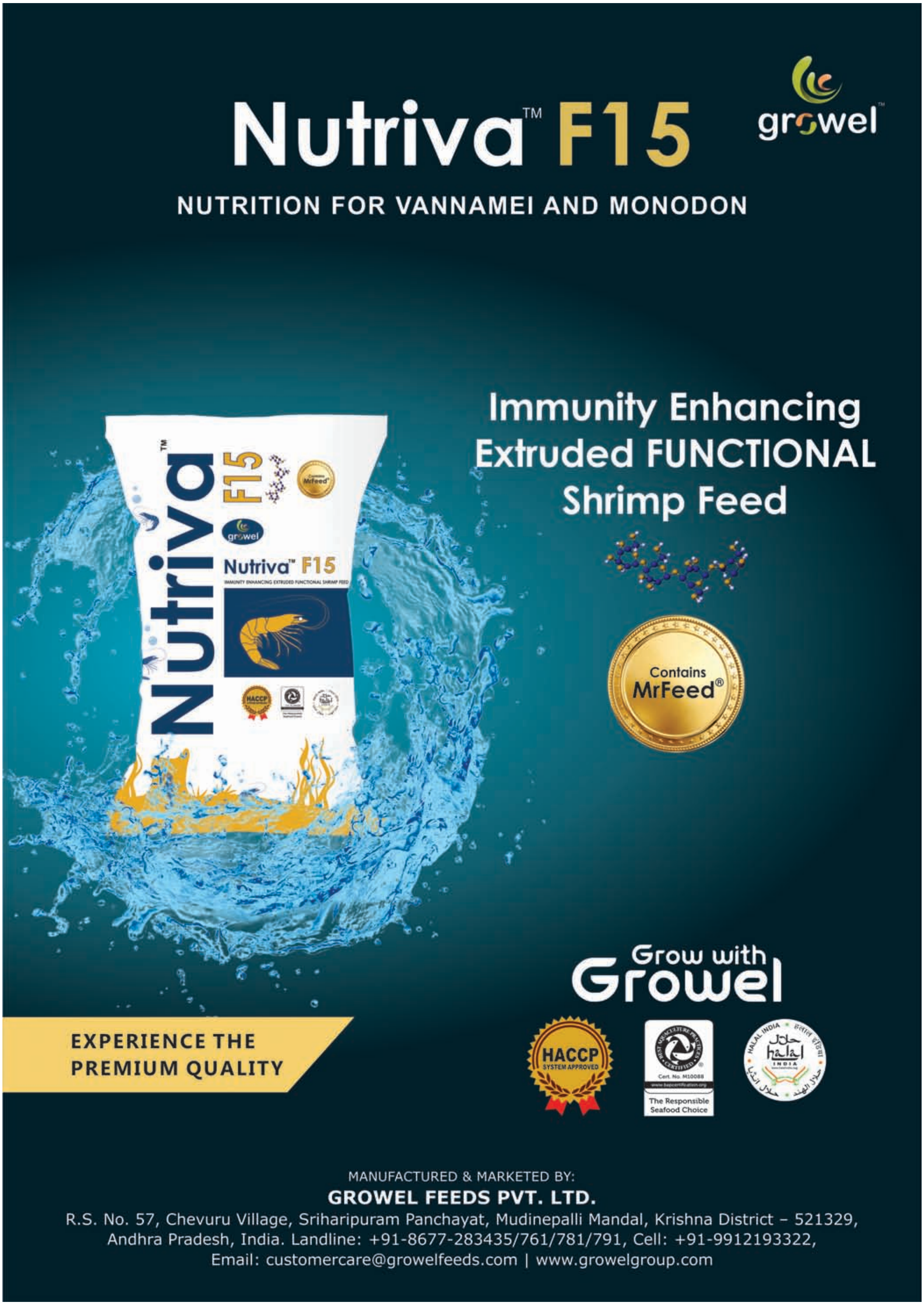

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Gender based Fisheries and Aquaculture practices

Abhishek kumar, Binod Kumar Choudhary, Mamta Choudhray

Background:

Historians believe that it was women who first domesticated crop plants and thereby initiated the art and science of farming. Indian rural women have always been an important and prominent partner in sustainability of agriculture sector. Since ages, women continued to be the important stakeholder in farming activities in India. Involvement of Indian women in farming enterprise has been on rise in recent years. Other than crops they are involved in allied sectors like Fisheries, animal husbandry, dairying, piggery, poultry, sericulture and apiculture. The extent of women contribution is aptly highlighted in a study conducted in Andhra Pradesh where it has been revealed that work day of women agricultural labour during season lasts for 15 hours and her male counterpart works for 7 to 8 hours (Mies, 1986, (Swaminathan, 1985). Fishery is the oldest and most important livelihood option for the inhabitants of the country since times immemorial. Approximate of about 1 % of the total population depends upon fishery sector in India as a primary source of livelihood – direct employment to about 6 million fishermen and to another six million people who are employed in fishery related activities. India is endowed with 2.02 million sq. km of EEZ (Exclusive economic Zone) along with a coastline of 8129 km and 0.5 million sq. km continental shelf with a catchable annual fishery potential of 3.93 million tonnes occupying a very important strategic position in the Indian Ocean. The aquaculture resources in the country comprise 2.25 million ha. of ponds and tanks, 1.3 million ha.of bheels and derelict waters, 2.09 million ha. of lakes and reservoirs and also 0.12 million kilometres of irrigation canals. Among the Asian countries India ranks second in the culture and third in capture fish production and one of the top leading exporters of sea foods (FAO, 2009, Ayyappan and Diwan, 2007). Fisheries and aquaculture are the sources of livelihood for over 14 million Indian people and also contribute to foreign exchange earnings considerably, constituting about 1% of the total gross domestic product (GDP) and 5.3% of the GDP from the agriculture sector of the country (DAHDF, 2011). Aquaculture is always consumer driven and the extension services need to focus their efforts beyond technology dissemination to adoption of food safety practices, value addition, environment safety and social responsibility issues, such as Fisher women empowerment. Aquaculture extension services are expected to facilitate the Fisher women farming community to access backward and forward inputs and services, educate the farmers on better farm management practices, food safety guidelines and enforce regulatory guidelines for the planned aquaculture growth. However, insufficient extension service orientation, inadequate manpower and lack of budgetary provisions for extension work have hampered the public extension agency in providing the expected service.

Introduction:

A key message from the Food and Agriculture Organization of the United Nations' report *The State of Food and Agriculture 2010–11*. Women in Agriculture – Closing the Gender Gap for Development (FAO, 2011) was that women's relative lack of access to education and extension services contributed to the "gender gap" in agriculture (including aquaculture) productivity. Gender concerns in the fishery business have a different dimension altogether in terms of physical as well as financial exploitation of the women even though they play an important role in the fish supply chain at the local level. The centre of power in terms of decision making, trade, financial access over product and market had been traditionally the domain of the male counter parts and women have little say in it. Fish drying and selling is the major activity in which the women are involved. The financial exploitation of women is severest in the market place because of the unregulated market. Also the choice interms of purchases is very limited at the landing centre where they have say only for the products of low value and category. Men and women engage in distinct and often complementary activities that are strongly influenced by the social, cultural and economic contexts in which they live. Male–female relations in the fisheries sector vary greatly and are based on economic status, power relations and access to resources. More commonly, in coastal artisanal fishing communities, women manage the smaller boats and canoes that go out fishing. Women are also involved in gathering shells, sea cucumbers and aquatic plants in the intertidal zone. They also contribute as entrepreneurs and provide labour before, during and after the catch in both artisanal and commercial fisheries. In addition, they are often responsible for skilled and time-consuming onshore tasks, such as net making and mending, processing and marketing catches, and providing auxiliary

Highlight Points

- **Women Empowerment in Fisheries Sector.**
- **Women in Agriculture are Closing the Gender Gap for Development.**
- **Women in Organized Processing Sector.**
- **Promotion of Equal Access to Resources and Opportunities.**
- **Elimination of Gender Discrimination.**
- **Socio Economic Upliftment of Women.**

services to the boats. However, gender issues in the fisheries and aquaculture sector have seldom been examined, and the important role women that play has often been overlooked and, thus, not taken into account in decision-making processes and outcomes, thereby hindering development. When fish business activities are being up-scaled in response to increasing globalization, local women risk being forced out of the business and, therefore, not benefiting from development and market opportunities in the sector in which they were previously extensively involved.

Picture showing Fisher women selling the farm produce in fish market in Purnea District of Bihar

Picture showing Fisher women selling their farm produce in fish market in Katihar district of Bihar.

Gender based fisheries activities:

In India fish is often a secondary source of food. Under such circumstances, fishing communities are a marginalized group occupying a lower priority in state policies relating to food. The priority given to fisheries in state policy is further attenuated when it comes to women. The fisheries sector has seen significant change over the last couple of decades in the region. Women in coastal states play a significant role in the small-scale fisheries sector. About 30% of women in rural and coastal areas are directly or indirectly engaged in small-scale fisheries. The major areas of women's involvement are aquaculture, shrimp culture, fish processing, net, gear and craft making. Though women in India are not involved in active fishing from the sea, they participate in certain forms of fishery as a family along with the men. This is usually seen in the estuarine areas where set bag nets are employed for fishing. However, a study of the set bag net fishing communities also revealed that though women work as a family in the set bag net fishery, their work remains largely unrecorded. In any case, set bag net fishery as an occupation is very low paying and most fishers involved supplement it with other occupations. Capture fishery in rivers, lakes and reservoirs, paddy fields and marginal lands and swamps are widely scattered throughout the country and is not organized. Most of the fishers involved in capture fishery are widely dispersed along rivers and other water bodies. They use mostly their traditional boats and fishing gears and thus generate only marginal economic benefits. Traditionally, rural women are involved either in fishing or fishing-related activities. To enhance fish production, a number of inland water bodies, e.g. lakes, reservoirs and swamps have been stocked with selected species of indigenous as well as exotic carps in collaboration with local fisher communities. In these inland water bodies, women are actively involved in mending nets, laying out the fishing gears, harvesting and marketing of the catch. Women farmers participate in various fields of inland fisheries. In aquaculture, rural women are deeply involved in manuring fish ponds, feeding fish, harvesting and marketing farm products.

