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Aqua International

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September 2023

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ఉపయోగములు

- 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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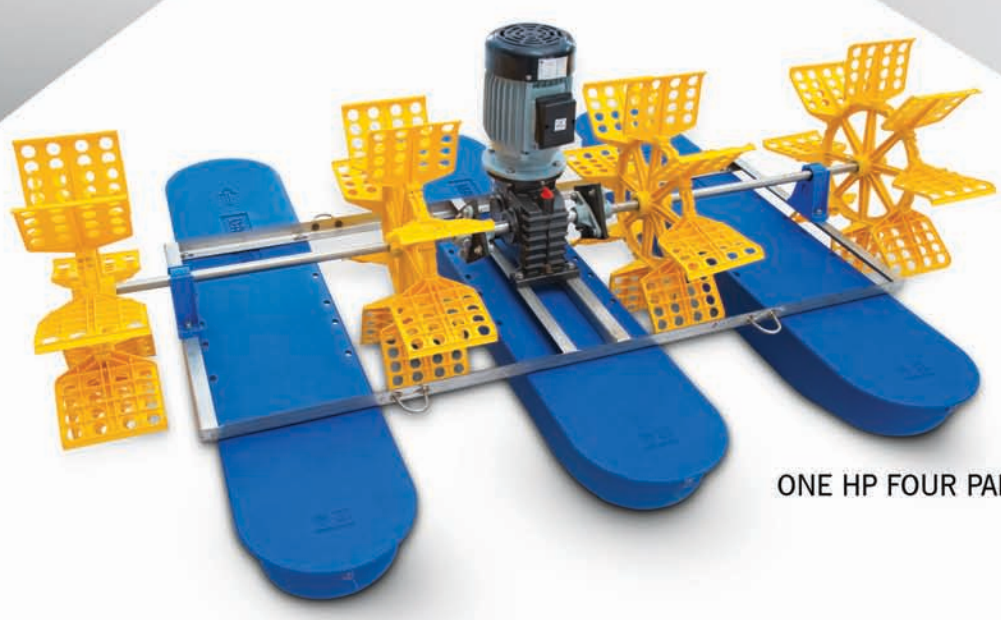

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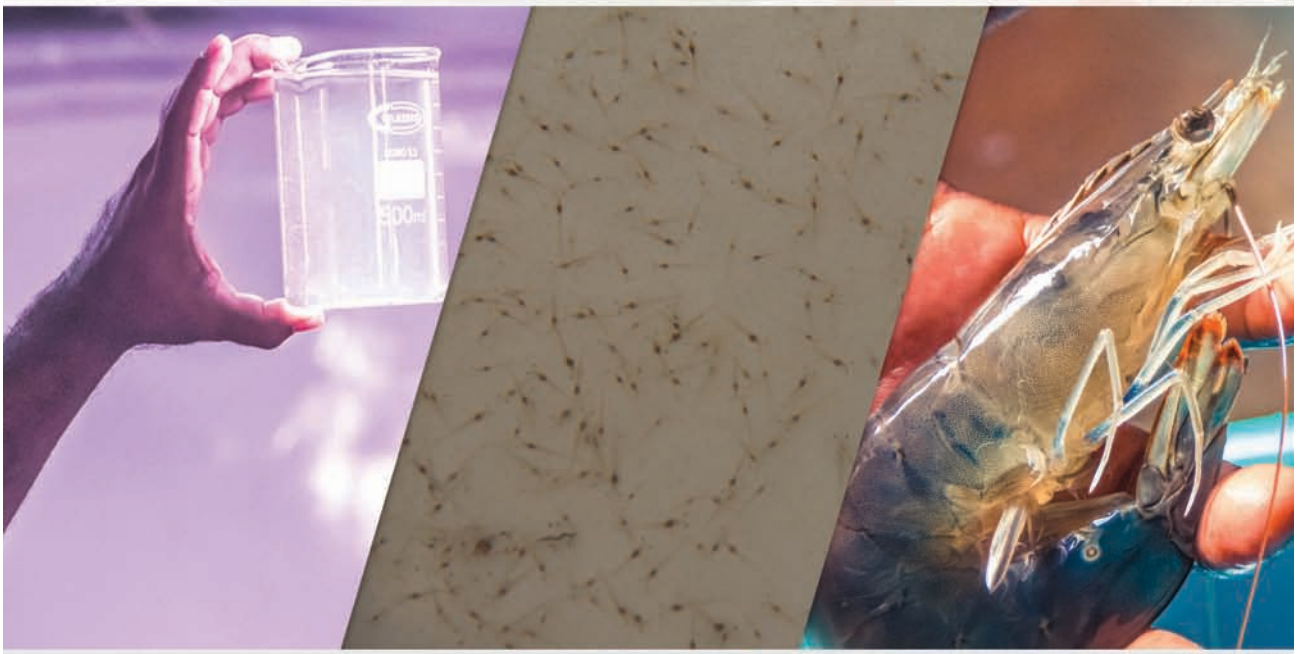

