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విబ్రియో బ్యాక్టీరియా ని పూర్తిగా నిర్మూలించి vibriosis నుంచి రొయ్యలకి రక్షణ కల్పిస్తుంది .
విబ్రియో ద్వారా సంక్రమించే white faeces ని అరికడుతుంది.
RMS నుంచి రక్షణ కల్పిస్తుంది
బయోఫేజ్ V వాడకం వలన ప్రోబయోటిక్ కి ఎటువంటి హాని జరగదు. మరియు probiotic పనితనం పెరుగుతుంది.
బయోఫేజ్ V వాడకం వలన biofloc పెరుగును. దానివలన గ్రోత్ పెరిగి F.C.R. తగ్గును.
వాడు విధానము:
WATER APPLICATION
6-20 రోజుల D.O.C లో :
ఒక ఎకరాకు 100 ml బయోఫేజ్ - V ని 10 లీటర్ల చెరువు నీటిలో కలిపాలి. అ కలిపిన ద్రావణం ని చెరువులో సమానం గా చల్లవలెను.
అవసరాన్ని బట్టి మరలా
40 నుంచి 50 రోజుల D.O.C లో రెండవసారి వాడవలెను.
FEED APPLICATION
6-20 రోజుల D.O.C లో :
ఒక లీటర్ చెరువు నీటిలో 10 ml బయోఫేజ్- V ని కలిపాలి.
అలా కలిపిన ద్రావణాన్ని 20 ml / kg మేతలో కలిపి
ఉదయం మరియు సాయింత్రం 5-7 రోజులు వాడవలెను.
అవసరాన్ని బట్టి మరలా
40 నుంచి 50 రోజుల D.O.C లో రెండవసారి వాడవలెను.
ఇలా బయోఫేజ్-వి వాడినచో చెరువు నీటిలో , మరియు రొయ్య గట్ లోని విబ్రియో పెరుగుదలను పూర్తిగా నిర్మూలించవచ్చును.
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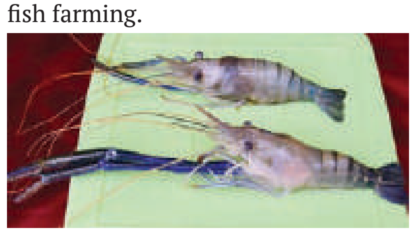

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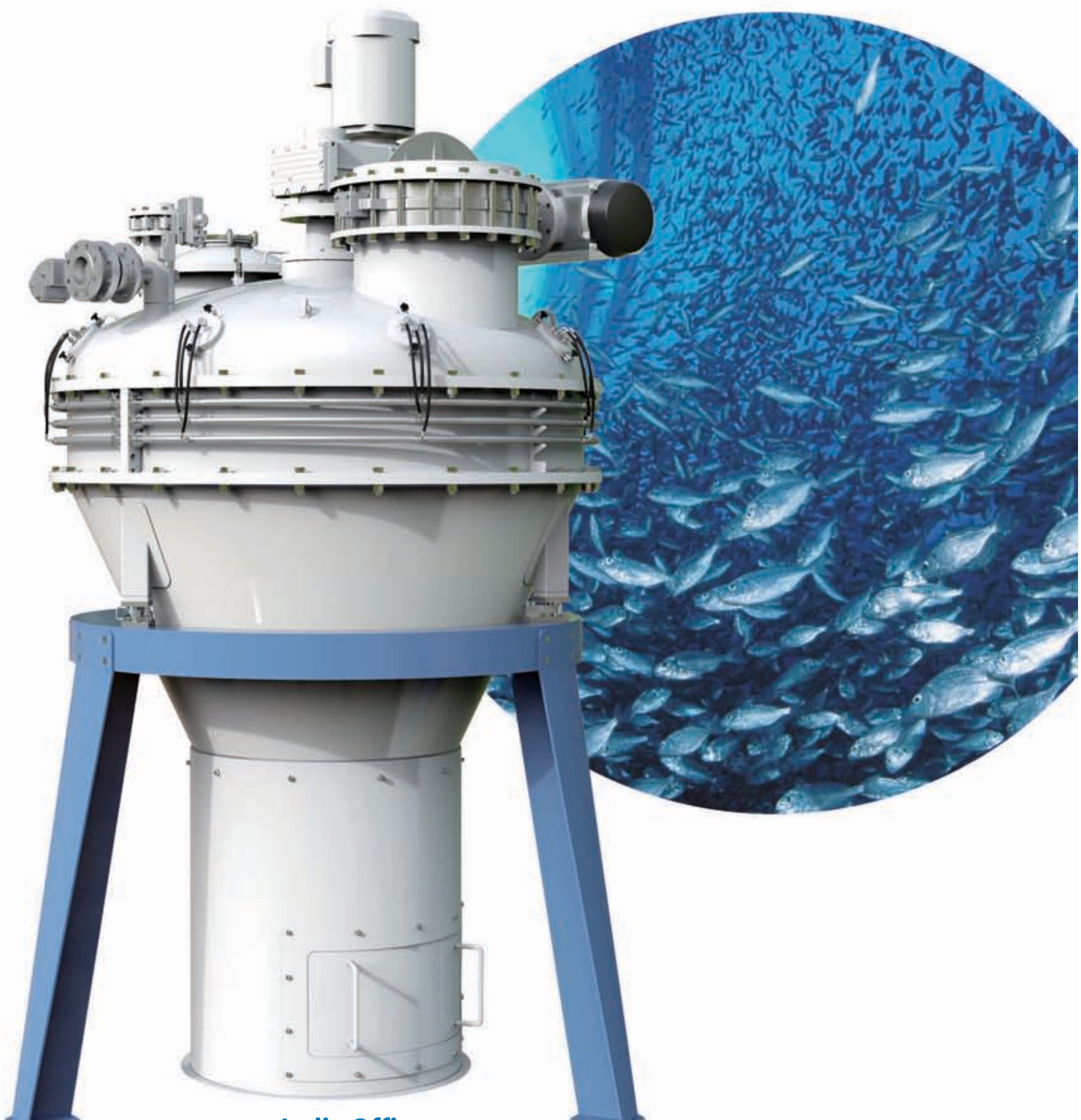

Scampi farming is all set to undergo a sea change in India with a new strain developed by Bhubaneswar based CIFA

As the Fishmeal requirements of the aquafeed industry cannot be met by current Fishmeal production, FM replacers are the only choice. Microalgal biomass and microalgal oil are considered as suitable choice as FM replacers with economically feasible technology. Presently, this is an active area of research in aquaculture nutrition and researchers should keep in mind the sustainable nutrition flow in the food web.

Dear Readers,

The August 2023 issue of Aqua International is in your hands. In the news section, you may find news about ...

Nellore scientist Dr D Jayaprada has developed a breakthrough treatment for Enterocytozoon Hapatopenai (EHP), which has become a significant threat to shrimps leading to major losses to farmers. She stated that notably, EHP can remain dormant in soil or water for extended periods and exhibits virulence under favourable conditions. The economic impact of EHP-infected shrimp farms are profound, with a drastic decline in production and challenges in achieving marketable sizes. She said the project was incubated at Centre for Cellular and Molecular Platforms (C-CAMP), Bangalore, which is a part of Bangalore Life Sciences Cluster, Conceptualized by the Department of Biotechnology, Government of India.

Rythu Swarajya Vedika (RSV) has urged the Telangana government to assert its authority and protect the public interest regarding the breach of policy decision on Genetically Modified (GM) crops by the Genetic Engineering Appraisal Committee (GEAC), the regulator appointed by the Government of India. In a letter addressed to Chief Minister K.Chandrasekhar Rao and Agriculture Minister S. Niranjan Reddy here recently, they said that the Telangana government has taken a decision to not allow Bacillus thuringiensis cotton field trials. However, there are growing concerns that the GEAC is attempting to introduce GM crops in Telangana through alternative channels. Prohibit all forms of open-air releases of GMOs in Telangana, including event selection trials, confined field trials, seed production trials, Biosafety Research Level Trials (BRLT)-1, BRLT-2 and environmental release. Reject the proposal for notified field trial sites in Telangana and uphold the integrity of the NOC system for GM crops. Ensure that GEAC does not entertain any applications for open-air releases of GMOs, including genome-edited organisms in Telangana or any other state with an explicit policy against GM crops.

Scampi farming is all set to undergo a sea change in the country with a new strain developed by Bhubaneswar based Central Institute of Freshwater Aquaculture (CIFA), a premier research centre of Indian Council of Agricultural Research (ICAR). Scampi production in the country has experienced a 2.5-fold increase, soaring from 8,303 to 21,317 tonne in last one year. In a bid to support the rapid expansion, five scampi hatcheries have been selected as multiplier hatcheries by CIFA. "These hatcheries will produce GI Scampi seeds and supply to the farmers. We are adding more hatcheries to our network to reach an ambitious target of bringing 25,000 ha under scampi by 2026," informed CIFA director Dr P. K. Sahoo.

Numerous complaints received by the Chenchus regarding illegal fishing activities in the Krishna River and its catchment areas, which fall within the fifth schedule area of the Nallamala forest, district forest officer Rohith Gopidi has instructed the forest divisional officers of Achampet and Amrabad to address the issue and take strict measures in accordance with wildlife protection laws against those involved in illegal fishing, including the fishermen from Andhra Pradesh and their contractors says a report in Indian Express. Gopi further clarified that outsiders are not permitted to stay along the Krsina river and its catchment area.

Contd on next page

NRS GROUP
Aqua International

Our Mission

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

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

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

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

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

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The fishermen unions in Kerala are planning to launch an agitation demanding to modify the guidelines for the regulation of fishing by Indian-flagged vessels in the high seas by incorporating provisions to modernise the small-scale fisheries sector."It is not wise to stay away from high seas fishing in the name of conservation as it will not make any difference. The squid fishing in the Indian Ocean region grew by 830% during the past five years and the resources are mostly tapped by China. India has been a votary of international agreements on sustainable fishing like the United Nations Convention on the Law of the Sea (UNCLOS), the Southern Indian Ocean Fisheries Agreement (SIOFA), the UN fish stocks agreement and the Indian Ocean Tuna Commission. We should adopt sustainable practices adhering to international regulations and discourage illegal, unreported and unregulated fishing." We should demand strong regulations to fix the number of permits based on scientific data and to set the catch quota. Besides, small-scale fishermen should be empowered to undertake high sea fishing by providing training and equipment. The number of permits for big vessels should be limited to 25%. By demanding a blanket ban we are missing an opportunity.

Phileo by Lesaffre celebrated the opening of the new factory in Valladolid, Spain. More than 100 customers and business partners from the agricultural industry joined Phileo for an afternoon and evening of networking and celebration followed by a thought-provoking symposium entitled 'Reconciling Planet. The inauguration of the new selenium-enriched yeast factory to serve the animal nutrition sector is an example of Lesaffre's desire to evolve and grow alongside its customers in a spirit of partnership, said Brice-Audren Riché Lesaffre during his speech.

The Karnataka Fisheries Development Corporation will shortly begin providing Matsya Vahini e-autorickshaws on lease to fishermen which will help them sell fish and value-added fish products, informed KFDC general manager U. Mahesh Kumar recently. Pilot of the project begins in Bengaluru where 150 such vehicles, each costing ₽8 lakh, will be provided to fishermen beneficiaries chosen by the Fisheries Department.

ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar observed National Fish Farmers' Day at its Kausalyaganga campus on July 10. The day was observed in remembrance of scientists Dr K H Alikunhi and Dr H L Chaudhuri who had successfully induced bred one of the carp species on 10 July 1957. To commemorate this epoch-making discovery National Fish Farmers' Day is observed throughout the country. This discovery had eventually revolutionized the Indian aquaculture industry. Over 200 farmers especially farm women, progressive farmers, entrepreneurs and Govt. officials from Odisha and other parts of the country participated and aquaculture experts of the institute had a detailed discussion on various problems faced by the farmers. Sixteen fish farmers / entrepreneurs from different parts of India were felicitated for their contributions to adopting and promoting ICAR-CIFA technologies across the country.

In the Articles section – Salinization associated with brackishwater aquaculture and its reclamation, *authored by* **Sudarshan S**, said that Brackishwater aquaculture has been argued severely for its negative environmental consequences. Rapid development of such farms on reclaimed mangrove lands and converted agricultural land leads to salinisation of soils. Technologies such as management of salt-affected soils, viz. alternate land-use systems, saline aquaculture, cultivation of salt tolerant crop varieties, agro-forestry, phytoremediation, bioremediation etc., can help to minimize the impact of salinization. Soil salinisation is a widespread soil degradation process, exacerbated by a mismatch between water demands for irrigation in food production and the amount of quality (nonsaline) water.

Another article titled – **Is Fishmeal free Aquafeed a Myth**? *authored by* **Ramya R,** described that the Fishmeal is prepared from small fatty fish species like anchovy, sprat, herring, krill, Norway pout, etc., by cooking, pressing, drying and grinding fresh raw fish or shellfish into a coarse brown flour. Virtually, any fish or shellfish in the sea can be used to make FM. Most of the fish used for FM have relatively short lifecycles, so population numbers can rise and fall substantially depending on fishing pressure and other environmental variables. As the FM requirements of the aquafeed industry cannot be met by current FM production, FM replacers are the only choice. Microalgal biomass and microalgal oil are considered as suitable choice as FM replacers with economically feasible technology. Presently, this is an active area of research in aquaculture nutrition and researchers should keep in mind the sustainable nutrition flow in the food web.