Women in the fish marketing sector: While fish processing is a female-dominated activity in the South Asian region, marketing of the processed product as well as selling of fresh fish is often seen as undesirable activities, usually a last resort for a poor family. Retail fish marketing is often best achieved through individual small-scale enterprise. In India, owing to the lack of an established marketing infrastructure and the demand for cheap fish, women have created a niche for processing and marketing fish at very low costs in the supply chain of fishes. The supply chain is defined as "the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers and final disposal after use."The important supply channels which cater to the various usages are –marketed fresh (70% of fish catch), fish drying and curing industry (14% of fish catch), Frozen fish production (6.5% of fish catch), reduction to fish meal (8.4% of fish catch), offal reduction (0.8% of fish catch), miscellaneous purposes (1.6% of fish catch). The most important supply chain is for the fish marketed fresh owing both to the size of market as well as the nature of the product i.e. perishability. A study undertaken by the Department for International Development (DFID) Post-Harvest Fisheries Project along the east coast of India, documents the heterogeneity among women who are involved in fresh and processed fish marketing (Post-

Harvest Fisheries Project, Department. The three categories identified are:

a. Head loaders: These are women who deal in small quantities of low value species, which are sold in inland villages. b. Petty fish traders: These are women who deal with medium value species and have considerably higher investment capacities and are therefore considered credit worthy by non-institutional credit sources. c. Dry fish traders: These are older women who are primarily involved in fish salting and drying in a large scale. Fish for processing is procured during "glut" landings of a particular species and they usually employ family labour (including their own) for processing activities. These women access weekly markets and are usually wholesalers. However, with the increasing use of ice and consequent movement of fish in its fresh form, this group is affected. While women in the post-harvest fisheries sector in India are more visible in fresh fish trade, It is important to recognize that credit plays a crucial role in fish marketing activities. To enable the participation of women in this sector, credit should be made easily available at affordable interest rates to better address the needs of women in fish marketing.

The role of transportation: Studies done by the DFID Post-Harvest Fisheries Project in the state of Tamilnadu along the East coast of India, document the problems faced by women in accessing public transport. One of the problems that has emerged with centralization of fishing has been the increasing distances to landing sites, as village landings have decreased. Women involved in fish marketing today have to travel long distances to buy fish and again to sell it. Considering that most fishing villages are often poorly linked by roads, access to public transport becomes a question of primary importance.

Women and the organized processing sector: The organized processing sector such as the shrimp processing units, usually employ women as peeling labourers. In India, these are found along the coasts of Veraval, Mangalore, Goa, Mumbai, Calcutta and Bhubaneswar. Studies done in India showed that it is usually migrant young women who are preferred as labourers in these units, which are mostly export-oriented and exploitative. Fishing, including aquaculture, and their associated downstream activities, like fish processing, are among the most depressed economic activities. Women from poor fisher households are involved in fish processing, aquaculture, small-scale artisanal fishing and fish mongering, but less often in commercial fishing using bigger vessels.

Outlook for Women empowerment in Fisheries:

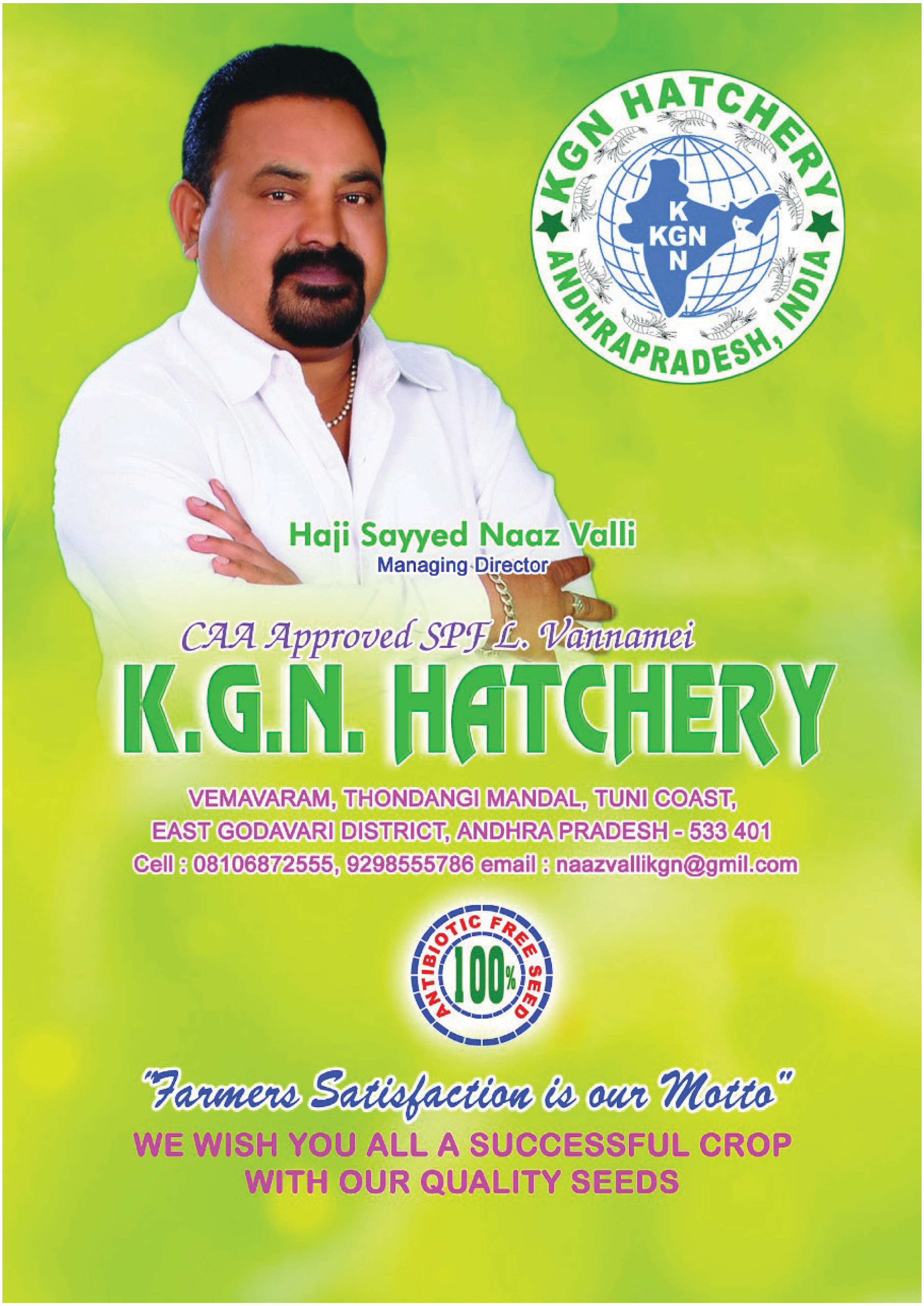
Gendered value-chain approaches can be used to recognize and value women's roles and contributions to agriculture and fisheries. To mainstream gender equality in development cooperation programmes and related activities, a number of steps are essential. Information provided by FAO indicates that, in 2008, 5.4 million women worked as fishers and fish farmers in the primary sector and represented 12 percent of the total. In two major producing countries, China and India, women represented 21 percent and 24 percent, respectively, of all fishers and fish farmers. Women make up at least 50 percent of the workforce in inland fisheries, while as much as 60 percent of seafood is marketed by women in Asia and West Africa. Moreover, although comprehensive data are not available on a sex-disaggregated basis, case studies suggest that women may comprise up to 30 percent of all those employed in fisheries, including primary and secondary activities. No single blueprint exists for closing the gender gap as yet, but some basic principles are universal. i.e,

- eliminate discrimination under the law, improving women's endowments, opportunities and agency to help shape more positive outcomes for the next generation;
- promote equal access to resources and opportunities, reducing barriers to more efficient allocation of women's skills and talents and helping to generate large productivity gains;
- ensure that policies and programmes are gender-aware, increasing women's individual and collective agency to produce better outcomes, institutions and policy choices;
- make women's voices heard as equal partners for sustainable development.

Empowering Fisherwomen, mainstreaming gender is an essential component of alleviating poverty, achieving greater food and nutrition security, and enabling sustainable development of fisheries and aquaculture resources. Gender considerations should be firmly placed on all fisheries and aquaculture policy agendas at all geographical and institutional scales.

Gender Mainstreaming:

"Gender mainstreaming is not only a question of social justice but is necessary for ensuring equitable and sustainable human development. The long-term outcome of gender mainstreaming will be the achievement of greater and more sustainable human development for all."(The United Nations Economic and Social Council (ECOSOC) 1997,). The issue at hand is how to ensure genuine and active mainstreaming of gender and the many facets of gender considerations in the fisheries and aquaculture sector. Indeed, until recently, gender analysis in fishing communities focused mainly on the different occupational roles of men and women, i.e. that men usually do the actual fishing and women are to a large extent involved in post-harvest and marketing activities. While the role of women in the management and utilization of natural resources is generally acknowledged, their role does not carry the same weight as that of men. Given that production goals have tended to be the focus of research and policy, the predominantly male catching sector has remained the centre of attention. However, with the shift to a multidimensional and more holistic definition of poverty and the increased focus on reducing vulnerability, gender has become more central to fisheries policy and development practice. Fisheries resource management is increasingly being linked to all levels of the so-called "deck to dish" fish value chain in which both men and women have important roles to play. Gender-disaggregated data, which are needed for in-depth gender analysis are largely lacking in most of these countries. It is imperative that such data is collected, and gender research is conducted, so that appropriate interventions and policies changes are implemented, to ensure that women are not left out of mainstream development, and are accorded the basic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rights, which all humans are entitled.

Conclusion:

There is an immense potential in fishery as a trade and livelihood option. The need of the hour is to develop sync between the two so that they reciprocate each other rather than come in conflict. The issues and concern of various players of the value chain need to be addressed so that they come in supportive mode rather than the exploitative mode. Here it is imperative to mention that environment will play a crucial role for success or failure of any intervention. Economic empowerment should be the end goal of a road map on gender in fisheries and aquaculture. The suggested approach could facilitate strong research and extension linkage and build partnerships with service-oriented private people like the farm opinion leaders, farmers' groups and fisheries professionals in the field, to streamline the fisheries and aquaculture in India. In view of the findings, it becomes imperative to scientifically educate and train women in specialized skill so that they too can improve and sharpen their skills and abilities for performance of tasks which need some technical knowledge and skill In view of the critical role of women in the agriculture as producers, concentrated efforts need to be made to ensure that benefits of training, extension and various programs reach them in proportion to their participation pattern. Strategies should be designed to enhance the capacity of women and empower them to meet the future participatory needs in farm operations. Special training programmes for women will enhance their skills and strengthen faith in them for effective and independent performance off arm operations and help them to make a shift from physically enduring operations to specialized tasks.

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Status and situation of Marine Fisheries in India

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1. Introduction

Fisheries is an important sector in India – It is a source of income and livelihood for millions of people around the world. India being the topical country is blessed with highly diverse marine fishery resources in its 2.02 million square km EEZ with a 530,000 square km of a continental shelf area and having a coastline of about 8118 Km. As per the NBFGR 2014 database, the country possesses a rich diversity of 2,953 indigenous finfishes which includes 877 freshwater species, 113 brackish water species and 1672 marine species besides 291 exotic species. Apart from the finfish resource as many as 2,934 species of crustaceans, 5,070 mollusks, 765 echinoderms, 486 sponges and 844 seaweed species.