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- Editor

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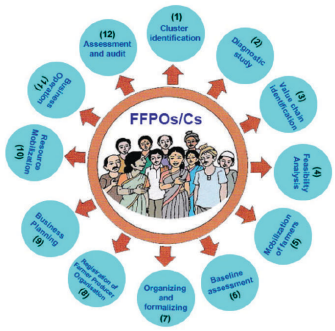

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Infini Foods India to establish a food company with a global network to provide wholesome, fresh, safe nutritious frozen, ready to cook and ready to eat food products

Lucrative aquaculture industry has been facing severe setbacks from diseases caused by infectious microbial pathogens. It is difficult to tackle this problem when compared to terrestrial animals and birds, because fishes remain underwater and the symptoms are difficult to judge most of the times. The current demand is thus for rapid diagnosis which can be done on-the-spot. Confirmative techniques require expensive equipment and time, prompt diagnosis is essential. While antibody-based sensors are widely used to monitor fish health, more sensitive, specific and robust approaches are now being developed to replace them.

Dear Readers,

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

Transforming Rural Poverty to Prosperity through Sustainable Fisheries and Fish Fair-2023 was organised by College of Fisheries, Kishanganj Alumni Association in collaboration with AIASA-Fisheries Chapter from 19 to 21 July 2023 at College of fisheries. Technical sessions on different themes namely Priming Indian Aquaculture for Boosting Rural Economy (Session I), Fisheries Resource and Environment Management (Session II), Biotechnological Intervention for Improving Fisheries Production (Session III), One Health for Fish Wealth (Session IV), Fisheries Value Addition and Supply Chain for Sustainable Consumption (Session V) and Fisheries Science Society Linkage and Rural Prosperity (Session VI) were held during the conference.

The Central Institute of Brackishwater Aquaculture along with The Tamil Nadu Coastal Aqua Farmers Federation, the Coastal Aquaculture Authority of India and Annamalai University's Centre for Advanced Studies in Marine Biology, Annamalai University is one of the first University's in the postcolonial era of India conducted a day long farmer's conclave.

CLFMA of India organised its 64th National Symposium 2023 on 18 and 19 August 2023at Hotel Le Meridien in New Delhi witnessed the participation of bureaucrats and industry stakeholders, who shared insights on the future of the animal husbandry, dairying and fisheries sectors in the country.The session began with lighting of the lamp by Mr ParshottamRupala, Minister of Fisheries, Animal Husbandry & Dairying, Government of India. CLFMA of Indiahonoured Mr Nadir B. Godrej, Past Chairman, CLFMA of Inida and Chairman of Godrej Industries Ltd and Mr Tarun Shridhar, IAS (Retd), Former Secretary, Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India Life Time Achievement Award. Dr Anand Kumar Pathak and Dr Pankaj Kumar Singh with CLFMA Awards.

Infini Foods India Pvt Ltd has been conceived with an intention to establish a food company with a global network to provide wholesome, fresh, safe nutritious frozen, ready to cook and ready to eat food products. Led by Mr K .Ravi Kumar, Managing Partner of Golden Marine Harvest, the promoters and stakeholders have in depth experience and expertise in all the verticals of shrimp aquaculture covering shrimp hatcheries, farming, processing and value addition. Supply chain logistics and cold storage hubs thus ensuring and enabling last mile connectivity.