Article titled – **Impact of Aquaculture on Environment,** *authored by* **Dr Jayashri Mahadev Swamy,** discussed that Fisheries sector occupies a very important place in the socio-economic development of the country. It has been recognized as a powerful income and employment generator as it stimulates growth of a number of subsidiary industries and is a source of cheap and nutritious food besides being a foreign exchange earner. Most importantly, it is the source of livelihood for a large section of economically backward population of the country. The fisheries sector is a source of livelihood for over 14.49 million people engaged fully, partially or in subsidiary activities pertaining to the sector. Thus the traditional simple aquaculture system began to be replaced by controlled farming methods such as the semi-intensive / intensive type of farming systems where resources are stocked in high densities and farmed under controlled conditions.

Article titled – **Best Management Practices in Monodon Farming,** *authored by* **Dr Raghavendrudu**, discribed that Aquaculture is an activity producing fish or shellfish mainly for human consumption. It is carried out in ponds, enclosures or in open water bodies and thus involves continuous interaction with the environment. Shrimp cultivation in brackishwater is a long-established practice in coastal districts of Gujarat and Andhra Pradesh states of India. Skretting is a global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry working closely with shrimp and fish farmers.

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

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National Fish Farmers Day celebrated at South 24 Parganas, West Bengal

Subarto Ghosh making presentation, a section of participants are also seen

Kolkata: Production of protein-rich table-size major carps and other fishes in pisciculture ponds in West Bengal and other states and their supply to consumers would not have been possible without the skill, hard work and dedication of elderly and progressive fish farmers in different districts. Thus on 10th July every year in India, efforts, achievements and contributions of progressive fish farmers to inland pisciculture sector are recognized and highly appreciated. Joygopalpur Gram Vikash Kendra (JGVK), located in the rural area of Joygopalpur village under Basanti Block, Dist. South 24 Parganas, WB is a non-Government organization for rural reconstruction, aiming to improve quality of life of poor and marginalized villagers in Sundarbans region of WB. Among others, the fishery programme of JGVK aims to raise household income of villagers through development of scientific and sustainable fish farming. Many local freshwater and brackishwater farmers received training here on scientific fish farming in last 5-6 years. Major carp spawn is produced by induced breeding at Maa Sarada Matsya Hatchery of JGVK; healthy fry are supplied to fish farmers.

JGVK organized a field-level programme on National Fish Farmers Day 2023 on 10 July 2023 and on this occasion, for the benefit of participants, News communicator Subrato Ghosh made two audio-visual farmer-friendly Presentations in Bengali on 'Induced breeding and seed production technique of freshwater fishes' and 'Water and soil quality management of freshwater pisciculture ponds' at Training Hall of JGVK during 10.30am till 1.30pm, emphasizing on the remarkable scientific contributions of renowned fishery and aquaculture scientist Late Hiralal Chaudhuri and his discovery on induced fish breeding by hypophysation made 66 years back on this day. Importance of fish and fish farming for food and livelihood security was also discussed. Forty fish farmers by profession and few women from near by villages of this organization participated actively in lecture sessions.

Mr B. Mahakur, Secretary, JGVK in his talk enlightened participants about some improved and emerging pisciculture practices and concepts as well as available technology packages that may lead increased fish production and income, and the importance of conserving and farming Small Indigenous Fishes. Towards the end, few of the participants shared their experiences and expressed the need of organizing more training-cum-awareness programmes, particularly on supplementary feed and health (disease) management of economically-important cultivable fishes.

Source: *Subrato Ghosh*

Nellore Scientist finds cure for shrimp disease

Nellore: After seven years of research, Dr D Jayaprada develops treatment for Enterocytozoon Hepatopenai-infected shrimp.

After seven years of rigorous research, Nellore scientist Dr D Jayaprada has developed a breakthrough treatment for Enterocytozoon Hapatopenai (EHP), which has become a significant threat to shrimps leading to major losses to farmers.

EHP is a detrimental intracellular microsporidian parasite, a disease which affects shrimps worldwide. They are responsible for growth retardation, increased fed consumption and size variations in the shrimp industry. The parasite spreads rapidly and feeds on the shrimp's nutrients, hindering growth and making the shrimp susceptible to other infections due to weakened immunity. ▸▸

Stating that treatment options for EHP in shrimps are unavailable currently, speaking to TNIE, Jayaprada said that antibiotics are ineffective even though its use in aquaculture is prohibited due to health concerns in consumers. Despite efforts to eradicate the pathogen from ponds using measures such as chlorination or sun drying, its resilience has proven challenging to overcome, she added.

"Notably, EHP can remain dormant in soil or water for extended periods and exhibits virulence under favourable conditions. The economic impact of EHP-infected shrimp farms are profound, with a drastic decline in production and challenges in achieving marketable sizes," she informed.

She further stated that a recent study in India revealed that 17 per cent occurrences of EHP infections are resulting in a production loss of 0.77 million tonnes, valued at over Rs 3,600 crore, she added countries such as Thailand and China face even more severe infection rates, with a 49 per cent occurance of EHP infections, Jayaprada and her team developed a formulation utilizing natural molecules such as flavonoids and hydrolysable tannins, known for their versatile therapeutic values. Derived from plant sources, these natural molecules are environmentally friendly, cost-effective and safe to use, leaving no residuals in the shrimp's body or faecal matter.

In the contrast to antibiotic drugs, our natural molecule therapies ensure the safety of seafood for consumers, providing a sustainable solution. The efficacy of our treatment method has been validated through intensive studies conducted by senior scientist at the Central Institute of Brackish Water Aquaculture (CIBA), Chennai, a research-oriented organization under the Government of India," the scientist noted.

She said the project was incubated at Centre for Cellular and Molecular Platforms (C-CAMP), Bangalore, which is a part of Bangalore Life Sciences Cluster, Conceptualized by the Department of Biotechnology, Government of India. Jayaprada is the head of research wing of Naturelle Herbal Remedies Pvt Ltd in Nellore, a company working on the evidence based herbal medicines.

Stop introduction of GM crops in Telangana, KCR urged

Hyderabad: Concerned citizens, organisations and Rythu Swarajya Vedika (RSV) have urged the Telangana government to assert its authority and protect the public interest regarding the breach of policy decision on Genetically Modified (GM) crops by the Genetic Engineering Appraisal Committee (GEAC), the regulator appointed by the Government of India.

In a letter addressed to Chief Minister K. Chandrasekhar Rao and Agriculture Minister S. Niranjan Reddy here recently, they said that the Telangana government has taken a decision to not allow Bacillus thuringiensis cotton field trials. However, there are growing concerns that the GEAC is attempting to introduce GM crops in Telangana through alternative channels.

"The current regulatory framework poses significant risks to the environment and public health. The near-deregulation of Site Directed Nuclease (SDN) -1 and SDN-2 gene-edited crops, which are categorised as GM crops, raises concerns about uncontrolled proliferation and potential contamination. Independent experts appointed by the Supreme Court have already recommended a ban on herbicide-tolerant GM crops and a 10-year moratorium on Bacillus thuringiensis food crops. Moreover, the GEAC has been granting approvals for open-air releases of GMOs in states with explicit policies against GM crops," they said in the letter adding that instances of GM mustard being planted in States without obtaining No-Objection Certificates (NOCs) from the state governments, including in state agriculture universities, raise concerns about regulatory oversight and accountability.

They said that open-air trials such as GM banana are being conducted without adhering to the Telangana state NOC system.

"Withdraw the environmental release approval for GM mustard by the Union government and GEAC. Prohibit all forms of open-air releases of GMOs in Telangana, including event selection trials, confined field trials, seed production trials, Biosafety Research Level Trials (BRLT)-1 and BRLT-2, and environmental release. Reject the proposal for notified field trial sites in Telangana and uphold the integrity of the NOC system for GM crops. Ensure that GEAC does not entertain any applications for open-air releases of GMOs, including genome-edited organisms, in Telangana or any other state with an explicit policy against GM crops," the letter read.


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CIFA's GI scampi to give new life to fish farming

Genetically improved strain of freshwater prawn will enhance productivity and profits

Bhubaneswar: Scampi farming is all set to undergo a sea change in the country with a new strain developed by city-based Central Institute of Freshwater Aquaculture (CIFA), a premier research centre of Indian Council of Agricultural Research (ICAR).

CIFA has developed a genetically improved strain of freshwater prawn 'Macrobrachium rosenbergii'. Named as CIFA-GI Scampi, the new variety will enhance productivity and profitability. The new freshwater prawn variety has been developed as part of a collaborative endeavour of CIFA with WorldFish, Malaysia. The collaboration was meant to implement a systematic selective breeding programme to develop a fast-growing strain of scampi.

With the new strain, the Prime Minister Matsya Sampada Yojana (PMMSY) is poised to breathe a new life into scampi farming, which had declined in recent years. Principal investigator of PMMSY scampi project, Bindu R Pillai said the breeding programme spanned 14 generations and involved the meticulous selection of scampi populations sourced from geographically diverse regions, including Gujarat, Kerala and Odisha.

"Through rigorous genetic selection protocols, CIFA has successfully developed the genetically improved fast-growing strain GI Scampi, which has received official registration marking a significant milestone in the field of aquaculture," she said.

CIFA has been extended funding support to the tune of Rs 4 crore under PMMSY to upscale the genetic selection programme and strengthen the seed value chain through supply of improved brood stock to a network of multiplier hatcheries.

The ICAR institute has also demonstrated polyculture of scampi with carp. Bata Krushna Jena from Jajpur district has got an yield of 950 kg per hectare of GI Scampi and 7,530 kg per hectare of carps in just seven months. "This step exemplifies the success and potential of carp-scampi polyculture, offering promising opportunities for fish farmers across the state," said Pillai. >>

>> Scampi production in the country has experienced a 2.5-fold increase, soaring from 8,303 tonne to 21,317 tonne in last one year. In a bid to support the rapid expansion, five scampi hatcheries have been selected as multiplier hatcheries by CIFA. "These hatcheries will produce GI Scampi seeds and supply to the farmers. We are adding more hatcheries to our network to reach an ambitious target of bringing 25,000 ha under scampi by 2026," informed CIFA director Dr PK Sahoo.

Restrictions on fishing in Krishna River under Amrabad forest

Gopidi further clarified that outsiders are not permitted to stay along the Krishna River and its catchment area.

Krishna River (File Photo)

Nagarkurnool: Following numerous complaints received by the Chenchus regarding illegal fishing activities in the Krishna River and its catchment areas, which fall within the fifth schedule area of the Nallamala forest, district forest officer Rohith Gopidi has instructed the forest divisional officers of Achampet and Amrabad to address the issue and take strict measures in accordance with wildlife protection laws against those involved in illegal fishing, including the fishermen from Andhra Pradesh and their contractors, says a report in Indian Express.

In a circular issued to the relevant officials recently, Gopidi said that fishing in the Amrabad Tiger Reserve (ATR) is strictly prohibited. He also made it clear that violating this prohibition will result in penalties and imprisonment as stipulated by the Wildlife Protection Act of 1972 and the Telangana Forest Act of 1967. Gopidi further clarified that outsiders are not permitted to stay along the Krishna River and its catchment area.

High-sea fishing Unions question Centre's move

The Union government introduced the Indian Marine Fisheries Bill in 2021, but it was not taken forward due to which the fishing in India's Exclusive Economic Zone continues to be unregulated.

Kochi: The fishermen unions in Kerala are planning to launch an agitation demanding to modify the guidelines for the regulation of fishing by Indian-flagged vessels in the high seas by incorporating provisions to modernise the small-scale fisheries sector.

The unions have objected to the draft guidelines alleging that it encourages private capital investment which may facilitate corporate firms to enter the sector and thus adversely affect the livelihood of traditional fishermen.

The draft notification to issue permits for fishing operations in the area beyond national jurisdiction was issued in July 2022.

"The scientific committee of the Indian Ocean Tuna Commission (IOTC) has cautioned against the over-exploitation of tuna resources. The precarious state of tuna stocks is evident from the fact that the catch of Yellowfin tuna has surpassed the maximum sustainable yield. The Centre is planning to issue permits to large factory vessels owned by corporate firms.

The guideline does not specify the number of vessels that will be provided licences to fish in areas beyond national jurisdiction. Issuing more permits will adversely impact the livelihood of traditional fishermen from Tamil Nadu and Kerala who are operating 900 vessels in the sector," said Fishermen Coordination Committee president Charles George.

The draft notification recommends a licence fee of Rs 5 lakh for vessels with a length of over 25m. The fee should be reduced by half and the number of licences should be regulated based on scientific advice, he said.

The concerns raised by small-scale fishermen are genuine and should be addressed, however, we cannot blindly oppose the move to promote fishing on high seas as large mother vessels from China, Korea and Japan are exploiting the resources, said fisheries researcher and founder vice chancellor of Kerala University of Fisheries and Ocean Studies (KUFOS) B Madhusoodana Kurup.

"It is not wise to stay away from high seas fishing in the name of conservation, as it will not make any difference. The squid fishing in the Indian Ocean region grew by 830% during the past five years and the resources are mostly tapped by China. India has been a votary of international agreements on sustainable fishing like the United Nations Convention on the Law of the Sea (UNCLOS), the Southern Indian Ocean Fisheries Agreement (SIOFA), the UN fish stocks agreement and the Indian Ocean Tuna Commission. We should adopt sustainable practices adhering to international regulations and discourage illegal, unreported and unregulated fishing," he said.