India has achieved significant progress in the development of the fisheries sector. Fish production has increased from 41.57 lakh tonnes (24.47 lakh tonnes for marine and 17.10 lakh tonnes for inland fisheries) in 1991-92 to 114.10 lakh tonnes (36.41 lakh tonnes for marine and 77.69 lakh tonnes for inland fisheries) in 2016-17. India contributes 6.7 per cent towards the global production of 170.9 million tonnes (FAO, 2018). Indian fisheries now occupy the second position in global fish production with an annual growth rate of 4.7%, with 3.2% growth in marine fisheries and 6.2% growth in inland sector, thereby contributing 1.1% of the total GDP and 5.3% of the agricultural GDP of the nation (Ayyappan et al., 2011). In particular, fish is considered as a good food for heart patients. The World Health Organization (WHO) recommended the consumption of 40 to 50 kg of fish per annum per head. But at present the per capita consumption per annum is around 20.3 kg (FAO, 2018). During the financial year 2017-18, India has exported Rs. 45,106.89 crore value of

Highlight Points

- **India stands at sixth position with regard to marine fish production in the world.**
- **Total marine fish landings of India increased from 2.88 MT to 3.49 MT in the last 12 years registering a growth of 21.1 %.**
- **Gujarat stands first in marine fish landings for the Sixth consecutive year.**
- **Pelagic fishery dominated in the marine landings with Indian Mackerel contributing the maximum share.**
- **Industrial fishing, pollution, destruction of breeding sites like mangroves and poor governance are major stressors impacting marine fishermen.**
- **Implementation of strict government laws and awareness programs by involving stakeholders can only way to solve the problems of marine fisheries.**

marine products which included 13,77,244 tonnes of seafood (Anonymous, 2018).

2. Marine Fisheries

Marine Fisheries in India have a potential contribution in agro-economic development, employment generation, supplying of animal protein and earning foreign exchange. It contributes to food security and provides direct employment to over 1.5 million fisher people besides others indirectly dependent on the sector. Fisheries sector in India is broadly categorized into capture and culture. Capture fisheries is intended for catching fishes, prawns, lobsters, crabs, molluscs etc. using various types of crafts and gears.

According to the Central Marine Fisheries Research Institute (CMFRI) Census 2010, there are 3,288 marine fishing villages and 1,511 marine fish landing centers in 9 maritime states and 2 union territories. The total marine fisherfolk population was about 4 million comprising in 864,550 families. The Indian boat type ranges from the traditional catamarans, masula boats, plank-built boats, dugout canoes, machwas, dhonis to the present day motorized fibre-glass boats, mechanized trawlers and gillnetters. In the marine fisheries sector, there were 194,490 crafts in the fishery out of which 37% were mechanized, 37% were motorized and 26% were non-motorized.

CMFRI plays a pivotal role in the field of fisheries research in India, focusing on various aspects of marine fisheries, which target sustainable fish production and well-being of fishermen communities. Ever since its establishment in 1947, the Institute has grown significantly in developing a creditable research infrastructure and scientific expertise, enabling a multidisciplinary approach in marine capture as well as culture fisheries. The marine fisheries sector of India, which contributes about 45% of the total fish production of the country, plays a noteworthy role in supplying protein rich food to the growing population and attracts rewarding foreign exchange earnings through seafood export. The vast expanse of the coastline of the country offers ideal sites for mariculture through which, the Institute is aiming at enhancing the production of food fishes along with developing appropriate strategies for sustainable management and conservation of biodiversity of the EEZ. In accordance with the global trends in marine fisheries management, the fishing industry in India should also attempt to meet the challenges of formulating a successful management system that addresses sustainability issues.

It is difficult to generalize the regional results since fish is a highly heterogeneous commodity with tremendous spatial and seasonal variations in size, quantity, quality and price. The data were collected from the annual reports of Central Marine Fisheries Research Institute and were tabulated and analyzed for the past 11 years of marine fish landings.

3. Marine Fisheries of India at a glance

Total marine fish landings of India in million tonnes (MT) were plotted against each year for the last 11 years and the results are presented in figure 1. The marine fish landings of the country grew from 2.88 MT in 2007 to 3.49 MT in 2018 registering a 21.1 % increase in the last 12 years. The highest marine fish landings of 3.94 MT was observed in the year 2012. It was an all-time highest marine fish landings of the country.

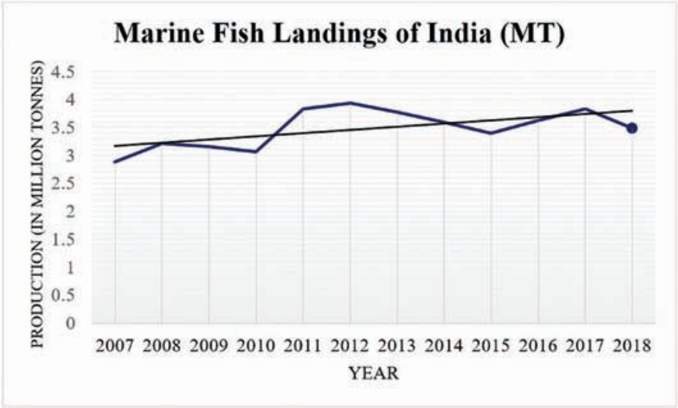

Figure 1: Year-wise total marine fish landings of India

3.1. States at a glance

India has an 18th longest total coastal length among all the countries of the world. The Indian coastline stretches over 8118 kilometers and thus, makes India one of the biggest peninsulas of the world. It runs over 9 states and 2 union territories and is bound by the Arabian Sea in the west and the Bay of Bengal in the east. The western coastal states are Gujarat, Maharashtra, Goa, Karnataka and Kerala; and the eastern coastal states are Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. The 2 union territories lying on the coast-line are Daman & Diu and Puducherry. While Andaman & Nicobar Islands and Lakshadeweep Islands are island territories.

The landings of Gujarat has substantially increased in the last 12 years but there is a 1% decline in marine fish landings compared to 2017. Fish landings increased from 4.57 to 7.80 LT from 2007 to 2018 (CMFRI, 2019). Gujarat ranks first among the maritime states for the sixth consecutive year. Non-penaeid prawns constitutes the major landings. Landings of different maritime states & union territories during 2018 are presented in Figure 2 (CMFRI, 2019).

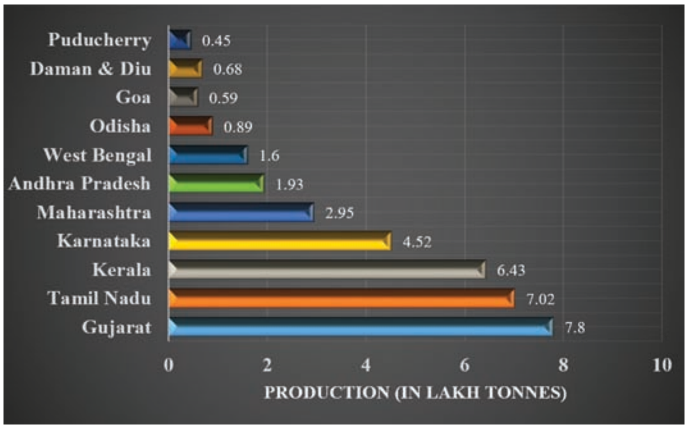

Figure 2: Landings of different Maritime states & Union territories – 2018

3.2. Marine Fisheries Resources at a glance

The marine fishery resources are categorized into four assemblage groups namely pelagic, demersal, crustacean

and mollusks based on their biological features and habitat. In India, pelagic finfishes dominate in the marine fish landings that includes fishes like Indian oil sardine, mackerel, anchovies, Thryssa sp., ribbon fish, carangids, lesser sardines, seer fishes, tunnies and Bombay duck. The major demersal resources landed are bullseyes (Priacanthus sp.), threadfin breams, croakers, silver bellies, lizard fish, pomfrets, flat fishes, perches, elasmobranchs and catfishes. Crustaceans include high value resources like prawns, crabs, lobsters and stomatopods. Mollusks include squids, octopus, cuttlefish, bivalves and gastropods.

Year wise different marine fisheries resources are presented in figure 3. It is clear from the figure that there is no significant difference in the resources in different years. But there is a significant difference between the resources i.e. in 2019 pelagic resources dominate in India's total landings with an average of 53.4 %, while demersal resources contribute with an average of 27.1 %; crustaceans resources contribute with an average of 13.1 % and mollusks contribute with an average of 6.5 %.

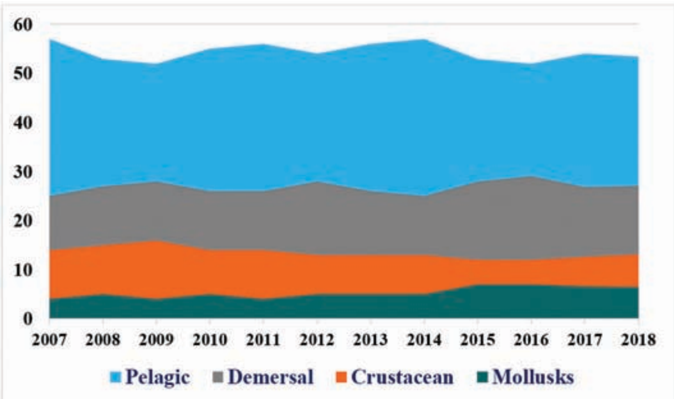

Figure 3: Percentage contribution of different marine fisheries resources

3.3. Major Resources at a glance

The resources which have contributed largely to the overall landings (in Lakh Tonnes) are presented in figure 4A, figure 4B, figure 4C and figure 4D. Indian Mackerel (Rastrelliger kanagurta) (Fig. 4A) became the major resource in 2018 with landings of 2.84 LT contributing 8.1% to the total marine fish landings. Oil sardine (Sardinella longiceps) (Fig. 4B) was a single major fishery along the Indian coast witnessed a drastic decline in its landings reaching to 9th position from 1st position in 2018. Landings of oil sardine decline from 7.2 LT in 2012 to 1.55 LT in 2018. The fluctuations in oil sardine landings can be connected to the El-nino phenomenon in the Indian waters (CMFRI, 2018). Another important marine finfish species is the ribbon fish. Landings of ribbon fishes increased from 1.32 LT (2007) to 1.94 LT (2018). Gujarat contributes the maximum share of ribbon fish in total fish landings. Landings of Cephalopods (Squids, Octopus and Cuttlefish) (Fig. 4C) has increased from 0.94 LT to 2.21 LT in the last 12 years. Tamil Nadu shares the major landing of Cephalopods. There is not much significant difference in the landings of penaeid and non-penaeid prawns (Fig. 4D) in the last 12 years. The annual average of penaeid and non-penaeid prawns in 2018 was 1.92 LT and 1.94 LT respectively.