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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West Bengal's Chaital turns a new leaf with mangrove plantation for sustainable aquaculture about 35 farmers in the Chaital village in West Bengal's North 24 Parganas district have been guided by experts to plant more mangrove trees for dense foliage leading to high shrimp yield. mangrove species with which the shrimp cultivators are experimenting include Heritiera fomes (sundari tree), Nypafruticans (nipa palm) and Rhizophora mucronata (garjan tree).

Soybean meal has long been a staple of diets in aquaculture industry. A researcher from the University of Idaho, funded by the South Dakota Soybean Research & Promotion Council, is testing just now soybean meal feed formulations can include in aquaculture diets without compromising the growth of gut health of the fish. We found that the diet with 30% soybean meal and 5% insect meal had the best feed efficiency and growth for the fish. Research indicates that insect meal could be considered as a complementary ingredient to enhance meal utilization in aqua feeds.

The demand for Bangladesh's black tiger shrimp export is fast losing ground in western markets, prompting the government to approve the commercial production of vannamei, a cheaper top-selling shrimp variety. There is no alternative to vannamei farming to increase shrimp exports, stakeholders said. It is no longer possible to compete in the market with black tigers. Many consumers want to buy vannamei and black tiger shrimp together. When there is only one kind in this country and not the other, then the order does not come to Bangladesh, they observed. Department of Fisheries told TBS that 8-9 companies have been given permission for commercial production of vannamei shrimp.

The Lok Sabha on August 7 passed an amendment bill to decriminalise the offences committed in carrying out the coastal aquaculture activities and ensure ease of doing business. Union Minister Parshottam K. Rupala said that the fishermen community of the country will welcome the bill. He said that through this, "we can send a message from parliament that we stand with the fishermen" introduction in the Lok Sabha, it was sent to the standing committee. The Ministry has accepted 45 amendments of the committee out of 56. Citing data, there was an expenditure of only ₹3,680 crore for the sector during 1947 and 2014. But the Modi-led government has the Pradhan Mantri Matsya Sampada Yojana with an investment of ₹ 20,050 crore in fisheries sector. During the last nine years, shrimp production in the country has increased to 11.84 lakh tonnes in 2022-23 from 3.22 lakh.

Preparations for the upcoming 2nd Annual International Conference and Exposition of the African Chapter of the World Aquaculture Society (AFRAQ2023), were given a boost recently following signature of the hosting agreement by Zambia's Ministry of Fisheries and Livestock. This special gesture means the Government of Zambia is fully committed to collaborate with WAS in ensuring smooth organisation of the event through financial commitments, support to the hiring of convention centre, appointment of State officials to the conference's National Organising Committee, national promotions, high-level officiation to the event among other roles and commitments institutions, companies and organisations continue to express their interest to participate at AFRAQ2023. Zambia, being one of the growing aquaculture producer countries in Africa with vibrant aquaculture value chains in action.

The Asian Pacific Aquaculture 2024 will be organized in collaboration between World Aquaculture Society -Asian Pacific Chapter (WAS-APC) and hosted by Directorate General of Aquaculture, Ministry of Marine Affairs & Fisheries (MMAF) Republic of Indonesia. The APA24, three-day international conference and exhibition will be held at the Grand City Convention and Exhibition Surabaya, Indonesia from the 11 to 14June 2024. APA24 will be the next global exceptional expo to learn and discuss the latest developments in aquaculture industry in this challenging time and see the rapidly expanding international aquaculture industry in Asia and the rest of the world.

In the Articles section – Fish: An Emerging Experimental Model in Biomedical Studies, *authored by* **M. Junaid Sidiq**, said that Biomedical research is a branch of applied science that studies human diseases by analysing biological samples and attempting to develop diagnosis and treatment methods for them. The nature and mechanism of human diseases are initially studied in some non-human biological organisms possessing distinctive behavioural and physiological characteristics and are referred to as models. In biomedical research, fish models can bridge the gap between preliminary in vitro studies and expensive in vivo screening of novel drugs and therapies for higher vertebrates. By taking these measures, not only will the dynamic engagement of novel animal models be facilitated, but the limitations of the traditionally employed ones will also be salvaged.