Though the Union government had introduced the Indian Marine Fisheries Bill in 2021, it was not taken forward due to which the fishing in India's Exclusive Economic Zone (EEZ) continues to be unregulated, said Madhusoodana Kurup.

We should demand strong regulations to fix the number of permits based on scientific data and to set the catch quota. Besides small-scale fishermen should be empowered to undertake high sea fishing by providing training and equipment. The number of permits for big vessels should be limited to 25%. By demanding a blanket ban we are missing an opportunity, he said.


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Phileo celebrates sustainable agriculture at its new factory in Spain

Phileo by Lesaffre brought together more than 100 key stakeholders of the livestock industry at its new Selsaf production factory to discuss the future of a sustainable agriculture.

Spain: Phileo by Lesaffre celebrated the opening of the new factory in Valladolid, Spain. More than 100 customers and business partners from the agricultural industry joined Phileo for an afternoon and evening of networking and celebration followed by a thought-provoking symposium entitled 'Reconciling Planet, People and Profit for a positive impact.'

An integral aspect of sustainability is the responsible local sourcing of raw materials and ingredients. Committed to a sustainable agrifood industry and to answer the growing demand, Lesaffre constructed a new factory in Valladolid for the production of Selsaf, Phileo's nutritional solution enriched in organic selenium, and the ideal location to discuss the future, and examine available and future solutions for a sustainable agriculture.

"For 170 years, and on the initiative of its founders Louis Lesaffre and Louis Bonduelle, the group has built itself up with a very strong entrepreneurial spirit, and a constant concern to meet the evolving needs of its customers in various fields of expertise. The inauguration of this new selenium-enriched yeast factory to serve the

General Manager Lesaffre, Dr Brice-Audren Riché welcomes visitors

animal nutrition sector is an example of Lesaffre's desire to evolve and grow alongside its customers, in a spirit of partnership," said Brice-Audren Riché, General Manager of Lesaffre during his speech.

In the event, Jean Baptiste Dollé, Head of Department Environment at Institut de l'élevage, set de scene of a climate smart agriculture, showcasing methodologies and tools like Cap'2r, that are developed to evaluate the impacts on climate change and water pollution and to assess the positive contributions on biodiversity and carbon sequestration of milk and beef production. A practical example of low carbon dairy and beef farming was given by Maxime Briche, Phileo's Western Europe Ruminant Manager with data showing how Actisaf, Phileo's yeast probiotic helps to reduce the climate impact of milk production.

Dr Elisabeth Santin, ISI Institute Brazil, had the attention of the public when she emphasized the importance of avoiding oxidative stress in animals as it has shown to compromise their health status and lead to immunosuppression and decreased production parameters.

Dr Ruth Raspoet shared this vision and elaborated how Selsaf helps the body resist against oxidative stress (which is detrimental to animal performance), both in the short term (thanks to selenocysteine) and in the long-term (due to selenomethionine) and boosts natural defences of animals.

This dual protection leads to dual benefits to farmers and consumers. For farmers, Selsaf supports animal health (better embryo viability and survival rate, more selenium transfer to offspring, less morbidity) and increases animal performance (higher feed efficiency, growth performance, laying intensity). In reducing the oxidation, and therefore the rancidity of animal-derived end-products, Selsaf also brings a lot of benefits to consumers, with more selenium in meat, milk and eggs, and more food pleasure with increased meat quality (less drip loss, increased juiciness and tenderness).

Dr Julie Schulthess concluded with a comprehensive talk on immunity and explaining how immune fitness is a measure of animal health, welfare and productivity.

Nourishing the world and preserving the planet is a huge responsibility — and opportunity — for agriculture and Phileo by Lesaffre following the group's vision, concluded, Dr Gildas Joalland, chairman of the symposium.

Left photo: Celebration 170 years Lesaffre at the new factory. (from left to right: Luis Ronda,General Manager Lesaffre Iberica – Brice-Audren Riché, General Manager Lesaffre -Joost Welten, Global Sales Director, Phileo by Lesaffre)

Pilot project of Matsya Vahini e-autorickshaws to sell fish and value-added products to begin in Bengaluru

Karnataka Fisheries Development Corporation to provide vehicles on lease basis to beneficiaries identified by the fisheries department.

Mahesh Kumar, general manager, Karnataka Fisheries Development Corporation, speaking at a training programme at the College of Fisheries in Mangaluru

Bengaluru: The Karnataka Fisheries Development Corporation (KFDC) will shortly begin providing Matsya Vahini e-autorickshaws on lease to fishermen which will help them sell fish and value-added fish products, said KFDC general manager U. Mahesh Kumar on recently.

Pilot of the project begins in Bengaluru where 150 such vehicles, each costing ₹8 lakh, will be provided to fishermen beneficiaries chosen by the Fisheries Department, Mr. Kumar said. He was speaking at the inauguration of a three-day training workshop on "Fish processing and value addition fish products" organised by the College of Fisheries here. Fishermen from Chamarajanagar and a few other districts are participating in the workshop.

The Matsya Vahini scheme is a part of Pradhan Mantri Matsyasampada Yojana. The vehicles, modified to suit the needs, are equipped with freezers and other essentials necessary not just to sell fresh, but also to sell 'chakkuli', pickles, and other value-added products made of fish, he said.

KFDC owns the vehicles and provide them on ₹3,000 monthly rent along with ₹2 lakh (₹1.5 lakh for SC/ST beneficiaries) refundable deposit. The KFDC has proposed to hand over the vehicles to beneficiaries upon successfully operating them continuously for five years. The department however is yet to ratify it, Mr Kumar said.

"The Government Order about this programme was issued on Wednesday. Norms for selecting the beneficiaries will be announced shortly," he said. Upon success of the pilot in Bengaluru, it will be extended to other regions in the State.

Mr Kumar said Karnataka has made significant progress in export of fish and the State is now placed seventh in terms of fish export. He urged fishermen to adapt techniques developed by College of Fisheries to give value addition to fish products, and wholesomely contribute to growth of blue economy of the nation.

Workshop coordinator and associate professor, Department of Fish Processing Technology, College of Fisheries, B. Manja Naik said the college has trained over 800 fishermen and good number of trainees have become entrepreneurs. "We are ready to share technology in preparation and marketing of pickles and other eatables made out of fish," he said.

College Dean H.N. Anjaneyappa, also spoke.

ICAR-CIFA observes National Fish Farmers' Day 2023

ICAR-CIFA observes National Fish Farmers' Day 2023

Bhubaneswar: ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar observed National Fish Farmers' Day at its Kausalyaganga campus today. The day is observed in remembrance of scientists Dr K H Alikunhi and Dr H L Chaudhuri who had successfully induced bred one of the carp species on 10th July, 1957.

To commemorate this epoch-making discovery National Fish Farmers' Day is observed throughout the country. This discovery had eventually revolutionized the Indian Aquaculture industry.

The Chief Guest, Dr N. Thirumala Naik, IAS, State Mission Director-cum-CEO, Department of Mission Shakti, Odisha appreciated ▸▸


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the institute for the service it is rendering to the nation and exhorted the scientists to develop customized technology packages for women farmers. He said SHGs have to graduate to thriving enterprises. With over six lakhs SHGs in Odisha and priority leasing of Gram Panchayat tanks given to them, fisheries in Odisha will grow rapidly, added Dr Naik.

The Guest of Honour, Dr B P Mohanty, ADG, ICAR stressed gender mainstreaming in aquaculture. Women need to be actively involved in aquaculture as it supports family's nutrition as well as economy, he added.

He called for more representation of women in decision-making roles in the aquaculture industry.

Earlier, Dr Pramoda Kumar Sahoo, Director, ICAR-CIFA said the institute has contributed significantly toward the development of breeding and culture of economically important fish and shellfish; use of plastics in aquaculture like FRP portable hatchery, feeder; feeds for different life stages of fish, disease diagnostics kits, improved rohu Jayanti, CIFABROODTM, CIFA GI Scampi, Amrut Catla and other useful technologies for the farmers. The Institute has developed Matsya Setu app to facilitate virtual learning and it has got a user base of 43000 and it's growing. ICAR -CIFA is committed to its stakeholders and is reaching out to them through Flagship Schemes under the Government of India.

Over 200 farmers especially farm women, progressive farmers, entrepreneurs and Govt. officials from Odisha and other parts of the country participated and aquaculture experts of the institute had a detailed discussion on various problems faced by the farmers.

Sixteen fish farmers/ entrepreneurs from different parts of India were felicitated for their contributions to adopting and promoting ICAR-CIFA technologies across the country. The awardees also shared their experience in fish farming with the audience during Farmers-Scientists interaction held in the afternoon.

Four Regional Research Stations of the Institute located at Vijayawada, Bathinda, Rahara and Bengaluru also observed this important day.

*(**Source**: ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar)*

The Center for Responsible Seafood hosting 2023 Shrimp Summit in Vietnam

Vietnam: The Center for Responsible Seafood is hosting the 2023 Shrimp Summit from 24 to 26 July 2023, in Ho Chi Minh City, Vietnam.

The three-day summit will gather leaders in the global shrimp industry to discuss production efficiency, growers' livelihoods, market demand, sustainability and climate change, according to the Center for Responsible Seafood President George Chamberlain.

"The 2023 Shrimp Summit will convene the global seafood value chain to address the critical challenges facing shrimp farming in Asia and across the globe, from stagnant production to growers' livelihoods. The ultimate objective of the Summit will be to improve the shrimp farming sector by developing practical, consensus solutions to existing challenges," Chamberlain said. "This is an opportunity to reshape the shrimp farming sector with improved efficiency and sustainability and to begin collective plans to expand market demand."

While the summit will have a virtual component, attendees will also have the opportunity to participate in tours showcasing high-tech super-intensive farming being performed by Minh Phu, Vietnam's leading shrimp farming firm and extensive shrimp aquaculture methods in mangroves and rice paddies in Ca Mau province.

Also during the event, The Center for Responsible Seafood will hand out lifetime achievement awards to Motosaku Fujinaga, who pioneered shrimp aquaculture in Japan and CP Foods Executive Vice President Robins McIntosh, who leads CP Foods' Homegrown Shrimp operation in the U.S. state of Florida. McIntosh will also deliver the keynote address.

The Center for Responsible Seafood is a non-profit organization centered on research, education and collaboration to support responsible and regenerative seafood production. The event is co-hosted by The Vietnam Department of Fisheries, the Vietnam Fisheries Society (VINAFIS), the International Collaborating Centre for Aquaculture and Fisheries Sustainability (ICAFIS), the Global Seafood Alliance (GSA) and is receiving support from the vice chairman of the Peoples Committee of Ca Mau.

Sponsors include The US Soybean Export Council (USSEC), AZ Gems, Inc., Thai Union, MinhPhu Seafood Corporation, Devi Seafoods, Grobest, The Center for AquacultureTechnologies, PT Suri Tani Pemuka, F3 Future of Fish Feed, Apex Frozen Foods, Devi Fisheries, Eastern Fish Company, Aqualma, C.P. Vietnam Corporation, Unibio(India), Mitsui & Co., Hatcheries Private Limited, Quoc Viet, Vitapro, Veramaris, North American Renderers, H&N Seafood, IDH, AEGIS and Stapimex.


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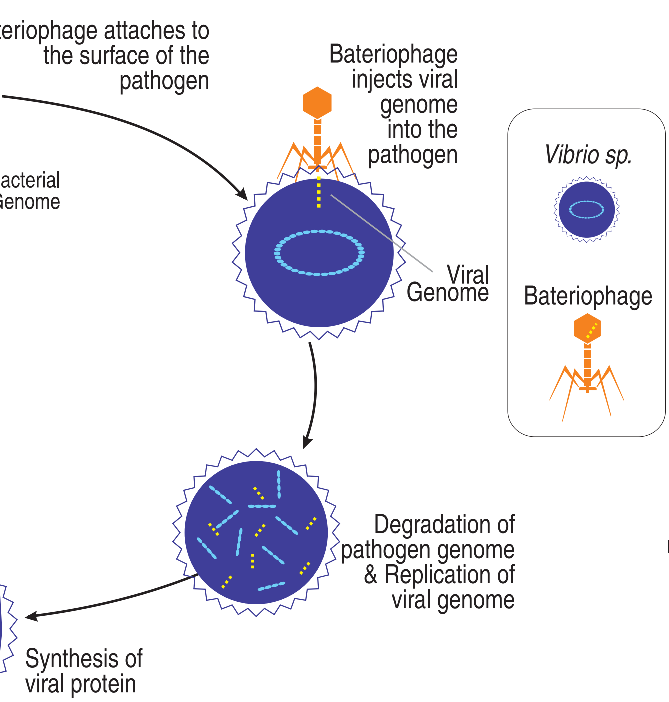

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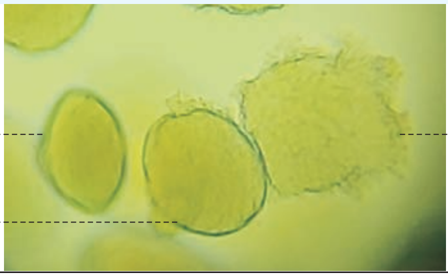
Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope

Colony 1 in Stage 1: Intact Colony may be infected or yet to get infected.

Colony 2 in Stage 2: Phage infected Colony showing Partial lysis.



Colony 3 in Stage 3: Phage infected Colony Completely lysed, cell contents with multiplied phages spreads out in search of their host.