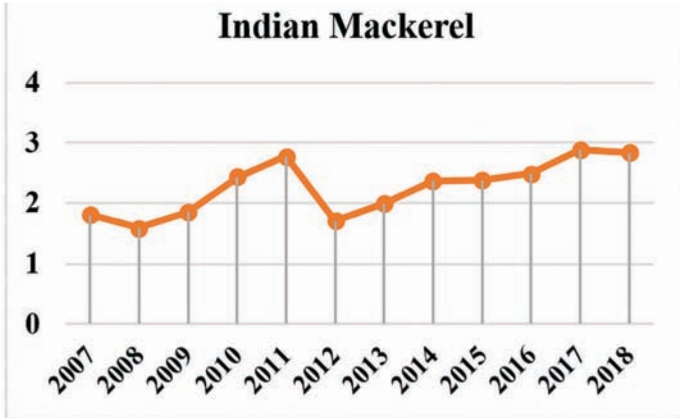

Figure 4A

3.4. Landings related to mechanization of fishing crafts

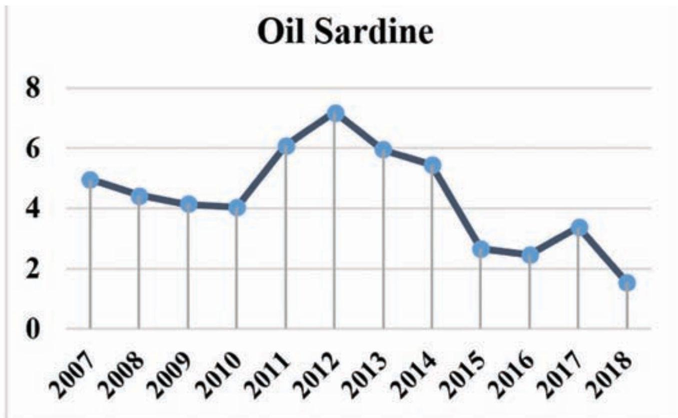

Figure 4B

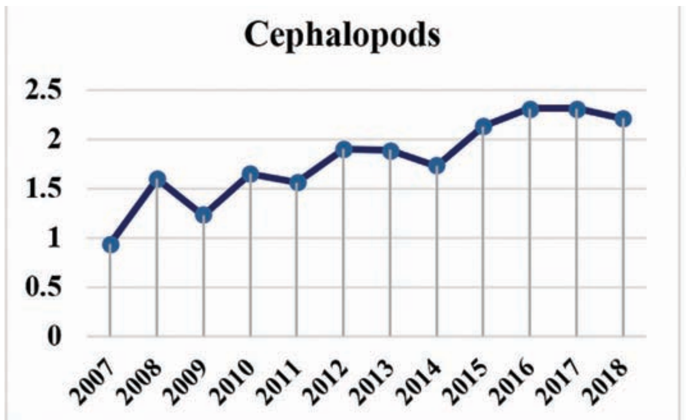

Figure 4C

The fishery in the country is categorized into three sectors based on the type of fishing crafts used namely mechanized, motorized and non-motorized. Fishing crafts that use machine power for both propulsion of the fishing craft as well as operation of the fishing gear are termed as mechanized crafts, whereas motorized are those fishing crafts that use machine power only for propulsion of the craft. The non-motorized fishing crafts do not use machine power of any kind. More than 35 different types of craft gear combinations are used for harvesting marine resources in Indian seas. Among them trawl nets accounted for half of the landings (CMFRI, 2015). In 2018, 81% of the landings was from

mechanized sector followed by 17% from motorized and only 1% from non-motorized sector (CMFRI, 2019).

4. Threats to marine fisheries

Marine fishing, being a natural resource dependent livelihood, is vulnerable to multiple stressors. The livelihoods of small-scale marine fishermen are especially threatened by their impacts. Industrial fishing, pollution, destruction of breeding sites like mangroves and poor governance (Daw et al., 2009; Sievanen, 2014) are some of the stressors impacting marine fishermen. Apart from these stressors, change in climate is projected to impact marine life extensively (Barange et al., 2014; Daw et al., 2009). The fishing community of India is one of the most sensitive to climate change (Allison et al., 2005). Marine fisheries of India are threatened by increase in sea surface temperature, sea level rise, changes in pH, precipitation, extreme events like storms, cyclones and El Nino (Vivekanandan, 2011). These can subsequently affect spawning and fish breeding habitats; lead to reduction in fish population and biodiversity; and increase risk to life and property (Vivekanandan, 2011). Out of 147 countries, marine fisheries of India ranks 29th in its vulnerability to projected climate change (Blasiak et al., 2017). Fish distributions are changing and there is already evidence of species, such as oil sardines, moving up towards northern latitudes with rise in sea surface temperature around India (Vivekanandan et al., 2009).

5. Conclusion

No doubt that the total marine fish landings of India increased from 2.88 MT to 3.49 MT in the last 12 years registering a 21.1 % increase. But landings of 2018 showed a decline of about 3.47 LT (9%) compared to 3.83 MT in 2017. The highest landings of 3.94 MT was observed in 2012. Gujarat with 7.80 LT of marine fish landings in 2018 ranked first among the maritime states for the sixth consecutive year. Landings of Karnataka has substantially increased in the last 12 years and has reached to 4.52 LT in 2018. Every year pelagic fishery dominated in the marine landings with oil sardine contributing the maximum share in the total fish landings, but in 2018 Indian Mackerel contributed the maximum share in pelagic fishery. India contributes 6.7% to entire global fish production. But most of the fish species found in the Indian seas are highly vulnerable to climate change and thus migrating from their natural environment. These numerous changes in the ocean ecosystem can consequently affect fish habitat as well as the livelihoods of the marine fishing community and it is crucial for the community to adapt to current and formidable future changes. Thus CMFRI is mandated to monitor the marine fishery resources by estimating the quantity of marine fish harvested and derive management measures to keep the harvest at a sustainable level for each of the commercially important marine fishery resources. The resource wise estimates of landings of marine fish are made through a scientific data collection system developed by CMFRI and being used every year.

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Ghost probiotics: Prospect in aquaculture

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Background

The intensification in the aquaculture sector have given rise to an ideal environment for increased disease outbreak from existing and newly emerging pathogens causing heavy financial losses (Flegel, 2006; Lafferty et al., 2015; Opiyo et al., 2018). Indiscriminate use of antibiotics and chemotherapeutics to control diseases in aquaculture advocated deleterious impacts leading to the development of antibiotic and drug resistant pathogens and, environmental and food safety issues. Alternatively, the health-promoting effects of various probiotics have been clarified and put to practical use worldwide. According to the definition given by FAO (2001), ‘probiotics’ are defined as ‘live microorganisms that, when administered in adequate amounts, confer a health benefit on the host’. These benefits are provided due to interactions between the probiotics and the gastrointestinal microbiota and immunological system. On the other hand, non-viable probiotics known as “ghost probiotics”, “paraprobiotics”, “postbiotics” and “inactivated probiotics”, have been drawn attention recently due to their beneficial effects on health.

Ghost probiotics

Non-viable microbial cells (intact or broken) or metabolic products from microorganisms, which when administered (orally or topically) in adequate amounts have biologic activity in the host and confer benefit to the consumer is referred to as ‘ghost probiotics’ or “paraprobiotics” or “postbiotics” or “inactivated probiotics” (Adams, 2010; Ananta and Knorr, 2009). Taverniti and Guglielmetti (2011) first introduced the terminology ‘paraprobiotics’ to interpret the concept of non-viable beneficial microbes. The Greek terminology ‘para’ means ‘atypical’, which indicated their similarity and difference from the classical ‘probiotics’.

Scopes and approach

The concept of ‘ghost probiotics’ is gaining momentum due to the consequences associated with the administration of ‘viable microbes’ i.e. probiotics. The affectivity of probiotics depends on the viability of probiotic microbes, which further depends on certain parameters like storage condition (Nayak 2010), the colonizing ability of the microbes, their capability to withstand the adverse condition of the gastrointestinal

tract of the host (Ottesen and Olafsen 2000) and the timing of probiotic application (Fuller, 1992; Ringo and Gatesoupe 1998; Balcazar et al., 2006). Interesetingly, in probiotic supplemented feed, the relative proportion of viable and non-viable bacteria varies greatly and even the population of dead cells could be larger than the viable cells. Therefore, the beneficial effect which is supposed to be derived from the viable probiotic bacteria may underestimate the effects that have been derived from the presence of the non-viable bacterial portion (Adams, 2010; Dash et al. 2015). In addition, the possibility of horizontal transfer of virulence gene from pathogenic to probiotic microbes in the aquatic environment is a major concern (Newaj-Fyzul et al., 2014). The main advantage of using 'ghost probiotics' are their longer shelf life which help their delivery to widespread areas without refrigerating devices and facilities, thus reducing the risk of microbial translocation, infection or enhanced inflammatory responses in immuno-compromised consumers. These issues provoked the development of alternative approaches such as 'ghost probiotics'.

Highlight Points

- **Indiscriminate use of antibiotics and chemotherapeutics to control diseases in aquaculture advocated negative impacts leading to the development of antibiotic and drug resistant pathogens, impacting environment and food safety issues.**
- **The health-promoting effects of various probiotics as an alternative to antibiotics have been clarified and put to practical use worldwide.**
- **Non-viable probiotics known as "ghost probiotics", "para probiotics", "post biotics" and "inactivated probiotics", have drawn attention recently due to their beneficial effects on health and the consequences associated with the administration of 'viable microbes' i.e. probiotics.**
- **The concept about 'ghost probiotics', their mode of action, scopes, approach and application in aquaculture to prevent deleterious health issues are discussed in the present article.**

How 'ghost probiotics' are produced?

'Ghost probiotics' can be obtained by inactivating probiotic microorganisms through various methods: thermal treatments (Chiu et al., 2013), high pressure (Ananta and Knorr, 2009), ultraviolet rays (Lopez et al., 2008; Van Hoffen et al., 2010), irradiation (Kamiya et al., 2006) and sonication (Shin et al., 2010). Several other methods such as pulsed electric field (PEF), ohmic heating and supercritical CO_2, drying and pH changes could also be potentially used for the production of the 'ghost probiotics'. It is most important to note that the inactivation method used to produce 'ghost probiotics' should be capable of retaining the health beneficial effects provided by the probiotic microorganisms (Raz and Rachmilewitz, 2005). Raz and Rachmilewitz (2005) reported that the 'ghost probiotics' concentration in probiotic formulations can be ranged from 1 x 105 to 1 x 1014 bacteria per unit doses (mL, gram, tablet or capsule).