Another article titled–**Fish Farmer Producers Organisations – its genesis and growth,** *authored* by**B Sahoo,** described Fish Farmer Producer Organizations have emerged as a successful model for promoting sustainable fish farming practices and improving the socio-economic conditions of small-scale fish farmers. FFPOs engage in various activities such as production enhancement, post-harvest management, infrastructure development and marketing of fish products. FFPOs are emerging as a popular model for promoting sustainable fish farming practices and improving the socio-economic conditions of small-scale fish farmers. They provide a platform for accessing technical, financial and marketing support and promote the adoption of eco-friendly farming practices.

Article titled – **Potential Application of Biosensors in Fish Health Management,** *authored* by **Shirsak Mondal,** discussed the lucrative industry of aquaculture has been facing severe setbacks from diseases caused by infectious microbial pathogens. It is difficult to tackle this problem when compared to terrestrial animals and birds, because fishes remain underwater and the symptoms are difficult to judge most of the times. The current demand is thus for rapid diagnosis which can be done on-the-spot. To create mitigation strategies and take appropriate action, it is critical in the current environment to obtain immediate, rapid and accurate information about the health status of fish and any pathogen. Because fish disease symptoms overlap and confirmative techniques require expensive equipment and time, prompt diagnosis is essential. While antibody-based sensors are widely used to monitor fish health, more sensitive, specific and robust approaches are now being developed to replace them.

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.

M.A.Nazeer
Editor & Publisher
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Aquaculture Africa 2023 Conference: Zambia Government commits to hosting

Zambian Minister of Fisheries and Livestock, Hon. Makozo Chikoti (centre); Permanent Secretary, Dr Anna Songolo (immediate left); WAS Africa Chapter President, Dr John Walakira (immediate right). Also present at the signing ceremony were senior officials in Ministry of Fisheries and Livestock, WAS delegation and its partner Africa Union.

Preparations for the upcoming 2nd Annual International Conference and Exposition of the African Chapter of the World Aquaculture Society (AFRAQ2023), were given a boost last week following signature of the hosting agreement by Zambia's Ministry of Fisheries and Livestock. This special gesture means the Government of Zambia is fully committed to collaborate with WAS in ensuring smooth organisation of the event through financial commitments, support to the hiring of convention centre, appointment of State Officials to the conference's National Organising Committee, national promotions, high-level officiation to the event among other roles and commitments.

The hosting agreement was signed by the Permanent Secretary in the Ministry of Fisheries and Livestock, Dr Anna Songolo in the presence of the Minister, Hon. Makozo Chikoti, also witnessed by other senior officials from the Ministry. From WAS's side, the President of the African Chapter of WAS co-signed the agreement. Representatives from the Africa Union and Southern Africa Development Community also witnessed this historic occasion.

More and more institutions, companies and organisations continue to express their interest to participate at AFRAQ2023. Zambia, being one of the fastest aquaculture producer countries in Africa, with vibrant aquaculture value chains in action, is undoubtedly the ideal place to be on November 13 to 16 2023!

Aller Aqua Ltd is the Gold Sponsor of AFRAQ2023. Additional sponsorship and exhibition opportunities are still available. More information is available on https://www.was.org/meeting/code/AFRAQ23. You are also welcome to contact the organisers for further queries: mario@marevent.com and worldaqua@was.org or africanchapter@was.org

The African Chapter of the World Aquaculture Society secretariat is hosted at the AUDA-NEPAD headquarters in South Africa.

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APA 24
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June 11-14, 2024

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2. HIGH ACTIVITY OF SPORES

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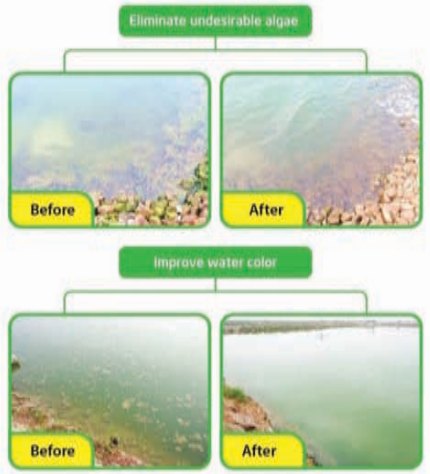
3. DECREASE AMMONIA CONTENT