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A note on prospects of marine finfish farming in cages in coastal waters and open sea

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Pressure upon marine finfish resources in nature

In India, marine fishery sector contributes significantly to production of economically-important fishfood towards food security, income generation and employment generation. Nutritive value of marine finfishes is considered equivalent or slightly superior to inland (freshwater) finfishes; protein and long-chain fatty acid content in the former is recognized as a valuable ingredient in our daily diet. Marine finfishes in Indian waters have been exploited continuously and often unjudiciously by professional and progressive coastal and marine fishermen communities, due to which, resources of some commercially-important marine finfishes have got degraded and overharvested. Ever-growing human population and rising demand for marine fish protein have gradually stressed the coastal and marinefinfish habitats during the last 15-20 years, which has led to gradual decline of production of many important marine finfishes.

We understand that sustainability of marine fishery resources in India is jeopardized by incessant fishing pressure applied, further made more worse by the impacts of marine pollution andintervention of coastal dwellers.In the last two decades, there have been reports on decline in the yield of conventional marine fish stocks from Indian seas, chiefly through overfishing. Indian marine capture fishery has gone beyond sustainable exploitation levels, and increase in the extent of overfishing will cause irreparable damage to important marine fish resources. Important marine fish stocks must be exploited sustainably with high long-term yields, but often commercial mechanized fishing trawlers operating with increasing fishing effort and excessive fishing capacity are less bothered to ensure it.

Importance and need of mariculture

In 2020-2021, marine fish production in India amounted to 34.80 lakh tonnes (Source: On-line Presentation of Dr A. K. Das, Principal Scientist, ICAR-CIFRI on Enclosure Culture on 1/11/2022); the same in West Bengal in 2019-2020 was 1.63 lakh tonnes (Source: Handbook of Fisheries Statistics, 2020, Government of India). As the growth and production level in Indian marine fishery sector continue to stagnate, which is likely to remain at the same level or even decline further, the only viable option to enhance marine fish production is through aquaculture in confined system under controlled condition. In a National Seminar at Kochi on 2/12/2009, Dr P. S. B. R. James (Former Director, ICAR-CMFRI, Kochi) in his Lecture opined that improvement in domestic marketing, diversification of marine product export, availability of culture technologies and favourable coastal waters for mariculture and sea farming will encourage fish production *via* mariculture in India. In order to sustain Indian marine fish production, mariculture is a viable and fruitful alternative, ensuring sustainability of livelihood income of fish farmers including fishermen. It is a priority thrust area to achieve and enhance the production of some commercially-important brackishwater and marine finfishes, whose controlled breeding, broodstock development, hatchery seed production, nursery rearing and grow-out technologies have been standardized till date - ongoing research in this aspect is certainly prospectful.

Late Dr P. V. Dehadrai, Former Deputy Director General (Fisheries), ICAR emphasizedin his speech at the 'Fish For All: National Launch programme' at Kolkata on 19/12/2003 on the need to develop and improve finfish farming in Indian seas and coastal mariculture technologies to help the sector achieve additional fish production. He further put thrust on consolidating mariculture and sea-farming technologies of finfishes in India into packages of practices for augmenting marine fishfood production.

Cage culture of marine finfishes in open seas is likely to make a big impact on Indian aquaculture in days to come in a sustainable manner. Padmashri Dr S. Ayyappan, Former Director General, ICAR emphasized on 'Need of Resilience in Fisheries and Sustainability in Aquaculture' in at-least three occasions in his Plenary Talks in National-level forums since 2/12/2001. India has a vast potential for marine aquaculture in cages in coastal seas in south-east, north-east, south-west and north-west coasts of India. The prospective candidate finfish species(s) for mariculture in India, both in brackishwater (coastal) farm ponds and in mariculture cages, are Asian seabass *Lates calcarifer*, grey mullet *Mugil cephalus*, cobia (*Rachycentron canadum*), silver pompano (*Trachinotus blochii*, *Trachinotus mookali*), grouper (*Epinephelus coioides*, *Epinephelus tauvina*, *Epinephelus fuscoguttatus*), seabream (*Lethrinus* sp), red snapper (*Lutjanus* sp). In the shallow coastal seas and coral reef ecosystems of India, seeds of *Lutjanus* sp and *M. cephalus* can be exploited sustainably for stocking and farming in net cages installed in shallow estuarine region and nearshore waters. All these finfishes exhibit fast growth rate in culture conditions, good meat quality and high market demand.

Available technologies of RGCA-MPEDA and ICAR-CIBA

Rajiv Gandhi Centre for Aquaculture (RGCA), a wing of MPEDA, Government of India produces and supplies good quality hatchery-produced seeds of *L. calcarifer* year round to fish farmers. *L. calcarifer* is a brackishwater-cum-marine finfish species, highly preferred in domestic market in West Bengal and other states. The institute has upgraded and perfected the grow-out culture technology of *L. calcarifer* in installed cages, both in brackishwater ponds and in open sea. It has been standardized at the Aquaculture Demonstration Farm Project of *L. calcarifer* where more than 90% survival rate was achieved. Cage culture is a 'more production' concept of commercial *L. calcarifer* culture. In West Bengal, necessary technical guidance can be obtained from RGCA scientists and experts on grow-out culture of *L. calcarifer* in cages. In the Technical Workshop on 17/1/2023, Dr S. Kandan, Director, RGCA comprehensively discussed in his presentation about promotion of *L. calcarifer* culture in West Bengal, the possibilities and popularization of its culture in commercial manner. He highlighted the methods of *L. calcarifer* farming in open sea cages (5 x 5 x 3 cubic.mt) installable in areas having more than 12mt water depth, with a stocking density of 5nos/sq.mt. According to RGCA scientists, grow-out culture of *L. calcarifer* in cages in open seas, estuaries and brackishwater ponds are the best commercial options.

Scientists of ICAR-Central Institute of Brackishwater Aquaculture have also standardized breeding and seed production technology for *L. calcarifer* in year 1997; scientists have made sure about availability of *L. calcarifer* seeds to the farmers of different coastal states of India throughout the year. It will definitely boost *L. calcarifer* culture and production in cages. A unique package of practice has been developed by ICAR-CIBA for *L. calcarifer* farming in cages and other aquaculture systems, and also that of intensive farming of the finfish in cages (extensively field-tested and demonstrated).

Available technologies of ICAR-CMFRI

Techniques for hatchery seed production of the marine finfish species *R. canadum*, *T. blochii*, *T. mookali* and *E. coioides* have been standardized by scientists of ICAR-Central Marine Fisheries Research Institute. Designing and fabrication of cost-effective sea cages (including engineering specifications) and successful demonstration of sea cage farming have been done on different locations on Indian coast with participation of local fishermen communities. ICAR-CMFRI is the pioneer to initiate open sea cage culture for domestic and export-oriented open sea marine finfish farming in all maritime states with the involvement of local marine fishermen community. The institute developed and commercialized the device for culturing marine finfish in open sea, *i.e.*, indigenously fabricated HDPE cage and epoxy-coated GI cage, having 6mt diameter and 6mt deep each, 1.2mt high above water. According to CMFRI scientists, mariculture in open sea cage is a promising venture;coastal and marine fishermen and other coastal inhabitants can fruitfully utilize the natural productivity of existing open coastal waters and farther sea regions- which is a step towards sustained marine fish production in India. Installed mariculture cages will occupy only a small fraction of the surface area of vast coastal waters and open seas.

Opportunities in Indian coastal states wrt West Bengal

Farming of marine finfishes in cage-type enclosures in India has certain advantages, which is a kind of aquaculture system diversification. Flow of water current in coastal areas and open seas brings in fresh marine water and removes excess feed and faecal matter of fishes under culture from cages. Simple cage designs for inshore waters are relatively easy to construct with minimum skilled labour. Presently seed collection from the wild is only done for grey mullet, red snapper, sea bream. For the other finfish species(s), availability of seeds (hatchery-produced) on a commercial scale is no more a bottleneck for marine finfish farming (for stocking in grow-out cages). ICAR-CIBA and RGCA-MPEDA can help in commercial level *L. calcarifer* farming in cages in West Bengal and other coastal states; appropriate mariculture technologies have been developed by ICAR-CMFRI.

The state of West Bengal is topographically blessed with potential marine fishery resources, with 777sq.km of inshore area, 158km of coastline, 8,02,900 hectare of estuaries - where marine finfish culture and that of *M. cephalus* can be taken up in cages. From Dr Kandan's presentation, we came to know that about 80,000 fishermen families and nearly 4,00,000 fishermen population are present in West Bengal. According to Performance Audit Report on Development of Pisciculture in West Bengal, unplanned fishing in the coastal areas (upto maximum distance of 50-75km from the shoreline) and its over-exploitation has resulted in a low yield, which declined from 1.82 lakh tones in 2011-2012 to 1.79 lakh tonnes in 2014-2015.

L. calcarifer is a potential finfish for farming in brackishwater-cum-estuarine areas and coastal seas in this state. In 2017, cage culture was initiated experimentally by West Bengal University of Animal and Fishery Sciences, Kolkata at Purba Medinipur, West Bengal for rearing *L. calcarifer* and pomfret. Two floating cages, each 4.5mt in diameter and made of GI pipes had been installed in open sea at a location 2km off the coast of Mandarmoni. These cages have been tied down with buoys to provide stability, covered with nets to prevent seabirds from preying on growing fishes within. In July 2018, State Fisheries Development Corporation, Government of West Bengal decided to cultivate *Trachinotus* sp and *Epinephelus* sp at Henry's Island and Frasergunj Fisheries Project, near Bakkhali in South 24 Parganas in coastal ponds. Seeds of these finfishes had been procured from ICAR-CMFRI by air route. In West Bengal, this organization first time started culture of *Trachinotus* sp at Alampore Fisheries Project near Digha in 2014. SFDC has four brackishwater fish farms at Alampore, Digha, Frasergunj and Henry's Island; farming of *R. canadum*, *T. blochii* and *Epinephelus* sp may be initiated in cages by SFDC in West Bengal in future.

Dr R. Jayakumar, Principal Scientist, Mandapam Regional Centre of ICAR-CMFRI informed author in a Conference at Chennai on 20/6/2019 that adequate numbers of marine finfish seeds (fry) are being supplied to Henry's island in West Bengal from Mandapam. Farming of the same in small volume cages may be taken up in sea near to Henry's island and other places, in addition to that farming in well-managed coastal ponds and brackishwater bodies. In recent past, Digha Regional Centre (Station) of ICAR-CMFRI has been established at Chowoddomile near Digha, PurbaMedinipur, from where, technical expertise and know-how on marine sea cage farming may be obtained. This technology can flourish commercially in near future or future in West Bengal. Most of the afore-mentioned finfishes are suited for culture in West Bengal conditions.

End note

It is obvious and well-accepted fact that in India, catch of many high-valued marine finfishes have declined in recent past years and hence, cage farming is the major option to enhance production to meet the growing demand of the same. Dr M. J. Modayil, Former Director, ICAR-CMFRI made a Presentation on 8/6/2008 in a Conference at ICAR-CIFA, Bhubaneswar on 'Open sea finfish culture - global overview', where remarkably he mentioned about the 10,00,000nos of mariculture cages in operation in middle of the seas of China, where 40 species of economically-important finfishes are cultured; also about structure and mariculture practice in very big floating cages (25-50mt diameter, 12-20mt underwater height), installed in seas of Latin America, Australia and northern Europe - where tuna (3-4 species), sea bream and groupers are cultured and harvested at 15-25kg individual size.

Author listened attentively to presentations of invited experts in different scientific forum as mentioned in this communication. For the first time, author had an on-site view of the *L. calcarifer* experimental farming cage at Ramakrishna Beach, Visakhapatnam on 26/2/2010. It was a cylindro-conical cage, 15mt inner diameter and 6mt underwater height, supported with floats, sinkers and anchor, installed 300mt away from the beach inwards sea. It was from here that for the first time in India, adult marketable size *L. calcarifer* was successfully harvested in April 2008 and the ICAR-CMFRI project launched - considered as a major breakthrough in Indian aquaculture.

It may be said that the gap between demand and supply of economically-important marine finfishes can be slowly and steadily filled up by adoption of marine finfish culture practice in cagesby reputed NGOs, private firms, prospective marine fishermen co-operative societies, and others. Conversion of mangrove areas, coastal agricultural fields and estuarine ecosystems into brackishwater aquaculture farms must neither be encouraged nor entertained. So installation of cages in open coastal water bodies and finfish farming therein holds additional importance, which will not lead to any conflicts nor controversies. Marine cage culture is undoubtedly an additional and/or alternative livelihood activity in coastal India, an appropriate alternative to over-exploitation and fishing pressure in the near-shore waters, and is expected to spread out more as a commercial venture in days to come. Marine finfish farming in cages in coastal waters and open sea can be a prelude to alternative livelihood development for Indian marine fishermen and reducing pressure on coastal and marine capture fisheries on both coasts of India.

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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
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Salinization Associated with brackishwater aquaculture and its reclamation

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Highlight Points

Brackish water aquaculture has been argued severely for its negative environmental consequences. Rapid development of such farms on reclaimed mangrove lands and converted agricultural land leads to salinisation of soils. Technologies such as, management of salt-affected soils, viz. alternate land-use systems, saline aquaculture, cultivation of salt tolerant crop varieties, agro-forestry, phytoremediation, bioremediation etc., can help to minimize the impact of salinization.