Application in aquaculture

Though the use of probiotic is well established in the aquaculture sector, but the concept and application of 'ghost probiotic' is still in its infancy. Several reports on application of heat killed microbes elucidating beneficial roles in fish and shellfish have been documented.The immunostimulatory potential of heat-killed Lactococcus lactis in turbot (Villamil et al., 2002), the effect of formalin killed probiotic in reducing the A. salmonicida induced mortality of Rainbow trout (Irianto & Austin 2002; Rodriguez Estrada et al. 2013), feeding with formalin-killed commercial probiotic in improving immunity of nile tilapia against Edwardsiella tarda infection (Taoka et al. 2006), positive effect of formalin-killed and sonicated Bacillus subtilis AB1 in rainbow trout against Aeromonas sp. (Newaj-Fyzul et al., 2007), impact of heat-killed Clostridium butyrium in increasing the survivability of Chinese Drum (Miichthys miiuy) against V. anguillarum and A. hydrophila infection (Pan et al., 2008), the beneficial effect of heat killed L. paracasei spp. paracasei and L. plantarum in Japanese pufferfish against pathogenic V. harveyi infection (Biswas et al., 2013), reduced mortality of rainbow trout by formalin-killed Enterobacter sp. against Flavobacterium psychrophilum infection (LaPatra et al., 2014) and the result of dietary heat-killed L. plantarum supplementation in reducing the cumulative mortality of A. hydrophila-infected M. rosenbergii (Dash et al., 2015) has been studied. Studies on inactivated microbes in modulating immunity and providing disease resistance has been documented (Irianto and Austin, 2002; Salinas et al., 2008; Roman et al., 2012; Kamilya et al., 2015; Dash et al., 2015; Dawood et al., 2015 a, b, c). Up-regulated in-vitro expression of many immune-relevant genes including pro-inflammatory cytokines, cell-mediated immune regulators, antiviral cytokines and other regulatory cytokines, antibacterial epinecidin-1, immunoglobulin and Toll like receptors have also been reported (Biswas et al., 2013 a,b; Roman et al., 2012; Sun et al. 2014; Giri et al., 2016). In-vivo administration of paraprobiotics have been reported to induce many humoral and cellular immune responses including serum and gut lysozyme activity, peroxidase content, oxygen radical production, myeloperoxidase activity, alkaline phosphatase activity, natural haemolytic complement activity, a1-antiprotease and immunoglobulin levels and total serum protein in various fish species (Dıaz-Rosales et al., 2006; Taoka et al., 2006; Newaj-Fyzul et al., 2007; Pan et al., 2008; Dash et al., 2015; Dawood et al., 2015 a, b; Singh et al., 2017). The effect of heat-killed L. plantarum in improving the immune parameters of giant freshwater prawn (Macrobrachium rosenbergii) (Dash et al., 2015) and in white leg shrimp (Litopenaeus vannamei) (Zheng et al.


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2017) has also been studied. Like probiotics, the inactivated microbes can also improve the growth performance and feed utilization of aquatic animals as evidenced by Dawood et al. (2015), Rodriguez Estrada et al. (2013), Yan et al. (2016) and Zheng et al. (2017). Contrarily, Mohapatra et al. (2012) opined that heat-killed probiotic bacteria (B. subtilis, L. lactis and S. cerevisiae) supplementation in the diet of rohu did not impart any significant changes in growth, nutrient retention, digestibility, feed conversion ratio and gut colonization. Dash et al. (2015) also observed insignificant increase in growth upon feeding with heat-killed L. plantarum to giant freshwater prawn. The reports individually and collectively indicate the beneficial effect of 'ghost probiotics' in terms of immunostimulation, both at the cellular and molecular level inducing disease resistance and better growth performances in fish and shellfish. The reason may be due to various structural and chemical components of the bacterial cell (Kataria et al., 2009; Adams, 2010; Taverniti and Guglielmetti, 2011; de Almada et al., 2016). However, further investigations are required to demarcate their mode of actions, so that the versatility of the 'ghost probiotics' can be applied as an important and promising alternative in aquaculture in specific cases where the addition of probiotics are injured and involve a technological challenge.

Conclusions

A number of biological effects have been associated with 'ghost probiotics', highlighting that they could constitute an excellent option to improve health status and wellness. Therefore, the use of feed as carriers for 'ghost probiotics' seems to constitute a field to be explored with several opportunities and challenges. But the most important task lies in the selection of strains to be used for 'ghost probiotics' production, the appropriate methods for inactivation and delivery, their shelf life in feed and to assess their biological effects on fish.

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***More references can be provided on request.**

Strategies for Optimum Utilization of Carbohydrate in Fish Feed

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Introduction

Carbohydrates are naturally occurring organic compounds that contain carbon, hydrogen and oxygen and represented by the empirical formula (CH2O)n. Among the different forms that are abundant in plant sources, only sugars and starches have nutritive value in fish nutrition (Kaushik, 2001; NRC, 2011). Fish feeds on energy satiation.The ability of farmed fish to use dietary carbohydrates (cheapest source) as an energy source is generally lower than in terrestrial livestock because of extreme diversity in feeding habits, anatomical-physiological features and farming habitats (Polakof et al., 2012).Fishes do not have a dietary requirement for carbohydrates because of their ability to efficiently synthesize glucose from non-carbohydrate precursors such as lactate, pyruvate and amino acids (NRC, 2011).

Optimal inclusion of carbohydrates in the diet of farmed fish can increase:

1. Protein and lipid retention by preventing the catabolism of these expensive nutrients for energy needs(Stone, 2003).
2. Reduce nitrogen load in the farm discharge (Peragonet al., 1999).
3. Provide metabolites for biological synthesis (Hemre et al., 2002).
4. Support feed formulations that maintain growth at a lower cost per unit gain (Hardy, 2010).
5. Help in pellet binding, stability and floatability (Horato et al., 2010).

Potential of dietary carbohydrate use in fish

The utilization of carbohydrates in feed are dependent on the presence of major enzymes involved in starch digestion as well as those of glucose metabolism (Enes et al., 2009). The presence of several members of the glucose transporter family (Planas et al., 2000) and other glucose sensing

components in central and peripheral tissues (Polakof and Panserat, 2015) independently controls the hyperglycaemic condition in fishes.

Why low carbohydrate utilization in fishes??

Efficiency of carbohydrate utilisation in fish is strictly based on the rate of glucose delivery from digestion and glucose clearance from the bloodstream (NRC, 2011).

The possible reasons behind the prolonged hyperglycaemia are:

1. Inhibition of insulin secretion by other hormones such as somatostatin and relatively low number of muscle insulin receptors (Navarro et al., 1999).
2. Poor use of glucose in white muscle- the largest tissue (West et al., 1993) and lack of inhibition of endogenous glucose production (Panserat et al., 2000).
3. Weak hepatic lipogenesis from glucose (Hemre and Kahrs, 1997) and less complex neural regulatory network i.e., the presence of glucose excited/inhibited neurons not yet demonstrated (Polakof et al., 2011).

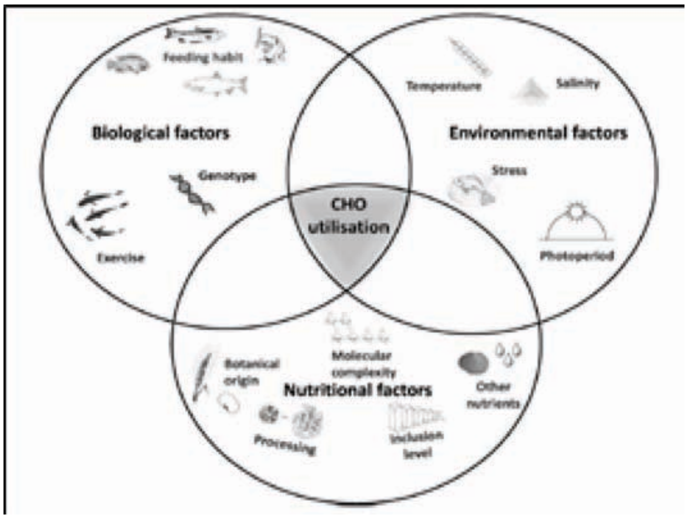
Plant ingredients as dietary carbohydrate source in fish feed

To sustain and stimulate the growth of aquaculture sector globally, more emphasis is being laid on shifting the dependence of fish feed production from limited and expensive marine ingredients towards abundant and competitively priced terrestrial plant ingredients (FAO, 2012). Most of the plant derived ingredients however have certain usage constraints that include their natural richness of carbohydrates in the form of energy reserves (starch and simple sugars) and structural polysaccharides (fibre). While excessive non-starch polysaccharides (NSP) are known to have a negative nutritional role in fish (Sinha et al., 2011), the higher inclusion of digestible starch fraction is considered to be economically indispensable in compound fish feeds (NRC, 2011). In this regard, dietary carbohydrates thus remain directly relevant to the sustainability of aquaculture operation.

Factors influencing carbohydrate utilisation in fish

Dietary carbohydrates can be used to meet energy requirements varies greatly between and even within species, depending on a multitude of factors categorized into:-

1. Biology of species (feeding habit, exercise, genotype)
2. Diet (carbohydrate source - botanical origin, molecular complexity, physical state; inclusion level, and feeding strategies; nutrient interactions)
3. Environment (temperature, salinity, stress, photoperiod)



The complex interaction of all these factors plays an important role in determining the capacity of the fish to use a carbohydrate rich meal.

1. Strategies to improve carbohydrate utilisation in fish.

Thermal or hydrothermal treatment

Hydrothermal treatments such as cooking, extrusion, steaming and expansion can alter the physical state of complex starches (Kaushik, 2001; Stone, 2003). Dry heat treatment, like roasting converts the CHO to dextrin (like starch to dextrin) which have comparatively less digestibility than gelatinized CHO. However, heating to 60-80°C in the presence of excess water, causes water to penetrate the starch granules until they swell and disrupted (gelatinization of starch) and leads to irreversible loss in crystalline structure, leaching ofamylose and amylopectin from the granule producinga viscous gelatinized suspension (Ernes et al., 2011a). Gelatinization thus effectively breaks down the starch granule exposing the bound amylose fraction and increases the surface area, which renders the starch more susceptible to enzymatic attack (French, 1973; Rooney and Pflugfelder, 1986). The amount of water used in the feed extrusion process can be directly related with the degree of starch

Highlight Points

- **Carbohydrates are the cheapest component of fish feed.**
- **Fish do not have a dietary requirement for carbohydrates because of their ability to synthesize glucose from non-carbohydrate precursors.**
- **Optimal dietary inclusion of carbohydrates can increase protein and lipid retention (sparing effect) as well as environmental safeguard (reduce nitrogenous waste).**
- **Glucose transporters and other glucose sensing components in central and peripheral tissues primarily controls glucose metabolism in fish.**
- **Strategies like thermal treatment, different feeding regimes, dietary inclusion level, supplementation of exogenous enzymes and hormones can increase the digestibility and utilization of carbohydrate in fish feed.**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The Effects of Different Preconditioning and Pelleting Processes on the Gelatinization of Starch[1]

Process Type	Processing Variables						Degree of Starch Gelatinization (%)
	Thermal Treatment	Max Temp. (°C)	Steam Exposure (min)	Moisture (%)	Pressure	Shear Force	
Preconditioning							
Thermal	Wet steam	85–100	0.5	15–20	Minimal	Minimal	<50
Expansion	Wet steam	>100	2–3	20–25	High	High	>80
Pellet production							
Cold pellet extrusion	No	na	0	15–20	Moderate	Minimal	0
Compressed pelleting	Dry steam	95	<1	~16	Moderate	Moderate	<40
Extruded dry pelleting	Wet steam	150	2–5	20–24	High	High	>80
Universal pellet cooking (UPC)	Steam	150	2–3	16–18	High	High	60–80

gelatinization and digestibility, i.e., lesser water addition in the extruder significantly reduced the starch gelatinization and digestibility in rainbow trout (Store bakken et al., 2015). The benefits of feeding gelatinized starch (>70% gelatinisation) is important in carnivores like trout, sea bass and sea bream, via maximised starch digestibility, energy supply and resultant protein sparing (Bergot, 1993; Hua and Bureau, 2009; Peres and Oliva-Teles, 2002).