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

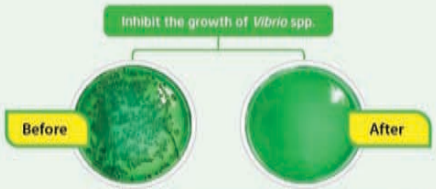
4. IMPROVE WATER COLOR

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



5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

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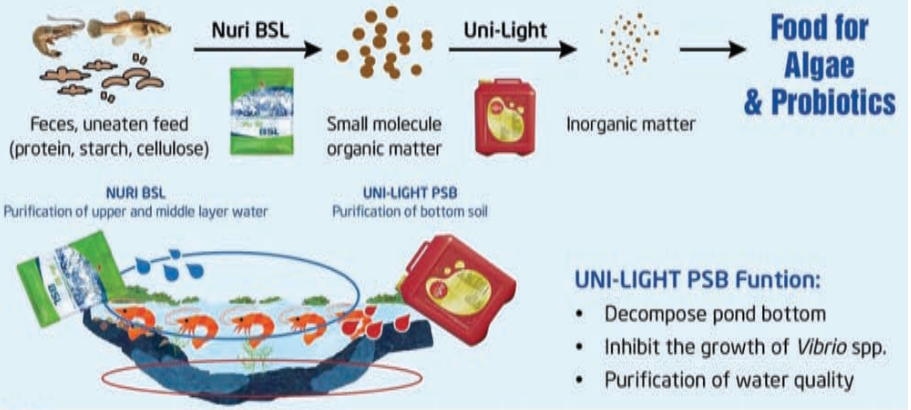

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- Inhibit the growth of *Vibrio* spp.
- Purification of water quality

BSL Dosage:

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7 days before stocking	800 g - 1,000 g	1,200 - 1,500 g	1,200 - 1,500 g
Day of stocking	300 g - 500 g	800 g - 1,000 g	800 g - 1,000 g
Every 7 - 10 days after stocking	300 g - 500 g	800 g - 1,000 g	3 - 5 days / use 1,000g - 2,000g

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The ASIAN PACIFIC AQUACULTURE 2024 will be organized in collaboration between World Aquaculture Society -Asian Pacific Chapter (WAS-APC) and hosted by Directorate General of Aquaculture, Ministry of Marine Affairs & Fisheries (MMAF) Republic of Indonesia. The APA24, three-day international conference and exhibition will be held at the Grand City Convention and Exhibition Surabaya, Indonesia from the 11 to 14 of June 2024.

The deadline for abstract submission on 31 December 2023, and online abstract submission is encouraged at www.was.org. The theme of the conference has been chosen to be "Aquaculture – Driving the Blue Economy".

The first APA24 signing agreement with Dr TB. Haeru Rahayu, Director General of Aquaculture of MMAF has been signed on 14 June 2023.

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National Conference held on "Transforming Rural Poverty to Prosperity through Sustainable Fisheries" and Fish Fair at College of Fisheries, Kishangan


Glimpses of Inaugural Function of TRPSF-2023

Kishanganj: National Conference on "Transforming Rural Poverty to Prosperity through Sustainable Fisheries (TRPSF-2023)" and Fish Fair-2023 was organised by College of Fisheries Kishanganj Alumni Association in collaboration with AIASA-Fisheries Chapter was held from 19 to 21 July 2023 at College of fisheries, Kishanganj. The conference and fair was sponsored and supported by National Fisheries Development Board (NFDB), Indian Council of Agricultural Research (ICAR), National Bank for Agriculture and Rural Development (NABARD) including research institutes such as CIBA, CIFRI, CIFE, CIFA, CMFRI, NGFGR, CIFT, DCFR, BOBP and PFGF. Different private companies' related to fisheries and aquaculture also sponsored for successful conduct of this mega event. The chief guest of the inaugural function was Dr J. K. Jena, Honourable DDG-Fisheries, ICAR-New Delhi, Dr Dilip Kumar, Former Director and VC ICAR-CIFE was Guest of honour and Dr S. D Singh, Former ADG, Inland Fisheries was special guest. Dr Rameshwar Singh, Honourable VC, BASU, Patna was the president of the function. The stage was also shared by Mr. Vivek Saurabh, National President, AIASA and Mr Tapas Paul, Organising Secretary, TRPSF-2023. Different awards were distributed during the inaugural session namely Dr S. N. Dwivedi lifetime achievement award conferred to Dr Atul Jain, Best Entrepreneur award to Dr Naseem Akhtar, Emerging Entrepreneur award to Dr Debtanu Barman, Best Progressive Farmer award to Muzzafar Kamal Saba (Bihar) and Dipankar Majumdar (West Bengal). Further, Post Fisheries Graduate Forum (PFGF) has conferred Best Fisheries Graduate of India (BFGI)-2022 award to Pankaj Kumar Singh (CoF, Dholi), Purva Sharan (CoF, Dholi), Pritisha Saikia (CoF, Raha), Samiran Mukherjee (FFSc., Kolkata), Haridarshan Thakur (CoF, Kishanganj) respectively. AIASA academic excellence awards were also conferred to top ten ranks holder in ICAR-AIEEA JRF-2022 examination. The programme was attended by more than 400 delegates including Deans, Directors, Scientists, Professors researcher and students from different institution across the country.