ABSTRACT

Low salt concentration ishelpful for the positive growth and metabolic activity of plants and microorganisms. But human activities such as brackishwater shrimp farming canincrease concentrations to levelsthat impact soil quality, microbial, plant and animal life. Salinization problem gaining more attention in recent years. Salinization of groundwater due to increased anthropogenic activities and urbanization. Globally more than 30% of the irrigatedsoils are under salinization impacts. Reclamation strategies to stabilize the native microbial population is gaining more attention in recent years. In this article, physicochemical and biological methods and their role on the treatment of saline soil are discussed.

INTRODUCTION

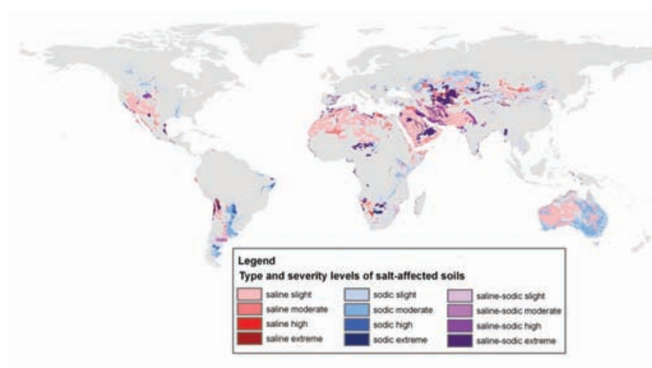

Figure 1. Saline and sodicsoils distribution in the world

Salinization is globally caused by the increase of dissolved solids (Na^+, Ca^{2+}) concentration in water and soil, which impacts ecosystems' health and causes water quality degradation due to changes in chemical composition. Salinization affects the osmoregulation of organisms, causing loss of biodiversity and has economic impacts, such as the loss of fertile cultivable lands. Nowadays, it is estimated that, globally, more than 30% of the irrigated soils are under salinization impacts.

Now it is estimated the worldwide distribution of salt-affected soils is 932.2 million ha, out of this the extent of human-induced salinization is 76.6 million ha. In India, the area under salt-affected soils is about 6.73 million ha **Fig 2. (A)** with states of Gujarat (2.23 m ha), Uttar Pradesh (1.37 m ha), Maharashtra (0.61 m ha), West Bengal (0.44 m ha) and Rajasthan (0.38 m ha) together accounting for more than

70% of saline and sodic soils in the country **Fig 2. (B)**.Soil salinity is attributable to the presence of inorganic solutes, primarily alkali and alkali earth metals such as sodium (Na^+) and calcium(Ca^{2+}), and associated anions: chloride, sulfate, and carbonate. Besides sodic soils refer to those soils that are particularly rich in sodium compared to the calcium and magnesium content.

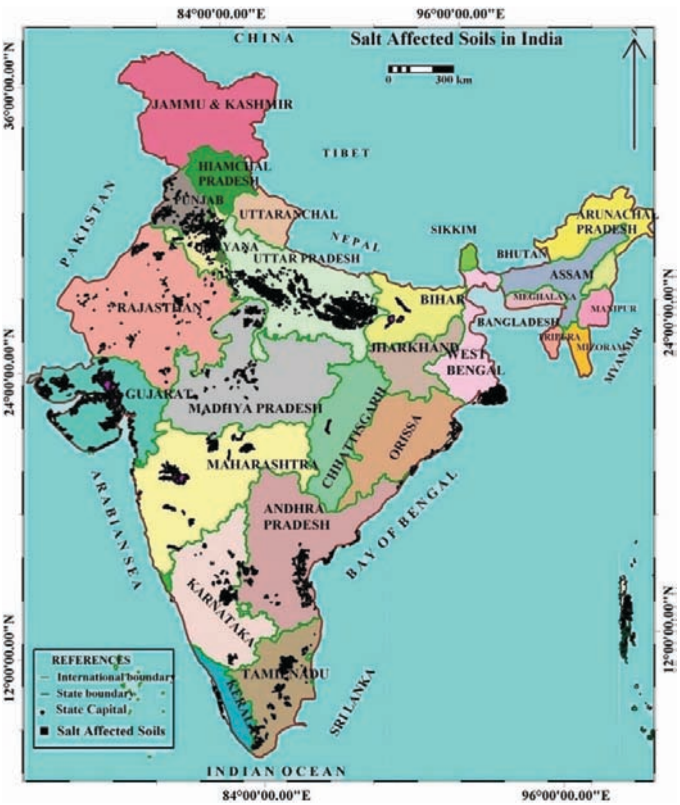

Figure 2. (A) Distribution of salt-affected soils in India

Activities such as brackishwater shrimp farming have caused soil salinization due to the addition of concentrated seawater into the manmade ponds to create suitable salinity forshrimp growth. Brackishwater shrimp farming area has rapidly increased just over a decade ago. This activity has caused severe anthropogenic soil salinization. Discharge of sludge, excess feeds and saline water into nearby irrigation canals, including seepage of saline water to adjacent cultivated areas and under the ground, has led to a significant build-up of toxicity and salinity.

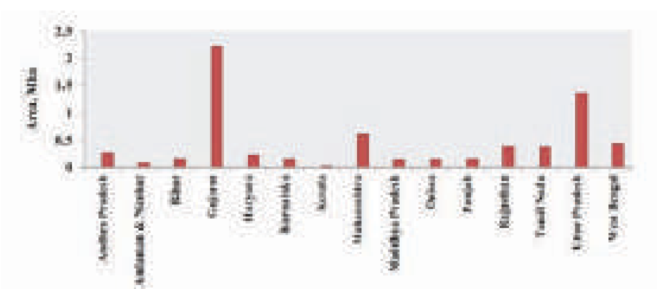

Figure 2. (B) State-wise distribution of salt-affected soils in India (Mha)

TYPES OF SOIL SALINIZATION:

Soil salinization can occur in many areas due to both natural and anthropogenic processes. (i) Natural processes of soil salinization (i.e., primary salinization) include the deposition of weathered minerals with high salt content, sea breeze deposition and the capillary rise of saline groundwater in regions with a low water table. (ii) Anthropogenic reasons of soil salinization (i.e., secondary salinization) include unsustainable agricultural practices, road salt application, brackishwater aquaculture and industrial activities that cause an increase in soil salinity.

SALINIZATION – AN EMERGING PROBLEM

Massive urbanization resulting in shrinking of cultivable agricultural land holdings and puts a putting great pressure on agricultural lands to produce foods from limited space through the process of intensive cultivation. The possible way of expansion of lands under agriculture exists in restoring the saline degraded lands. In India, around 6.73 million ha area is salt-affected. Estimates suggest that every year approximately 10 percentage of additional area is getting salinized and by 2050, around 50% of the cultivable land would be salt-affected. Saline soils occupy 44% area and covering 12 states and one Union Territory, while sodic soils occupy 47% area in 11 states.

SALINIZATION DUE TO SHRIMP FARMING:

Human induced salinization impacts the health of both aquatic and terrestrial ecosystems worldwide. In tropical and subtropical areas, bracishwater shrimp farm aquaculture uses water from adjacent open water bodies such as creeks, estuary, or sea to fill the culture ponds, where enhanced evaporation cause salinization of discharged water.

In coastal ecosystems, river salinization promoted by factors such as agriculture practices, industrial and urban effluents, and removal of natural vegetation such as mangrove ecosystem, causes salinization of fresh water that arrives to the coastal and estuarine ecosystems. In addition, coastal ecosystems, land-use change and groundwater pumping for urban use or for agriculture cause seawater intrusion, which increases the salt concentration in nearby soils and aquifers. These effects could be more severe by on-going climate change, mainly through the co-occurrence of global warming, causing increased evaporation and sea level rise, making coastal ecosystems more vulnerable to salinization. These factors affect coastal biodiversity, such as coral reefs, zooplankton and mangrove forests, amongst others.

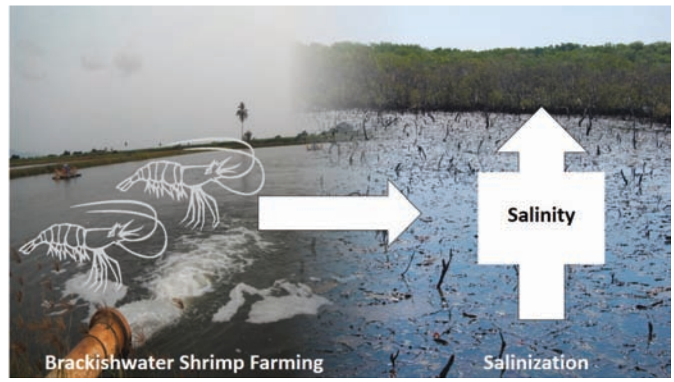

Figure 3. Salinization due to brackishwater shrimp farming

Additionally, global effects can be worse by local activities. Shrimpaquaculture is mainly developed in tropical and subtropical ecosystems, where thepredominant management system is intensive and semi-intensive. In China, where 62.3% of the globalaquaculture is produced and approximately 85% of which are shrimpfarms, use semi-intensive aquaculture by practicing traditional techniques. To fill the ponds, shrimp farms take water from adjacent ecosystems such as estuaries, lagoons, creeks or the open sea, where evapotranspiration is increased by ~50% compared to natural wetlands and at harvest, the pond waters are discharged to the surroundingcoastal bodies. Shrimp pond effluents reach a higher salinity concentration than the receiving ecosystems.

TYPES OF RECLAMATION:

i) CONVENTIONAL METHODS:

The simplest method for the remediation of salt accumulation in soils is leaching, where by huge amounts of fresh water was applied to the soil to wash away the soluble salts. This may be feasible in areas with a low water table and where freshwater is readily available and abundant.Another physical reclamation method is deep till age where the surface soil enriched in salts is mixed with soil from deep in the profile, effectively diluting the salt concentration in the upper portion of the soil profile.

ii) CHEMCIAL BASED METHOD:

Chemical amendments for sodic soil reclamation can be broadly grouped into three categories: (a) Soluble calcium salts, e.g., gypsum, calcium chloride, (b) Acids or acid forming substances, e.g. sulphuric acid, iron sulphate, aluminium sulphate, lime-sulphur, sulphur, pyrite, etc., and (c). Calcium salts of low solubility, e.g. ground limestone.

Farmyard manure and press-mud are also used asamendments for contamination ofsodic soils. Chemical amendmentsrequire moisture content(rainfall or irrigation) in order to activate the chemicalreaction that can reduce sodium levels or leach salts from therhizosphere. On the other hand, the organic amendments areable to alleviate excessive salts orsodium from soil without supplemental irrigation.

The quantity and type of chemical amendments required for reclamation of sodium rich soils depend primarily on soil pH, electricalconductivity (EC), and exchangeable sodiumpercentage (ESP). Soluble calcium sources are recommended for use in non-calcareous soils while acids or acid-formers are recommendedfor calcareous soils. Due to their availability and low cost, gypsum ($CaSO_4.2H_2O$) followed by pyrites(FeS_2) has emerged as the most preferred and acceptable chemical amendment for sodic soils in India. The gypsum-based alkali land reclamation technology has found large scale on-farm adoption in the country. Nearly 2.07 million ha of barren sodic soils have been brought under cultivation, contributing 16-17 million tons of paddy and wheat per annum to the country's food basket. Farmers are harvesting 5 t ha^{-1} of rice and 3 t ha^{-1} of wheat from third year onwards in such reclaimed lands. Pyrite (FeS_2) was much less effective than gypsum. The pyrites to be effective for reclamation must contain at least 5–6% soluble Sulfur (S).

iii) SALINE AQUACULTURE

Inland saline aquaculture defined as land-based aquaculture using saline groundwater, is being commercially practiced in many saline tracts of Australia, Israel, and USA. This knowledge was also used in India to make the use of inland saline water flooded soils profitable. The experience in many parts of Punjab and south western Haryana have shown that the degraded soil and water resources could be put to profitable use by fish and shrimp farming. In coastal areas of Andhra Pradesh, many farmers have converted their rice fields into brackishwater fish farms for reason of high profits from aquaculture with short duration culture. They store brackishwater, drawn from the sea through creeks and drains, in big ponds for raising high value shrimps. Estimates suggest that nearly 0.2 million ha is under saline aquaculture in the coastal districts of Andhra Pradesh.

iv) CULTIVATION OF HALOTOLERANT CROPS VARIETIES

Cultivation of salt tolerant plantvarieties is another way to effective utiliationof saline soil. This technique is feasible and cost effective and suits well for both the small and marginal farmers who are unable to bear the costs of chemical amendment-based reclamation technologies. Salt tolerant varieties of rice, wheat, fruit trees, mustard and other crops, grasses, shrubs, aromatic and medicinalplants have been developed/identified for commercial cultivation in salt-affected soils.