2. Dehulling

Dehulling of raw CHO sources followed by extrusion and micronization with 80% gelatinization can enhance the CHO digestibility up to satisfactory level (Navarro et al., 1999). Such CHO can be incorporated up to a level of 25% in salmon diet, otherwise it is always <20% (Hua and Bureau, 2009).

3. Source of carbohydrate

Depending on the plant source, the starch constituent is highly variable in terms of primary structure, shape, size, distribution, type and amylose to amylopectin ratio (Svihus et al., 2005). These characteristics eventually influence the nutritional and technical value of the starch as a carbohydrate source in fish feed (Glencross et al., 2012). The size of the starch granule and the branching structure decides the available surface area and cleavage sites for the action of digestive enzymes (Dona et al., 2010). The starch granule size of wheat is 22 µm, maize is 35 µm and potato is 40–100 µm and their respective digestibility values in rainbow trout were found to be 58, 34 and 5% (Bergot, 1993).

4. Feeding strategies

A. Meal timing

Meal timing was found to influence the carbohydrate utilization in fish (Lopez-Olmeda et al., 2009). Felip et al. (2015) reported that carbohydrates from a morning meal were used more efficiently than from an afternoon meal. Moreover, provision of a diet with 40% highly digestible dietary carbohydrates in the morning meal resulted in improved digestion and absorption processes in gilthead seabream, leading to a protein-sparing effect and growth comparable to commercial diet with approximately 20% digestible carbohydrates (García-Meilán et al., 2014). Starch digestibility was found to decrease with increasing meal frequency in rainbowtrout (Yamamoto et al., 2007).

B. Alternate feeding schedule

Low protein followed by high protein diet on alternate day influence the carbohydrate utilization in fishes (Brauge et al., 1999b). Juan et al. (2001) reported that 40% CP, 20 % carbohydrate and 25% CP, 40 % carbohydrate fed on alternate day, 25% CP, 40 % carbohydrate gave better growth performance in gill head sea bream.Similar findings are also reported by Enes et al. (2006a), Guerreiro et al. (2004), Kirchner et al. (2003) in Rainbowtr out, Atlantic salmon and Japanese flounder respectively.

C. Influence of dietary lipid

Carnivorous fish such as salmonidsfed with relatively high levels of lipids in their diets have a better protein sparing effect than carbohydrates at a similar level of digestible energy intake (Brauge et al., 1994). High lipid diets reduce starch digestibility in Atlantic salmon (Grisdale-Helland and Helland, 1997) which may be due to the fact that lipids can pass with more velocity than other nutrients through the gastrointestinal tract. Rainbow trout fed with high level of dietary lipids was found to increase the expression and activity of glucose 6-phosphatase, resulting in an elevated postprandial glycaemia that leads to poor dietary carbohydrate utilisation (Panserat et al., 2002b). Change in dietary lipid source from fish oil to vegetable oil was also found to decrease starch digestibility in Atlantic salmon (Figueiredo-Silva et al., 2012).

D. Influence of dietary protein

Optimum dietary protein level and amino acid composition of diet have a greater influence on dietary carbohydrate inclusion and utilization (NRC, 2011). There is positive correlation between dietary protein content and gluconeogenic enzyme activities in fish (Guerreiro et al., 2014).An increase in dietary starch content through a reduction in protein content was associated with poor stimulation of insulin secretion, depressed starch digestibility and fat deposition in black spot sea bream (Figueiredo-Silva et al., 2009). Low protein intake was also associated with high postprandial glycaemia in rainbow trout (Kirchner et al., 2003).

These findings emphasize the need to strike a fine balance

between dietary protein and carbohydrate levels (optimum P:E ratio) in each fish species to make the best use of energy from carbohydrate (protein sparing role of dietary carbohydrate).

E. Influence of dietary vitamin and minerals

The biochemical and physiological roles of certain dietary micronutrients in regulating glucose metabolism have been recognized, but not well understood in fish.For example, vitamin thiamine (vitamin B1) and niacin also take parts in dietary carbohydrate metabolism and utilization in fishes (Shiau and Suen, 1992).A trace element, chromium is known to potentiate the action of insulin and helps in blood glucose clearance in rainbow trout (Bureau et al., 1995). Also, supplementation of dietary zinc is found to influence carbohydrate utilization and growth in tilapia (Zhao et al., 2011).

5. Dietary inclusion level of carbohydrates

The level of dietary carbohydrate inclusion is a major species-specific criterion that determines the utilisation prospects of carbohydrates. CHO digestibility & utilization is found to be more efficient at lower inclusion level. Inclusion beyond tolerable limits causes decrease in ADC of carbohydrate itself but also reduces the digestibility of protein and lipids that hampers the feed utilization and growth performance of the fish thus optimum level should be incorporated in diet (Krogdahl et al., 2005; Stone, 2003). The reduction in digestibility may be due to the substrate overload and subsequent saturation of digestive carbohydrases or a decrease in gut transit time (Spannhof and Plantikow, 1983).

The maximum recommended levels of dietary carbohydrate inclusion fall within 15-25% for salmonids and marine fish, and can go up to 50% for herbivorous and omnivorous species (NRC, 2011).

6. Temperature

Changes in temperature can modify the processing/fate of dietary inputs in terms of carbohydrate utilisation. An increase in the temperature of rearing water within the optimal range is often known to improve amylase activity and starch digestibility leading to higher activity of glycolytic enzymes and finally protein sparing i.e., protein retention and growth in fishes (Alexander et al., 2011; Moreira et al., 2008). Brauge et al. (1995a) reported that energy metabolism is affected by an interaction between temperature and non-protein energy sources (carbohydrate and lipid).

Warm water fish having an edge in carbohydrate utilization over coldwater fish is also apparently true (Wilson, 1994). In tropical countries, within an optimal range when temperature increases, digestibility of starch also increases. So inclusion of carbohydrate is more at higher temperature. Moreover, during summer, maximum CHO should be included in fish diet but during winter it should be reduced. On the other hand, it is important to note that the difference in glucose metabolism and use between carnivorous trout and omnivorous carp exists even at the same temperature (Panserat et al., 2000c).

7. Salinity

During metabolism, salinity was shown to interact with the regulation of glucose oxidation and lipogenesis from radio labelled glucose in rainbow trout fed different levels of dietary starch (Brauge et al., 1995b). In rainbow trout and Atlantic salmon, starch digestibility was found to be lower in sea water than in freshwater which may be due to alteration in intestinal structure or function (Krogdahl et al., 2004). Conversely in African tilapia, intestinal glucose transport was found to be greater in seawater fish than in those acclimated to freshwater, possibly due to enhanced Na+ binding properties which increase carbohydrate utilization (Reshkin and Ahearn, 1987).

8. Stress and photoperiod

Stressors like overstocking, repeated handling and contamination of rearing water by pesticide, heavy metal or other pollutants decreases CHO digestibility and its utilization. Decrease in the length of photoperiod subsequently decreases the digestibility and utilization of carbohydrate. Atlantic salmon reared under continuous light showed higher CHO utilization capacity than fish exposed to simulated winter photoperiod (Hemre et al., 2002b).

9. Genetic modifications

The existence of genotypic differences within species also remains possible in fish, in terms of glucose tolerance and dietary carbohydrate metabolism (Mazur et al., 1992). In two experimental lines of rainbow trout were fed a higher level of gelatinized starch (17%), transgenic trout with growth hormone gene construct reportedly have an enhanced ability to digest and metabolically utilise high dietary levels of carbohydrate than the non-transgenic counterparts (Jin et al., 2014b).So there is a possibility of intra-specific differences in glucose metabolism that could influence the utilization of dietary carbohydrates in farmed fishes.

10. Exercising or training to learn swimming

Training at sustainable swimming speeds was found to reduce the post-prandial hyperglycaemia associated with intake of a high carbohydrate diet (30% digestible starch) in rainbow trout (Felip et al., 2012). Glucose utilisation by trout red muscle increases 28 folds during peak swimming activity (West et al., 1993).Possible reasons behind this phenomenon include the increase in oxygen consumption during swimming, increased energy metabolism and use of blood-borne glucose as fuel (Lauff and Wood, 1996; van den Thillart, 1986).

11. Dietary supplementation of exogenous enzymes

Dietary supplementation of exogenous carbohydrases (α-amylase, cellulase, xylanase, pectinase) in feed can enhance dietary CHO utilization in fishes. Dietary supplementation α-amylase in the feed @ 0.5% level can increase starch and glycogen utilization in Labeo rohita fingerlings (Kumar et al., 2005). Ghosh et al. (2001) reported improved digestibility and utilization of carbohydrate in rohu(Labe rohita) fingerlings when fed diets that had been supplemented with α-amylase and xylanase @ 1.25% level.

12. Reducing the level of crude fibre in fish diet

Crude fibre is a non-digestible carbohydrate which can be incorporated in fish feed upto 8% as roughage or filler. It increases the bulk of chyme in which the digestive enzyme can act more efficiently leading to optimum digestion of carbohydrate (Leggatt et al., 2009). However, higher

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inclusion of crude fibre can lead to constipation, increase in gut transit time, decreases the satiation level and may reduce the utilization of CHO, protein and lipids in feed (Meriac et al., 2014).

13. Modification of gut microbes

During early stages of life digestive system is not well developed in fishes. High carbohydrate rich diet in early stage of fish creates hyperglucosidic and hypoproteic condition in body which can act as stimuli to enhance better gut microbial colonization and proliferation (Meriac et al., 2014). In later stages of life, these microbes can secrete CHO utilizing enzymes which can help in better utilization of dietary carbohydrate in fishes (Ah-Hen et al., 2014).