Fish Fair-2023 sponsored by NFDB, Hyderabad was inaugurated by Dr Rameshwar Singh, Honourable VC, BASU, Patna in presence of other dignitaries. Various institutions such as ICAR-CIFRI, ICAR-CIFE, ICAR-CIBA, Aqua Doctor Solutions, Shivshakti Agro Pvt Ltd., State Bank of India, Blueweight Pvt Ltd., Singhal Fibers, Naseems Modern Hatchery, Virbac India, Das and Kumar, Dartari participated in the exhibition. Healthy Fish Recipe Competition and Ornamental Live Fish Competition were organised during the fair.

Technical sessions on different themes namely as Priming Indian aquaculture for boosting rural economy (session I), Fisheries



Glimpses of Fish Fair-2023 sponsored by NFDB, Hyderabad

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Glimpses of different technical and satellite sessions held during TRPSF-2023

resource and environment management (session II), Biotechnological intervention for improving fisheries production (session III), One health for fish wealth (session IV), Fisheries value addition and supply chain for sustainable consumption (session V) and Fisheries science society linkage and rural prosperity (session VI) were held during the conference. The conference inaugural lecture was given by Dr Dilip Kumar, Former Director and Vice-Chancellor, ICAR-CIFE, Mumbai on topic "Fisheries Sector and its potential". In technical session I, Dr. Dilip Kumar was the chair and Dr R. S. Chauhan, Former Dean, COF, GBPUAT, Pantnagar was co-chair. Dr N. P. Sahu, Joint Director, ICAR-CIFE, Mumbai has given keynote address on topic "Changing Aquaculture and Aquafeed Scenario: Looking beyond 2030". Lead speakers of this session are Dr B. K. Chakraborty, Former Director, Department of Fisheries, Bangladesh, Dr A. K. Singh, Former Director, ICAR-DCFR, Bhimtal and Dr H. K. Wadia, Former Dean, COF, DSVCKV, Chhattisgarh. In technical session II, Dr B. K. Chakraborty was chair and Dr A. K. Singh, Dean, COFS, BAU, Gumla was co-chair. Dr L. L. Sharma, Professor, COF, MPUAT, Udaipur was keynote speaker and Dr S. K. Chakraborty, Professor Emeritus, ICAR-CIFE, Mumbai was lead speaker. In Biotechnology session, Dr S. D. Singh Former ADG, Inland Fisheries, ICAR, New Delhi was chair and given keynote address on "Biotechnology Interventions for improving Fisheries and Aquaculture Production". Dr Vindhya Mohindra, Principal Scientist and Head FCD, ICAR-NBFGR, Lucknow given lead talk on "Role of genomics in aquaculture" and Dr Aparna Chaudhary, Principal Scientist, ICAR-CIFE, Mumbai given lead lecture on "Biotechnology: The Knowledge Translational Toolkit for Aquaculture". Dr B. K. Das, Director, ICAR-CIFRI, Barrackpore was the chair and keynote speaker of technical ssession IV. He has given lecture on one health approach in fish health management. Other experts in the session includes Dr R. K. Saha, Dean, COF (CAU), Tripura as Co-Chair and Lead Speaker and Dr K. Pani Prasad, Dean (External Affairs) and PS, ICAR-CIFE, Mumbai as Lead Speaker. In session V, Dr Ravishankar C.N., Director and Vice-Chancellor, ICAR-CIFE, Mumbai was the chair and Dr B. K. Sharma, Dean, COF, MPUAT, Udaipur was Co-Chair. Dr B. B. Nayak, Dean (Academics) and P S ICAR-CIFE, Mumbai given keynote address on "Value Addition and Supply Chain management of aquatic food products for food and nutrional security". Dr R. K. Majumdar Former Professor COF (CAU), Lembucherra, Tripura and Dr Amjad K. Balange, Head, IARI, Assam given lead talk during the session. In session VI, Dr P. Krishnan, Director, Bay of Bengal Prog. IGO was the chair and Dr Ananthan P. S., Principal Scientist,