Table 1. Relative tolerance of selected crops and grasses to exchangeable sodium

Tolerant	Semi-tolerant	Sensitive
Karnal grass **Diplachnefusca**	Wheat **Triticumaestivum**	Cowpeas **Vignasinensis**
Rhodes grass **Chlorisgayana**	Barley **Hordeumvulgare**	Gram **Cicerarietinum**
Para grass **Brachiariamutica**	Oats **Avenasativa**	Groundnut **Arachishypogaea**
Bermuda grass **Cynodondactylon**	Raya **Brassica juncea**	Lentil **Lens esculenta**
Rice **Oryzasativa**	Senji **Melilotusparviflora**	Mash **Phaseolusmungo**
Dhaincha **Sesbaniaaculeata**	Bajra **Pennisetumtyphoides**	Maize **Zea mays**
	Cotton **Gossypiumhirsutum**	Cotton, at germination **Gossypiumhirsutum**
Sugarbeet **Beta vulgaris**	Berseem **Trifoliumalexandrinum**	Mung **Phaseolusaurus**
	Sugarcane **Saccharumofficinarum**	Peas **Pisumsativum**

Several varieties of important field crops like rice, wheat and mustard, having potential to yield reasonable economic returns in saline and sodic soils, have been also developed.

v) BIOREMEDIATION

The bioremediation approach, which involves plant-microbial interaction, has received increased attention worldwide for enhancing productivity of salt-affected soils. Microorganisms present in the rhizosphere could promote plant growth and yield in salt stress environment in different ways, directly and indirectly. For example, some plant growth-promoting rhizobacteria may directly stimulate plant growth and development by providing plants with fixed nitrogen, phyto-hormones, iron (sequestered by bacterial siderophores), and soluble phosphate, while others may indirectly benefit plants by protecting them against soil-borne diseases, mostly caused by pathogenic fungi by inducing cell wall structural modifications, biochemical and physiological changes leading to synthesis of proteins and chemicals involved in plant defense mechanisms. Halophilic bacteria have the potential to remove sodium ions from soil and increase metabolic and enzymatic activities in plants.

vi) PHYTOREMEDIATION OF SALT-AFFECTED SOILS

Phytoremediation of salt-affected soils refers to the processes of removing excess salts from soil by growing different type of plants. Growing of salt tolerant trees, shrubs, and grasses is a cost-effective and environmental-friendly way of restoring saltaffected soils.

Plants remove excess salts from soil through root absorption and accumulate them in their biomass, a process called *phytoaccumulation or phyto-extraction.* It decreases exchangeable sodium and soluble salt concentrations in soil. They also augment soil organic carbon and nutrient content thereby gradually improving physical (bulk density, porosity, infiltration, water holding capacity etc.), chemical (nutrient concentrations), and biological (microbial population) properties of soils and overall soil productivity.

CONCLUSION:

Soil salinisation is a widespread soil degradation process, exacerbated by a mismatch between water demands for irrigation in food production and the amount of quality (nonsaline) water. Several technologies are available for the reclamation and management of salt-affected soils. The site-specific restoration programmes suchas different land, crop and/or water management approaches (e.g. conservation tillage, crop selection/rotation, groundwater level control) to combat salinisation processes and to mitigate salt-induced stresses in food/feed production is also in practice. Although salt resistance in plants improved and developed by biotechnological methods such as selective breeding and transgenic approaches creates a path to improve salinity resistance could contribute to enhancing crop production over millions of ha of salt-affected areas worldwide.

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Is Fishmeal free Aquafeed a Myth?

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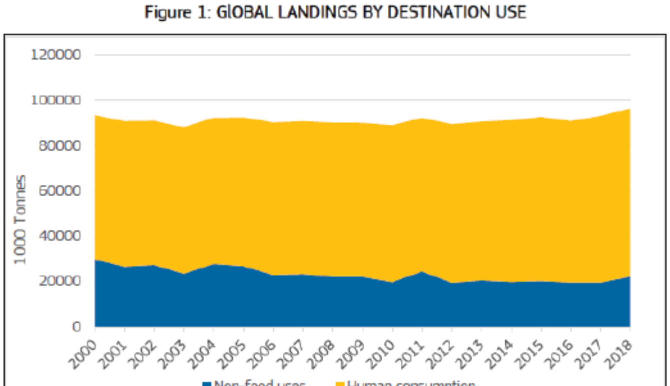
Fishmeal (FM) and fish oil (FO) are the two incredible ingredients of aquafeed. FM is an excellent protein source, mainly used in feed for aquaculture species and livestock. FO is mainly used to produce feed for farmed fish and refined FO for human consumption (FO capsules). This article highlights the need for FM, its unmatchable nutritional quality, FM replacers, and sustainable feeding of the growing human population.

Statistics

Global fish production in 2018 is estimated at 179 million tonnes, of which 156 million tonnes were used for human consumption, and the remaining 22 million tonnes were destined for non-food uses, mainly to produce FM and FO. China has remained a major fish producer, accounting for 35% of global fish production in 2018, while also having the largest consumption market for FM(FAO, 2020). From 2000 to 2018, there was a 25% decrease in the non-food use share of total landings. The reasons for this were the increased use for human consumption and a decrease in fishing for feed production due to reduced quotas and better fishery management.

Figure 1: GlOBAL LANDINGS BY DESTINATION USE



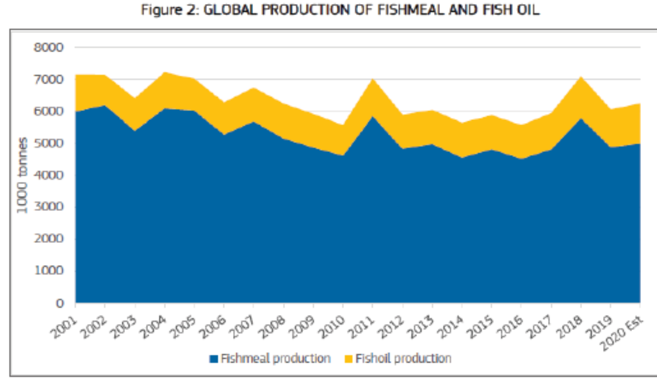
Source: FAO

Fish consumption was 20.5 kg in 2018, increasing at a 3.1 percent annual rate from 1961 to 2017, nearly twice the rate of annual world population growth (1.6 percent) during the same period (FAO,2020). This line, the estimated fish consumption in 2030 would be around 29.5 kg per capita, and the human population would be about 9.2 million. This is a challenging figure as capture fisheries are stable and the only possibility is aquaculture.

Highlight Points

- Fishmeal and fish oil is a balanced diet incredible ingredient.
- Hunt for fishmeal and fish oil replacer is need of the hour due to stable production of FM and FO.
- Change the strategy of research; prioritize palatability in the sequence of research.
- Consider the carbon footprint while doing the research.
- FM and FO replacer ingredients are mostly plant based; be cautious about the human food chain.
- Sustainability must be the driving force of industrial fisheries and aquaculture.

Figure 2: GLOBAL PRODUCTION OF FISHMEAL AND FISH OIL



Source: IFFO

Fish meal

The FM is prepared from small fatty fish species like anchovy, sprat, herring, krill, Norway pout, etc. by cooking, pressing, drying and grinding fresh raw fish or shellfish into a coarse brown flour. Virtually, any fish or shellfish in the sea can be used to make FM. Most of the fish used for FM have relatively short lifecycles, so population numbers can rise and fall substantially depending on fishing pressure and other environmental variables. For instance, periodic El Nino climatic events influence Anchoveta stocks. Virtually, the industrial fishery provides its catch for the FM industry. The countries with major industrial fisheries are Peru, Iceland, Denmark, Chile, Norway, and South Africa.

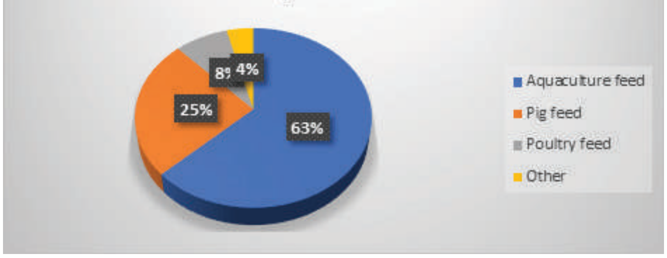


Figure 3: Percentage use of global FM production

Source: *Boyd, 2015.*

Fish oil

FO is obtained while fatty fish is processed into FM. It is rich in omega-3 fatty acids. FO is currently the only economically viable source of these essential fats for feed purposes.100 kg of raw material produces around 21 kg of FM and between 3 and 6 kg of FO.

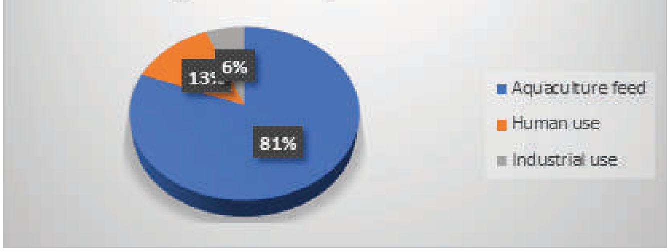


Figure 4: Percentage use of global FO production

Source: *Boyd, 2015.*

Table 1: Major Fish Species that contribute to FM

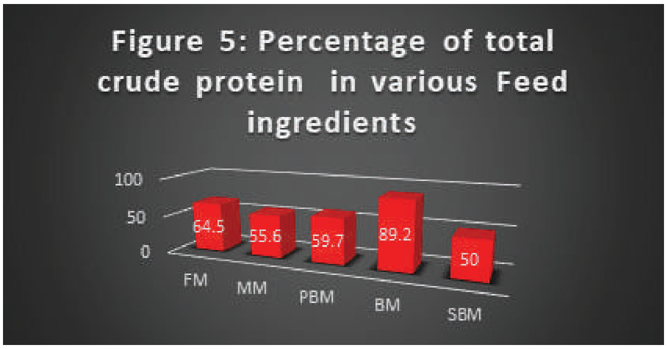
	Anchovies (Engraulidae)	Peruvian anchoveta *(Engraulis ringens)* Japanese anchovy *(Engraulis japonicus)*
	Herrings, Menhaden, Sardines and Shads (Clupeidae)	Atlantic herring (Clupea harengus) Menhaden (Brevoortia tyrannus and B. patronus) South American and Japanese pilchards (Sardinops sagax) European pilchard (Sardina pilchardus) European sprat (Sprattus sprattus)
	Smelts (Osmeridae)	Capelin *(Mallotus villosus)*
	Jacks (Carangidae)	Chilean horse mackerel (Trachurus murphyi) Atlantic horse mackerel (Trachurus trachurus)
	Pollock, Cod, and Haddock (Gadidae)	Walleye or Alaska Pollock *(Theragra chalcogramma)* Atlantic and Pacific cods *(Gadus morhua and G. cephalus)* Georges Bank haddock *(Melanogramus aeglefinus)* Norway pout *(Trisopterus esmarkii)* Blue whiting *(Micromesistius poutassou)*
	Hakes (Merlucciidae) and Sand lances (Ammodytidae)	Hake (*Merluccius* sp.) Hoki (*Macruronus novaezelandie*) Small and lesser sandeels (*Ammodytes marinus* and *Ammodytes tobianus*)
	Tunas and Mackerels (Scombridae)	Skipjack tuna (*Katsuwonus pelamis*) Yellowfin tuna (*Thunnus albacares*) Chub mackerel (*Scomber japonicus*) Atlantic mackerel (*S. scombrus*)
	Cutlassfishes (Trichiuridae)	Largehead hairtail / Atlantic cutlassfish *(Trichiurus lepturus)*

Source: *Miles and Chapman, 2006*

Nutritive value of FM

Protein

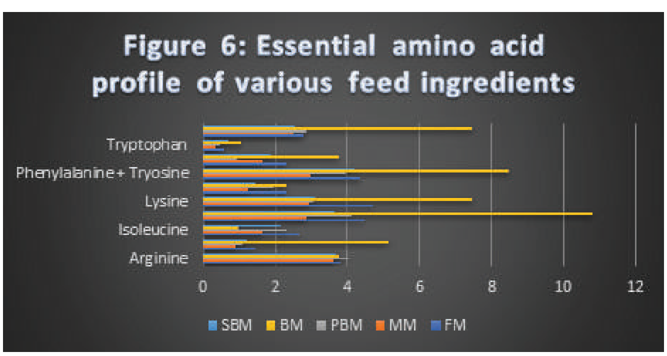
FM contains the profile of amino acids that most closely meets the amino acid requirements of fish.



Source: *Miles and Chapman, 2006*

Note: Fishmeal (FM), rendered meat meal (MM), poultry byproduct meal (PBM), blood meal (BM), soybean meal (SBM)

The ten essential amino acids (EAA) listed below cannot be synthesized by fish and must be included in their diet: Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, and Valine. Certain non-essential amino acids (non-EAA) should be supplemented to increase their concentration and for better growth. For instance, Cobia in the wild consume enough taurine because of their natural carnivorous crustacean or fish-based feeding habits. Plant-based aquafeeds for cobia, which tend to be low in taurine, need to be supplemented with taurine and other amino acids to be more beneficial.



Source: *Miles and Chapman, 2006*

Note: Cystine can be synthesized from methionine.Tyrosine can be synthesized from phenylalanine.Fishmeal (FM), rendered meat meal (MM), poultry byproduct meal (PBM), blood meal (BM), soybean meal (SBM)

Lipid: EPA (Eicosapentaenoic acid) and DHA (Docosahexaenoic acid) flow from microalgae and zooplankton in the food chain to the fish. The quantity and quality of oil in FM will in turn depend on the species, physiology, sex, reproductive status, age, feeding habits of the captured fish, and the method of processing.

Mineral: Minerals like calcium, phosphorus, and magnesium are found in FM which is normally estimated by analyzing the ash content. More ash content indicates more minerals.

Vitamins: The fat-soluble vitamins in FM are relatively low because of their removal during the extraction of the FO. FM is a moderately rich source of vitamins of the B-complex, especially cobalamin (B12), niacin, choline, pantothenic acid, and riboflavin.

Palatability: FM contains certain compounds like glutamic acid, taurine, trimethylamine oxide, nucleotides and glycosaminoglycans that make the feed more acceptable and palatable and allow the feed to be ingested rapidly, thus reducing the nutrient leaching.