15. Dietary supplementation of hormones

Dietary supplementation of different neuropolypeptides like cholecystokinin, galanin, gastrin and hormones like leptin, ghrelin and thyroid hormones may enhance the food intake, metabolic activity and digestion of nutrients in fish.

Conclusion

Dietary carbohydrates are the cheapest component in feed. There appears to be more scope for the use of carbohydrates as an energy source to spare protein for omnivorous and herbivorous fish than carnivorous fish. The poor utilization of dietary carbohydrates as an energy source by carnivorous fish suggests that suitable diets for their culture will rely on the presence of lipid to provide energy. More and more basic and applied research is needed to find out some new strategies that can increase the dietary carbohydrate inclusion and utilization by the fishes.

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Ghost nets: Invisible Fishers in the seas

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Fishing gears may get lost into the seas due to rough weather conditions, damages in the gear, entanglement with bottom obstructions like wrecks and reefs or sometimes dragged away by other fishing gears/ boats. Also gears may be discarded intentionally into seas by fishermen if the gear is found defective. These lost gears referred to as abandoned, lost or otherwise discarded fishing gear (ALDFG) continue to catch fishes eventhough fishermen have lost the control over those gears. The phenomenon of capturing target and non-target fishes and other aquatic organisms by ALDFG known as Ghost fishing causes several harmful impacts on fish stocks as well as on endangered species and benthic habitats (Smolowitz, 1978).

Abandoned fishing gear has become a global problem. About 6.4lakh tons abandoned nets are reported to be spread across the world's oceans, contributing to around 10% of oceanic litter according to Food and Agriculture Organization and UN Environment Program (UNEP) (Macfadyen, 2009). Over the last 50 years, the magnitude and impacts of the problem have increased notably due to the growing levels of fishing intensity and increasing durability of fishing gear. Fifty to sixty years ago, nets were fabricated from biodegradable materials like hemp or cotton. With the emergence of synthetic, decay-resistant materials like nylon, nets now can stay active in seas for several years. Concern over ALDFG is increasing due to various negative ecological and economic impacts as well as navigational risks and related safety problems. Studies have shown the occurrence of capture, injuries, and death of marine creatures due to ALDFG (Good et al., 2009; Hong et al., 2013). Living organisms may swallow parts of the lostnets and thus introduce them irreversibly to their digestive system. Ghostnets are pausing greater impacts to fishes and crustaceans. Moreover, these nets are non-selective and poses a greater threat to marine organisms irrespective of their sizes and also to sessile species like corals (Chiappone et al., 2005).

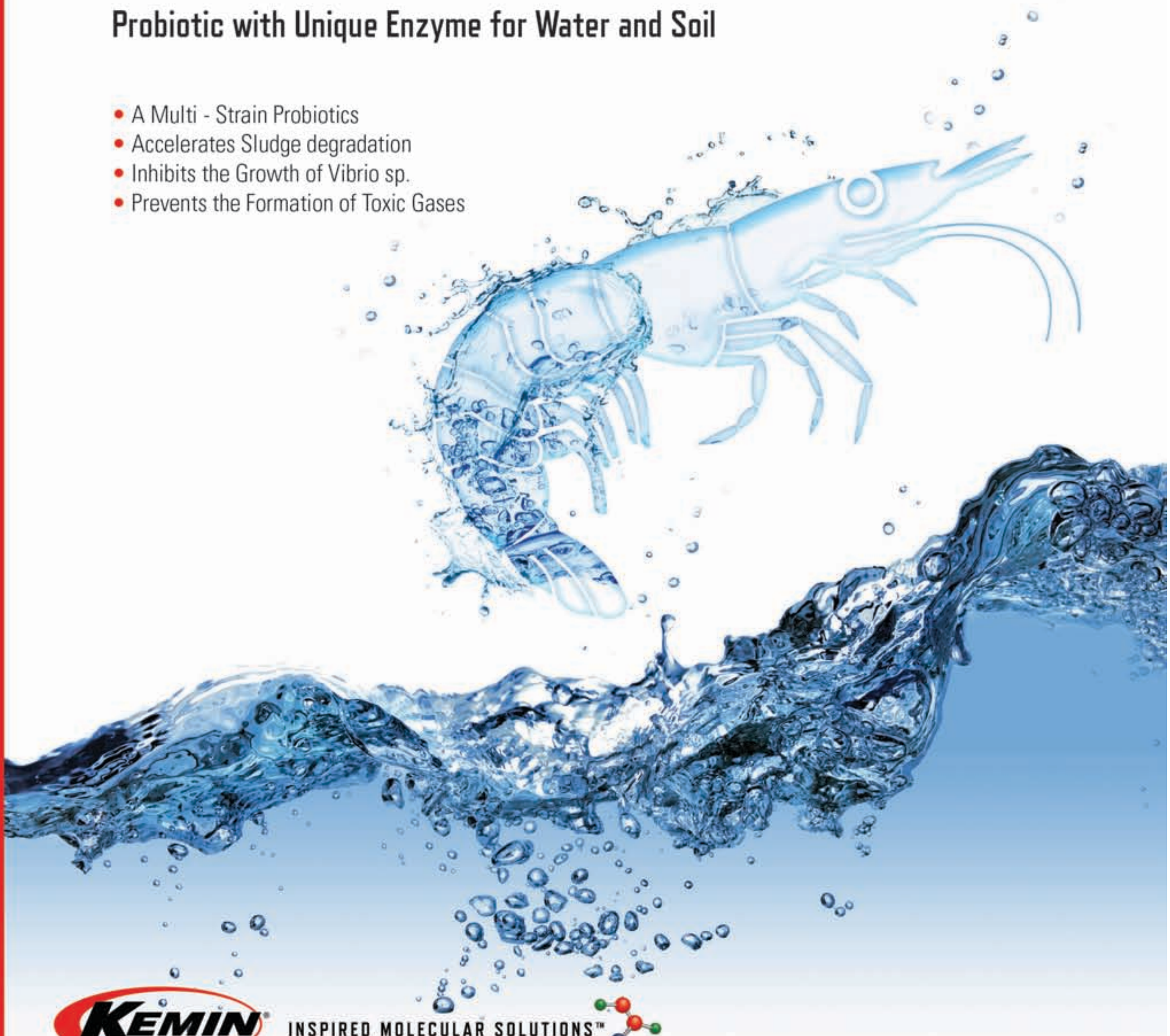
Ghost fishing is mostly due to passive gears like gillnets, tangle nets, trammel nets and traps (Brown et al., 2005). Eventhough gear loss may happen in all fishing activities, active gears like trawls and seines are not much contributing to ghostfishing. Trawls are non selective nets and during operation they disturbs or harms the benthic organisms/environment. However when control over these nets were lost, they become ineffective and does not create much impacts as ghost nets. But passive gears like gillnets and traps keep on fishing for years evenafter the control over them has been lost. These lost nets may become physically damaged or get heavily colonized by encrusting biota due to which they may lose their catching abilities. But before losing their catching efficiency, these nets might have caught numerous target, non-target and threatened organisms which causes their mortality (Nakashima & Matsouka 2004).

Information regarding the magnitude of gear loss or how long these gears continue to fish are limited. This may be due to the reluctance of fishermen to provide such information and the practical difficulties to undertake such realistic long-term studies (Pawson, 2003). Moreover, losses from the respective fisheries due to lost nets are significant from a conservation and economic point of view. Several retrieval programmes have been undertaken in different parts of the world inorder to lessen the number of ghostnets (Cooper et al., 1987; Bech, 1995; Humborstad et al., 2003). The first comprehensive group of studies on lostnets and ghost fishing consequences were by the European Commission funded FANTARED studies, done between 1995–2005 (the FANTARED 1 and 2 projects) into the extent, impact, causes and preventative measures of ghost fishing by static nets and pot fisheries. Various attempts have been made by researchers to reduce the effects of ghost fishing through: techniques designed to find lost nets, removing lost nets with the help of divers or vessels (Large et al., 2009; Mcelwee, 2012), incorporating biodegradable products into nets (Bilkovic et al., 2012), technological support to fishers etc.

From Indian waters such information regarding ghost fishing by gillnets and traps are very less. Pieces of lost gear washed ashore has been reported. Nets washed ashore with crabs entangled in them has been reported during visits to Mithapur beach of Gujarat coast, under Gujarat coast

Highlight Points

- **Abandoned, lost or otherwise discarded fishing gear (ALDFG) continue to catch fishes, other and other aquatic organisms referred to as Ghost fishing and causes harmful impacts on fish stocks as well as on endangered species and benthic habitats**
- **Ghost fishing is mostly due to passive gears like gillnets, tangle nets, trammel nets and traps**
- **Information regarding the magnitude of gear loss or how long these gears continue to fish are limited.**
- **Scientific study is initiated by ICAR-CIFT to quantify the loss rates of traps and gillnets, reasons for their loss and their catching efficiency.**



coral securement Project. Retrieval of ghostnets from few places in India has been reported where ghost nets have been removed from Puducherry and Thiruvananthapuram by Temple Reef Foundation and NGO Friends of Marine Life respectively. Fishing gear loss assessment relating to gillnets and trammels nets in Indian waters' was undertaken by ICAR-CIFT, Cochin during 2017 funded by FAO of UN in association with Integrated Coastal Management, Kakinada in the states of Gujarat, Kerala, Tamil Nadu and Andhra Pradesh of India . The study showed that purposeful gear discard into the water body was almost negligible while the abandoned and lost gear was significant in quantity. However details regarding amount of ghost nets/ lostgears and their catching rate, efficiency are still lacking from Indian waters. ICAR- CIFT under ICAR- Extra Mural Research Fund Scheme , has initiated a scientific study to quantify the loss rates of traps and gillnets, reasons for their loss and their catching efficiency from off the coasts of South Kerala and TamilNadu. The information from the study will be useful to provide valuable insights into the extent of ghost fishing as well as to develop mitigation measures in the future.

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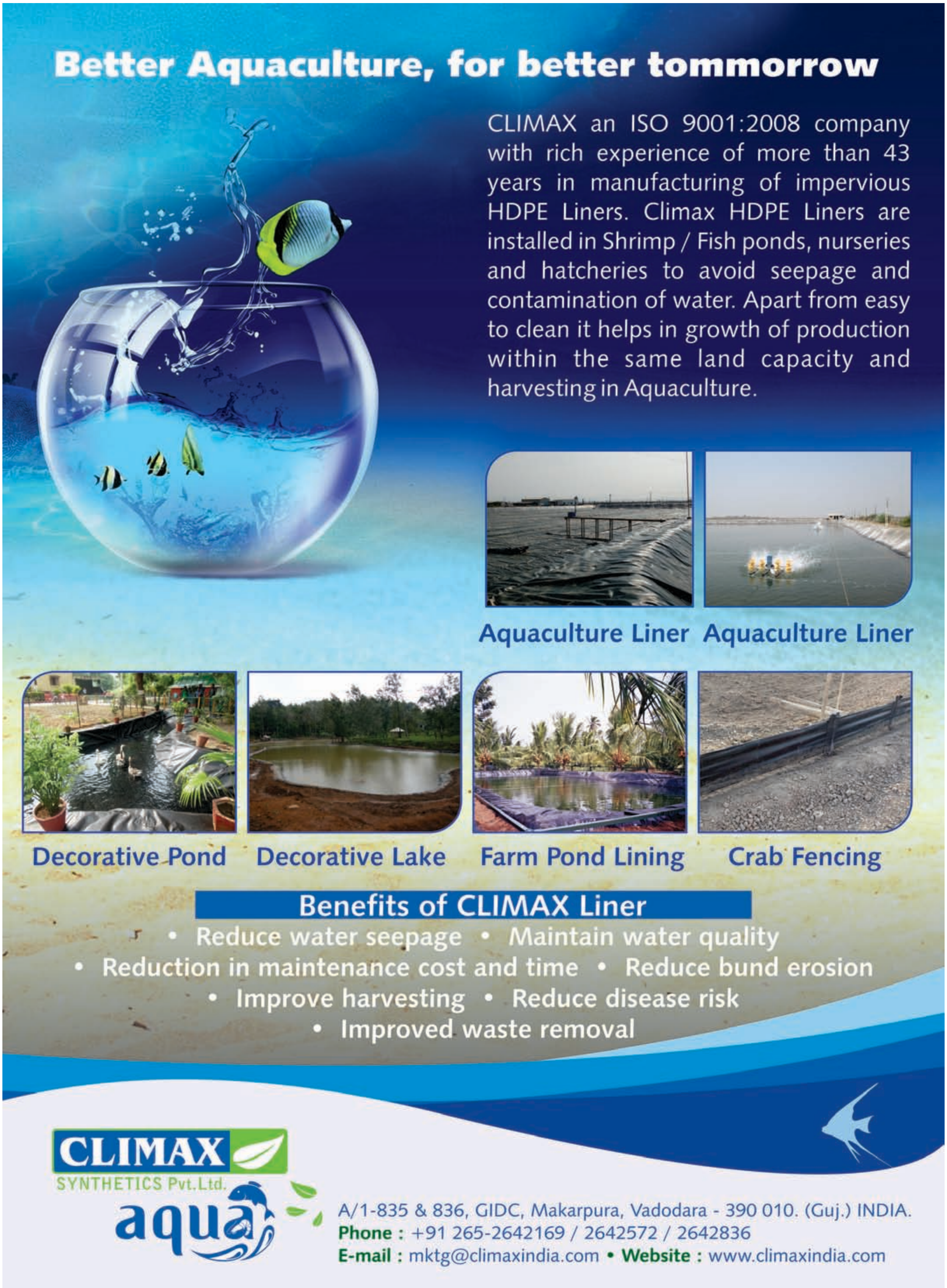
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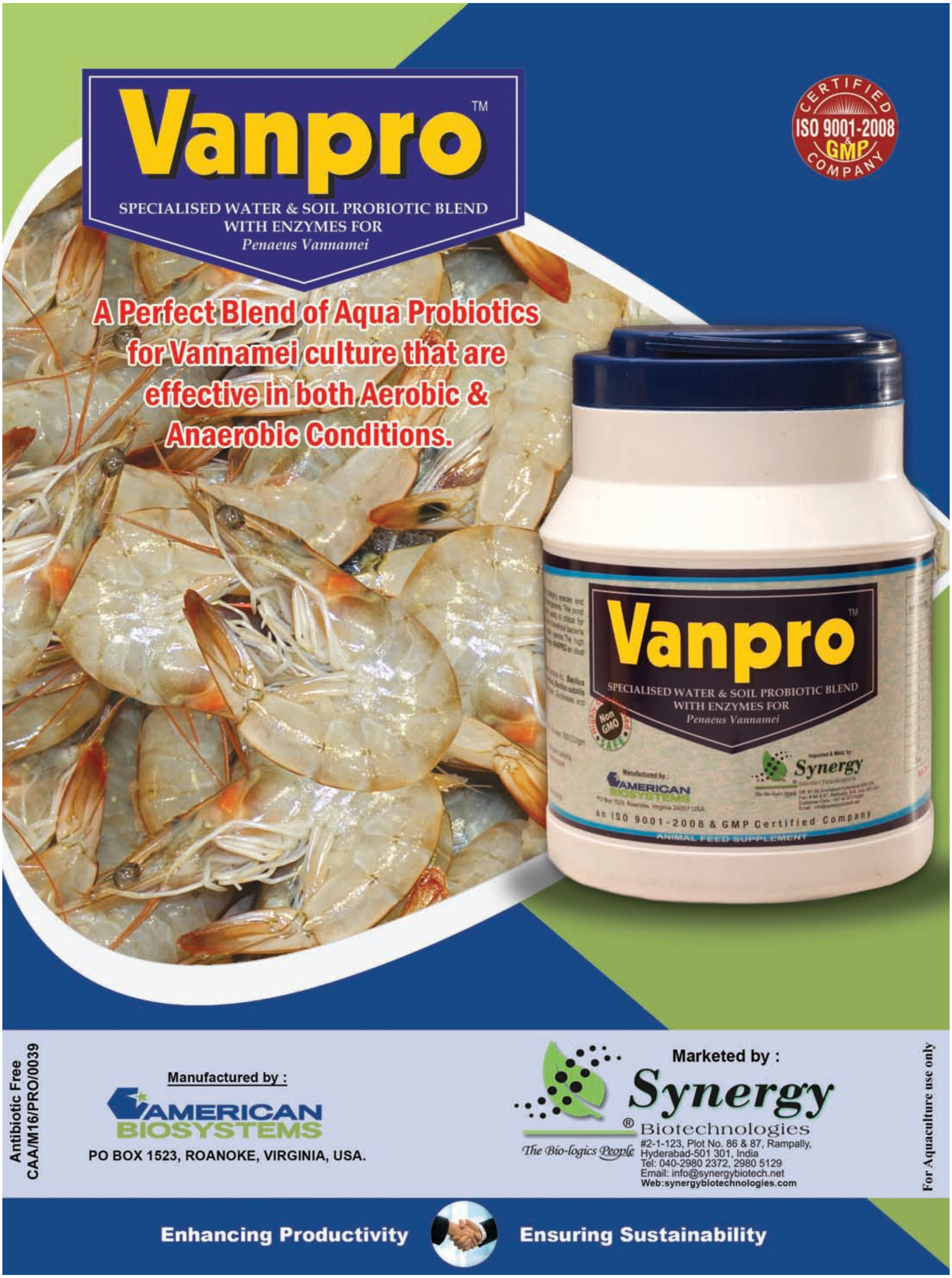
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Gassen Plus

Bon Ammonia and obnoxious Gasses

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

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

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

COMPOSITION:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
STABILIZERS

DOSAGE : 1 Kg per Acre or consult your Aqua Technician For Specific Usage & Dosage

PRESENTATION: 500 gms &1 kg

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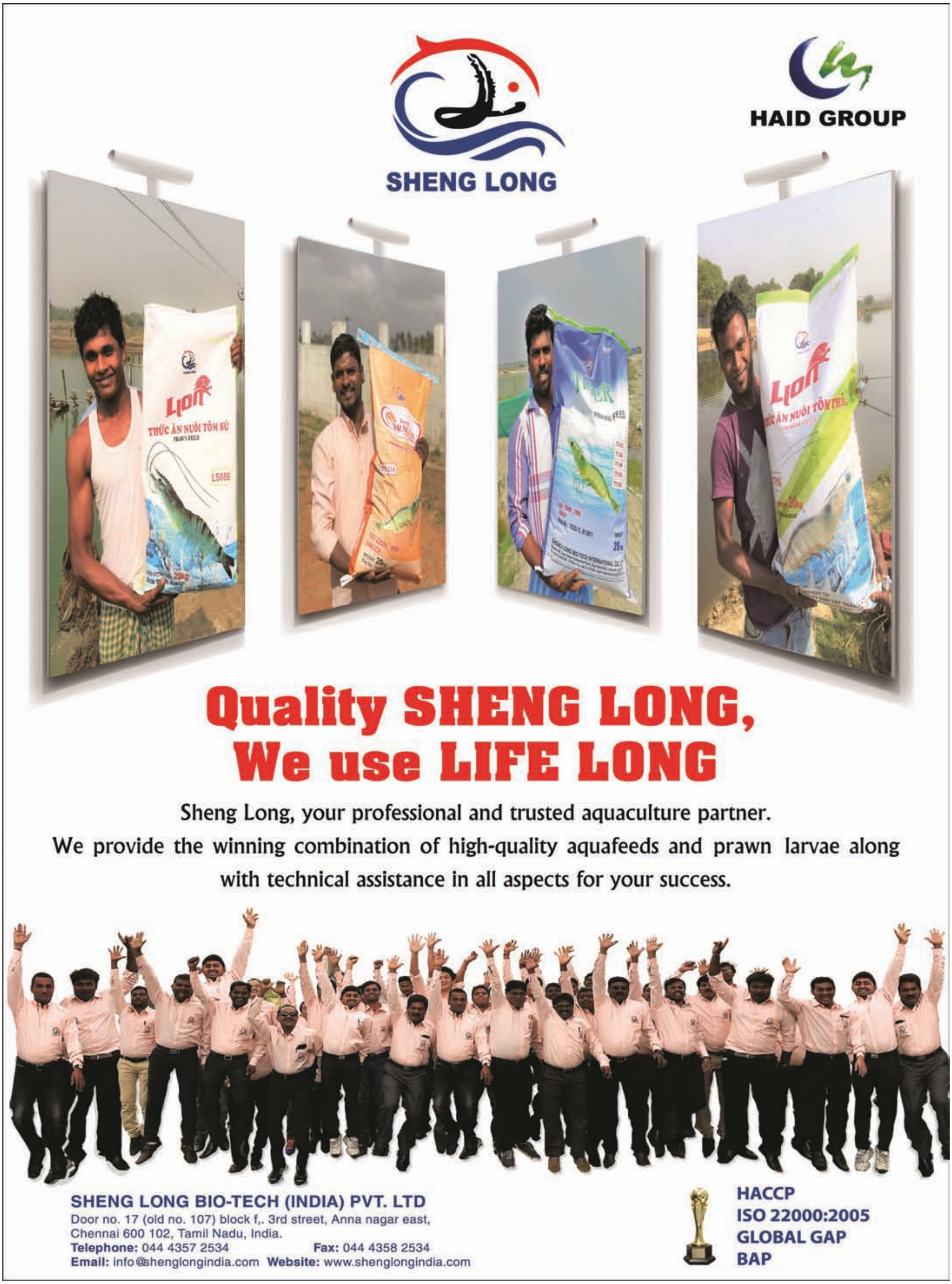
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