Energy: The energy in aquafeed relates directly to the percentage of protein and lipid in it. The higher digestibility of lipid in FM means higher usable energy, which consequently breaks down the valuable protein for energy.

Grades of FM

Table 2: Details to grade FM

Nutrients	Grade 1	Grade 2	Grade 3
Moisture (%, maximum)	10	10	10
Crude protein (%, minimum)	60	50	40
Crude lipid (%, maximum)	8	10	11
Salinity (%, maximum)	2	3	5
Ash (%, maximum)	2	3	4
Hard and sharp solid materials	Not permitted		
Total volatile nitrogen (mg/100g, maximum)	150	250	350

Source: *FAO*

Table 3: Inclusion Rate in Diet

Type of Feed	Inclusion rate (Total Protein by Weight)
Fish	32- 45%
Shrimp	25- 42%
Carp and Tilapia	5-7%
Salmon, Trout and some Marine Fishes	40-55%
Terrestrial livestock diets	5 % or less (on dry matter basis)

Source: *IFFO, 2020.*

Advantage of FM and FO as Aquafeed Ingredient

1. **High Productivity:** Global FM and FO production averaged 6.5 and 1.3 million metric tonnes, respectively, over the past 20 years.
2. **Waste recycling:** Supplementing aquaculture feed with FM and FO effectively returns 5 million tonnes of sustainable non-food products back into the human food chain and decreases the impact on ecosystems.

3. **Multiplier effect**: 1 kg of wild fish through aquaculture produces over 4.5 kg of farmed seafood with the benefit of the additional predominantly plant-based ingredient supply (IFFO, 2021).
4. **Forage fish value addition:**
   - Fish with no market value can have value added when used as FM. Example: Gulf menhaden, sandeel, Atlantic menhaden, Norway pout.
   - Fish that are demanded on a small scale, localised or niche-based can be used for fish meal production. Example: Peruvian, Japanese, European and other anchovy, Capelin, blue whiting and European sprat.
   - Fish with an established fish market but not in demand for food can be diverted for FM and FO. Example: Chilean Jack mackerel, chub mackerel, and other species of sardine and herring.
5. **Low environmental footprint:** Fish production and consumption have low generation of greenhouse gas (i.e., carbon footprint). Use of FM also have low environmental carbon footprint than other plantbased ingredients.
6. **Lack of nutritional inhibitors**: Proteins isolated from plants are associated with indigestible non-structural carbohydrates (oligosaccharides) and structural fiber components (cellulose), which are not associated with animal proteins. FM lacks nutritional inhibitors or anti-nutritional factors, which makes this meal more attractive than plant proteins for use in aquaculture diets.
7. **Synergistic effects:** The balanced amino acid composition of FM complements and provides synergistic effects with other animal and vegetable proteins in the diet to promote fast growth and reduce feeding costs.
8. **Low waste stream valorization:** Incorporation of FM into diets of aquatic animals helps to reduce pollution from the wastewater effluent by providing greater nutrient digestibility.
9. **Wholesomeness**: The incorporation of high-quality FM into feed imparts a 'natural or wholesome' characteristic to the final product, such as that provided by wild fish.

Constraints of using FM

1. Raw material freshness and processing conditions affect the nutritive quality of the fish meal.
2. Gizzerosine effect: Toxins are produced in fish meal produced from fish with high histidine content. One such toxin gizzerosine causes gizzard erosion in poultry and mortality in shrimp.
3. Rancidity of lipids in FM and FO affects feed quality.
4. Use of antibiotics in the aquafarms contaminate the FM produced out of the farmed fish.
5. Microplastic contaminants are reported in the FM.
6. Need for antioxidants like ethoxyquin, butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), tocopherols (with, or without rosemary extract) may increase the processing cost.

FM Replacers: The Next Generation Fish Nutrition

For sustainable aquaculture to grow and supply the world's food fish demand, he industry must identify alternatives to FM and FO that are economical, environmentally friendly, and sustainable. The relatively static production of FM will not meet the demand for protein ingredients that accompanies the projected increase in worldwide aquaculture production. Also, the market price for FM and FO has continued to rise due to increased demand as well as increasing energy costs related to fishing, processing, and transportation, which has driven the aquafeed industry to consider more economical protein sources.

Table 4: A List of FM Replacers and Their Application

S.No.	FM Replacers	Species studied	Command	Reference
1.	Defatted silkworm (*Bombyxmori* L.) pupae meal	Pacific whiteleg shrimp (*Litopenaeusvannamei*)	Replacement is restricted to 75% as total replacement led to shrinkage ofhepatopancreatic cells.	Rahimnejad *et al.*, 2019
2.	*Bacilluspumillus* SE5 fermented soybean meal (FSM)	Spotted seabass (*Lateolabraxmaculatus*)	Optimum replacement level of FM with the FSM was estimated to be in the range of 26.9–37.1%.	Rahimnejad *et al.*, 2021
3.	Black solider fly larvae meal	Atlantic salmon (*Salmosalar*)	Promising ingredient as acomplementary protein source in low fish meal, high plant protein diets.	Fisher *et al.*, 2020
4.	Solid state fermented plant protein sources	Pacific whiteleg shrimp (*Litopenaeusvannamei*)	Replacement of fish meal at 30 %with *B. subtilis*-fermented soybean meal and corn gluten meal was possible.	Hamidoghli *et al.*, 2020
5.	Full-fat black soldier fly larvae (*Hermetiaillucens*) meal (BSFL) and paste	Atlantic salmon (*Salmosalar*)	BSFL meal and paste could replace up to 12.5% and 6.7% of dietary protein, respectively, without compromising growth performance.	Weththasinghe *et al.*, 2020

6.	Enzyme-treated soybean meal	weaned pigs	Replaced FM.	Ma *et al.*,2019
7.	*Tisochrysislutea* and *Tetraselmissuecica* dried Marine Microalgal biomass	European sea bass (*Dicentrarchuslabrax*)	Replaced about 45% crude protein and 36% lipid from FM and FO, respectively.	Cardinaletti *et al.*, 2018
8.	*Brassicacarinata* and *Camelinasativa* seed meal	Rainbow Trout (*Oncorhynchusmykiss*)	Replaced FM.	Kasiga*et al.*, 2020
9.	Marine microalgae meal (*Pavlova* sp. 459)	Atlantic salmon (*Salmosalar* L.)	Up to 20% inclusion level of Pav459 meal was recommended.	Tibbetts and Patelakis, 2021
10.	Soybean meal and isolated soy protein	Silvery-black porgy juveniles (*Sparidentexhasta*)	Maximum replacement of FM was between 16.5 and 27.3%.	Yaghoubi *et al.*, 2016
11.	Oilseed Protein Concentrates	Rainbow Trout (*Oncorhynchusmykiss*)	Replaced FM when properly supplemented with essential amino acid.	Stickney *et al.*, 1996
12.	Blend of Poultry Byproduct Meal and Soybean Meal	Largemouth Bass (*Micropterussalmoides*)	FM could be reduced to 160 g/kg.	Ren *et al.*, 2017
13.	Rapeseed Meal	*Pseudobagrusussuriensis*	Appropriate substitution level of FM was 17%.	Bu *et al.*, 2017
14.	High protein distiller's dried grain product (HPDDG)	Pacific white shrimp (*Litopenaeusvannamei*)	20% HPDDG replaced up to 15% of FM.	Guo *et al.*, 2019
15.	Mixture of Soybean Meal and Chlorella Meal	Crucian Carp(*Carassiusauratus*)	FM could be replaced by 25%.	Shi *et al.*, 2017
16.	Linseed protein concentrate	Silver catfish, (*Rhamdiaquelen*)	FM could be replaced by 40%.	Pianesso*et al.*, 2021
17.	Poultry byproduct meal, soy protein concentrate, and poultry byproduct meal combined with feather meal	Cobia, (*Rachycentroncanadum*)	Inclusion levels of up to 25% dietary protein.	Raggi*et al.*, 2019

Limitation of FM Replacers

1. Plant-based lipids, particularly those rich in n-6 PUFA, affect the fish liver, causing steatosis.
2. Plant-based protein sources have some disadvantages regarding CP content, palatability issues, amino acid deficiencies (including the absence of taurine), and the presence of numerous antinutritional factors.
3. **Need for additional supplements:** For instance, Digestarom PEP MGE (a supplement) is incorporated into shrimp low FM diets to compensate for the negative performance and immunological effects of partially replacing FM with plant-based protein. (Kesselring *et al.*, 2021).

Change the Strategy of Nutritional Research:
According to Brett Glencross, IFFO, the Marine Ingredient Organization, growth studies should not be the starting point of ingredient evaluation. Growth occurs only when the feed is ingested by the fish.

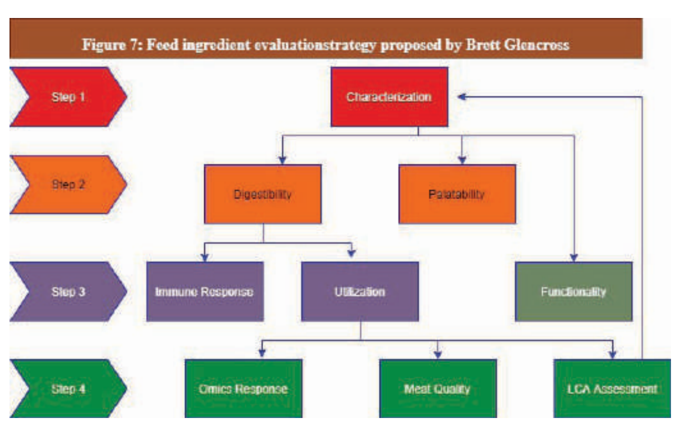


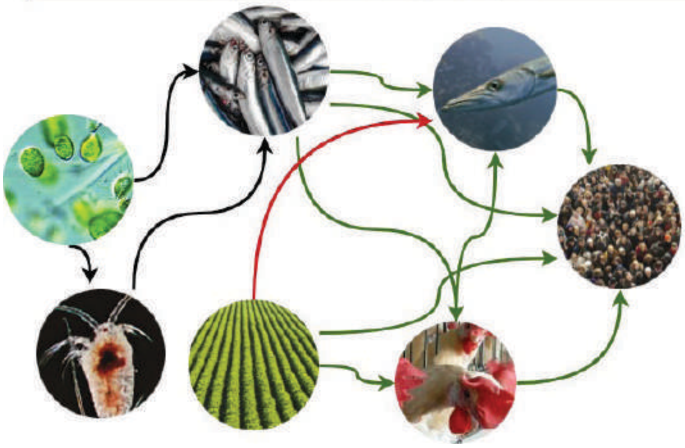
Figure 7: Feed ingredient evaluationstrategy proposed by Brett Glencross

Leibig's Law states that growth is only responsive to the first limiting nutrients. Hence, the feed ingredient taken for preparing the aquafeed should satisfy the limiting nutrients of the fish. This explains why it is impossible to replace FM completely, as no other feed ingredient is equivalent in supplying the limiting nutrients required by the fish.

Sustainable Feeding of the Growing Population

The nutrient cycle in the food web should not be diverted from human consumption to another sector like biofuel, or as an ingredient for fish feed or poultry feed. If the nutrient cycle is disturbed, there will be an imbalance in the food chain which is deleterious to the human population. That is explained in the following figure.

Figure 8: Food web showing the nutrient flow



The green arrow shows the direction of healthy nutrient flow among the species. The red arrow is a newly introduced nutrient flow by humans to produce more fish protein. Currently, this is satisfying the demand for fish by the growing population. The estimated human population in 2050 will be almost 10 billion people, which means more agriculture products as well as fish. If more agricultural products were diverted towards aquaculture, this would lead to more fish production. Consequently, agricultural products used as human food will become scarce, causing an imbalance in the nutrient flow. This leak in nutrient flow from agriculture to aquaculture should not cross the threshold level that seriously affects the sustainable feeding of a growing population.

Aquafeed VS Aquaculture in China

The total aquafeed production in China was only 7.5 x 105 tonnes in 1991 and it increased to 2.2 x 107 tonnes in 2019. After 29 years of development, the output of aquafeed in China has increased more than 30 times, accounting for 40.3% of the global total aquatic feed (FAO). The current import of FM has increased by 32.39% (947.67 million US Dollar on September 2020 to 1254.63 million US Dollar on September 2021) (Statista, 2021). The rapid research and development of the aquafeed industry has made China the global producer of aquaculture products.

Conclusion

FM and FO should come from fisheries managed under the key principles of the FAO Code of Responsible Fishing. Researchers are focusing on FM replacers, and the outcomes have a mixed response. The type of species, stage of development, presence of anti-nutritive factors in plant-based protein meal, etc., are the reasons for the mixed response. The FM and FO should be in the feed at a ratio equivalent to the requirement of the limiting factor, and the remaining can be replaced by other meals, considering anti-nutritional factors. Analysis of the limiting nutrient requirements of various fish species and palatability of the ingredients should be studied initially as a basic criterion before growth studies. As the FM requirements of the aquafeed industry cannot be met by current FM production, FM replacers are the only choice. Microalgal biomass and microalgal oil are considered as suitable choice as FM replacers with economically feasible technology. Presently, this is an active area of research in aquaculture nutrition, and researchers should keep in mind the sustainable nutrition flow in the food web.

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More references can be provided on request.

IMPACT OF AQUACULTURE ON ENVIRONMENT

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Highlight Points

- Fisheries is a Sun raising sector and Promising sector.
- Important sources of food, nutrition, income and livelihoods for hundreds of millions of people.
- Major role in satisfying the needs and palates of the world's growing middle income group consumers.
- Richest food for the poorest of the poor.
- Fish represents 16.6% of all the animal protein and 6.5% all of the protein consumed globally.
- Fish is a highly traded commodity in international markets.

Introduction

Fisheries sector occupies a very important place in the socio-economic development of the country. It has been recognized as a powerful income and employment generator as it stimulates growth of a number of subsidiary industries, and is a source of cheap and nutritious food besides being a foreign exchange earner. Most importantly, it is the source of livelihood for a large section of economically backward population of the country. The fisheries sector is a source of livelihood for over 14.49 million people engaged fully, partially or in subsidiary activities pertaining to the sector.

FUTURE ASPECTS OF THE FISHERIES SECTOR

By 2050 the world's population will reach 9.1 billion, 34 percent higher than today. Nearly all of this population increase will occur in developing countries. On the contrary the demand for protein of animal is increasing day by day due to rapid urbanization. The crown of the world's most populous country is on China's head for decades, India is all set to take the number one position by 2030. With the population growth rate at 1.2%, India is predicted to have more than 1.53 billion people by the end of 2030.

By 2050, consumption of meat and dairy products is projected to increase by 173% and 158%, respectively, as that of 2013. To meet the growing demand and to cope up with 9 billion world population by 2050, agricultural production needs to increase by 60% (compared to 2005/2007 production) including of increase in animal production and animal product. In addition cropland per capita is one of the biggest challenges for feeding Indian people who are on the track of rapid urbanization.

The growing world population, environmental degradation, limited natural resources and climatic change pose a greatest challenge to the food security of human population. Hence, it is necessary to provide an insight into India's future challenges of food security with special emphasis on livestock production and to explore a possible strategic options applicable to the country so as to overcome these challenges which have major policy implications on India's food security and livestock development.

Fisheries and aquaculture must address many of these difficult challenges. Especially with rapidly expanding aquaculture production around the world, there is a large potential of further and rapid increases in fish supply—an important source of animal protein for human consumption. Aquaculture is the fastest growing food-producing sector in the world, contributing one-third of global food fish production.

But the way we produce food cannot be at the expense of the Earth Planet. Sustainability will be at the heart of the new global developmental goals. Production increase must occur in a context where resources necessary for food production, such as land and water, are even scarcer in a more crowded world, and thus the sector needs to be far more efficient in utilizing productive resources. Further, in the face of global climate change, the world is required to change the ways to conduct economic activities.


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FROM TRADITIONAL TO MODERN AQUACULTURE

With the increase in human population, the need for farmed fish increased and accordingly farming systems were modified and new systems were developed. Thus the traditional simple aquaculture system began to be replaced by controlled farming methods such as the semi-intensive / intensive type of farming systems where resources are stocked in high densities and farmed under controlled conditions.

However, unplanned growth and farming without considering the ecological potential of the farming area has lead to several negative impacts both to the farm and also to the natural ecosystem.

IMPACTS OF AQUACULTURE ON ENVIRONMENT

I. Destruction of Habitat for Agricultural activities :

- The creation of ponds for marine shrimp aquaculture has led to the destruction of thousands of hectares of mangroves and coastal wetlands.
- Mangroves provide nursery grounds for many species, including commercially important fish, and their destruction may lead to substantial losses for commercial fisheries.

II. Colleting wild Juveniles as Stock :

- Aquaculture of some species relies on juveniles fish or shellfish being caught from the wild to supply stock, rather than using hatcheries to rear them.
- Shrimp farms in many areas rely on wild caught juveniles.
- This has led to over exploitation and shortages of wild stocks.
- The main environment impact of crab culture is the procurement of larvae from wild brood stock, and the on growing of wild crablets.

III. Depletion and Stalinization of Water / land

- Pumping of groundwater to supply freshwater to marine shrimp farms has resulted in depletion and, sometimes, Salinization of local water supplies, causing water shortages for coastal communities.
- There have also been many reports of crop losses after agricultural land has become salinized by effluent water pumped out from shrimp farms onto land.

IV. Poor Research in fish diseases and abuse of medicines :

- Novel fish diseases cannot be treated and diagnosis of aquatic diseases in the third world involves undeveloped instruments and weak technical power.
- Hence inabilities to distinguish bacterial and nutritional diseases, which directly influence correct medications. once the diseases comes on, the abuse of medicines is imminent.

V. Residual feeds and excrements (Fish waste) :

- Feeds are the basic material of aquaculture and the sources of main nutritional matters.
- Most feeds of aquaculture are outsides sources foods and given to aquatic animals directly.
- Large amount of residual feeds and the excrements of aquatic animals all impact the water environment.

VI. Escaping Salmon and their threat to Wild Fish :

- Farmed Atlantic salmons have escaped in vast numbers and are successfully breeding with their wild counterparts.
- Framed salmon have a lower genetic variability than wild salmon.
- Experiments show that the offspring are less fit than wild salmon and a high proportion die.
- Interbreeding of farmed with wild salmon could therefore drive already vulnerable populations of wild salmon towards extinction.

VII. Weak environment protection consciousness :

- Though various high-yielding aquaculture methods such industrial fish farming, cage fish culture and raceway culture are developed to some extent.
- Fishing and environment protection consciousness are still deficient, and the random discharged of aquaculture waste waters without any treatment has deteriorated the whole aquaculture environment and blocked the sustainable development of this industry.


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Best Management Practices in Monodon Farming

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Dr Raghavendrudu
Product Manager – Skretting India

Aquaculture is an activity producing fish or shellfish mainly for human consumption. It is carried out in ponds, enclosures or in open water bodies and thus involves continuous interaction with the environment. Shrimp cultivation in brackish water is a long-established practice in coastal districts of Gujarat and Andhra Pradesh states of India. India is one of the leading shrimps exporting countries, producing more than 0.7 million MT and about 92-95% of shrimp produced is exported. Over the last few years, with increase in disease challenges in *L. vannamei* the production of Black tiger shrimp (*Penaeus monodon*) has been on a rise. Shrimp culture can be a sustainable activity, if it is carried out in socially and environmentally responsible manner, by adopting good aquaculture practices or best management practices It helps in sustainable farming while improving productivity and profitability.

What are BMPs?

Best management practices (BMPs) for shrimp farming are a standardized set of farming practices to ensure the environmental and financial sustainability of shrimp farming systems. It includes the following key points:

1. Pond preparation methods
2. Water quality
3. Removal of organic wastages from pond bottom
4. Fertilization of the pond
5. Biosecurity systems
6. Seed selection
7. Stocking methods
8. Feed management
9. Disease management
10. Harvest methods

1. Pond preparation methods:

Following best management practices of pond preparation provides a cleaner environment for shrimp cultivation by adopting scientific methods to reduce the risk of diseases and other outbreaks. The following should be practiced while preparing ponds:

a. Maintain min water level 1.4 MT to maintain water holding capacity.
b. Disinfection before stocking with a powerful disinfectant helps to control microbial load of ponds.
c. Sludge management is equally important esp. in cases where the gap between two cultures is less. Sludge is a buildup of organic materials that accumulate in pond, mixes with inorganic materials. It causes algal bloom and growth of pathogens.
d. Use a powerful probiotic before and post stocking to control growth of harmful bacteria in ponds and support shrimp health.
e. Managing mineral balance in ponds is important to ensure that the mineral requirements of shrimp are met.

2. Water quality

Water quality is the most important element to achieve a successful crop. The entire culture is dependent on this aspect and to maintain a good water quality, we must adopt following methods.

a) Maintain reservoir for water treatment.
b) Use double layered 60 mesh to avoid unwanted carriers and use 80 mesh below the inlet.
c) Use good quality bleaching powder (35% or 70%) for treatment, do not use any pesticide and insecticide.
d) Use triple salt compounds like **Aqua Care 3D** to avoid pathogens in water.
e) To maintain healthy plankton bloom, apply fermented juices with yeast and apply good quality probiotics like **Aqua Care Control**.
f) Chain dragging is also recommended when healthy bloom has not happened.
g) Use good quality minerals to maintain ionic balance in the water system especially calcium, magnesium, and potassium like **Aqua Care Mineral Balance.**

3. Removal of organic waste from pond bottom

Organic matter releases toxic gases like ammonia and hydrogen sulphide in the pond leading to stress or death of shrimps. Organic waste is in the form of layer on the soil with black colour found in feeding area, corners, trenches and in the centre in ponds. Aerators should be checked for the presence of black layer when it is in wet condition. For removal of organic matter, following methods can be utilised:

a) Use *Nitrosomonas* and *Nitrobacter* probiotics along with Photo-synthetic bacteria like *Rhodocooccus* and *Rhodobacter* to remove nitrates and hydrogen sulphides.
b) Drying and ploughing of the pond enables oxidizing the organic matter and reducing the sludge.
c) Plough the swoil for removal toxic gases and removal of gastropods and other unwanted debris.
d) To remove unwanted species, apply good quality of teased cake around 40kg per acre.

4. Fertilization of the pond

Fertilization of the pond helps to balance the mineral content of the pond and increases pond carrying capacity

as well as soil fertility. It can be achieved through:

a) Maintaining organic matter content at min. 1.5% - apply 500kg to 1000kg vermicompost or potassium humate at 80 kg per acre.
b) Apply good quality lime to maintain optimal pH of the soil.
c) Apply chelated zinc 6kg per acre.

5. Biosecurity

Biosecurity in shrimp farming involves stocking disease free seed, pond preparation, water screening, prevention of entry of disease carriers, personal hygiene, and sanitation. Biosecurity plays a pivotal role in farming to maintain disease free environment.

a) To control carriers (Burrowing) use crab fencing with good quality nylon & lDPE materials.
b) Use bird fencing to avoid birds and its droppings preferably red and blue coloured threads.
c) Farming area should be clean and maintain sanitization dip at entry and exit areas.
d) Clean farm equipment and utensils regularly with potassium permanganate or any hypochlorite solutions to avoid cross contamination.
e) Maintain personal hygiene of the farm workers.

6. Seed selection & stocking methods

Selection of the seed is the one of the most important factors on which the entire crop depends.

a) Select seed from CAA certified hatchery with SPF bloodstock and PCR tested.
b) Before selecting the seed check your pond water conditions according to your salinity and do stress test in the hatchery with your pond water inputs.
c) Avoid wild seed and contaminated, unhealthy seeds.
d) Seed should be packed with sufficient aeration and good quantity artemia for longer transport.
e) Select good PL size (PL 15 to 20) is ideal.
f) Seed stocking should be done in early mornings or late evenings.
g) Before stocking maintain acclimatization process.

7. Feed management

Feed management is important for successful shrimp production and costs 50-60% of the total operational cost.

a) Monodon requires higher protein, omega-3, phospholipids and phosphorus. A good quality feed like **Kuroline** which is specifically formulated to meet the requirements of species should be given.
b) The feed should not be more than 120 days from date of manufacture.
c) Follow feed chart as per your shrimp body size and weight to avoid wastage.
d) Reduce feeding by checking in check tray feeding.
e) Reduce feed in rainy and cloudy weather conditions as well as plankton crash and high temperatures.
f) Reduce feed in pre moulting and low DO conditions.
g) Regularly monitor ammonia and nitrate conditions.
h) Do regular sampling in every week to determine the growth, survival, and FCR.
i) Do not feed excess as it leads to pond water quality deterioration.
j) Feed should be stored in cleaned and good ventilated areas avoiding direct sunlight and keep feed in pallets and rodent free environment.

8. Disease management

Check the health of shrimp in feed check trays on daily basis. If there is poor feed consumption for consecutive three to four days, it indicates health problems. Check the general health and growth of shrimp collected by cast net on weekly basis. Carry out sampling during early morning or late evening at different places.

1) Regularly check bacterial loads and water quality parameters.
2) Identify fouling and deformities.
3) Gut should be 80% filled with feed.
4) Observe antenna cuts and hepatopancreas colour.
5) During virus outbreaks sanitize with good sanitizers and use good probiotics on regular basis.
6) Avoid cross contamination by adopting hygienic methods.
7) Dead and affected shrimp should be buried outside the pond area.
8) Don't move equipment from affected ponds to unaffected ponds.

9. Post Harvest and Harvest methods

For freshness and quality of the shrimp, harvest methods are important:

a) Exchange 30% water before one week
b) Apply soil probiotics to avoid gill infections.
c) Apply oxidizers like Hydrogen peroxide or potassium permanganate to avoid black colouration.
d) Avoid harvesting in moulting period.
e) Don't feed before 6 hrs of harvesting.
f) Complete the harvest process in mornings to avoid discolouration.
g) After harvest apply lime and bleaching in the harvest area to avoid cross contamination.
h) Packing should be done with good quality ice.

About Skretting

Skretting is a global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry working closely with shrimp and fish farmers. Our purpose is 'Feeding the Future'. Skretting has 30 production facilities in 18 countries on five continents and manufactures and delivers high-quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 3 million tonnes. It is headquartered in Stavanger; Norway and it employs 4,000 employees. Its team of more than 140 employees is dedicated to Innovation that works on the core competencies of nutrition, feed production and health for aquaculture. In India, we have head office in Hyderabad and our manufacturing footprint in Surat, Gujarat.

For further information, kindly write to us at contact.india@skretting.com or visit our website: www.skretting.in


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