Glimpses of valedictory function of TRPSF-2023

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ICAR-CIFE, Mumbai given the keynote address on "Planning without data is cooking without fuel: The case of an Elephant in the Fisher(ies) development room". Lead speakers in this session are Dr Archana Sinha, Principal Scientist, ICAR –CIFRI, Brrackpore and Dr S. Athithan, Professor and Head (Aquaculture), FC and RI, TNJFU, Thoothukudi, Tamil Nadu.

Different satellite events on Student Science Village, Women Scientist Oration Award, Young Scientist Conclave, Career Counselling Consortium, Farmer-Scientist Interaction, PFGF Meet were also organized. Eminent experts during these session are Dr Shivendra Kumar, Associate Professor, COF, RPCAU, Dr Raman Kumar Trivedi, Professor, AEM, WBUAFS, Kolkata, Dr Atul Jain, Director, Ornamental Fisheries Training and Research Centre, Udaipur, Dr Naseem Akhtar, MD, Dr Naseems's Modern Hatchery and Research Farm, Bihar, Dr Shivkumar Magada, Professor, COF, KVAFSU, Mangalore, Dr K. G. Mandal, Former OSD, COF (BASU), Kishanganj, Dr M. L. Ojha, Associate Professor, Aquaculture, COF, MPUAT, Udaipur Dr Archan Kanti Das, Principal Scientist, ICAR-CIFRI.

The valedictory function of National conference on TRPSF-2023 was held on 21st July. Md Afaque Alam, Hon'ble minister of Animal and Fisheries resources, Government of Bihar was the chief guest of this programme (virtually). Dr Dilip Kumar, Former Director and VC, ICAR-CIFE and Shri Ijaharul Hussain, Member of Legislative Assembly, Bihar were the guest of honour. Dr Sanjeev Kumar, Registrar, BASU, Patna was the special guest of this function. Different awards were conferred during the valedictory function namely Dr V. G. Jhingran gold medal to Dr Vikash Kumar, Scientist, ICAR-CIFRI, Dr P. V. Dehadrai gold medal to Dr Saurav Kumar, Scientist, ICAR-CIFE, Dr Hiralal Chaudhuri gold medal to Dr Abdul Azeez P., Scientist, ICAR-CMFRI, Professor M. C. Nandeesha memorial gold medal conferred to Mr T. Ganesh Kumar and Ms Rishika (ICAR-CIFE), Mr Saket Bhardwaj and Mr Prassan Pandey (CoF, Gumla), Ms Kumari Priya and Ms Ankita Suman (CoF, Kishanganj). Women scientist award was given to Ms Abhilipsa Biswal (SMS, Dr RPCAU, Samastipur), Dr Jyoti Saroj (Assistant Professor, NDUAT, Faizabad) and Ms Prapti Sudan (CoF, GADVASU).

Further, best oral and poster presentation awards of TRPSF-23 under different themes were distributed to the winners. Different awards were also given under various competition organised during the Fish fair such as healthy fish recipe competition, Ornamental fish show and best stall in various institutional, NGO and farmer's category. During the function Dr K. G. Mandal (Former OSD, CoF, Kishanganj) were felicitated for his significant contribution towards development of this college. The programme was ended with the vote of thanks given by Mr Tapas Paul, Asst. Prof. and Organising Secretary, TRPSF-2023.

Shrimp Farmers Conclave held at Parangipettai

Tamil Nadu: On 1st August, the Central Institute of Brackishwater Aquaculture (ICAR-CIBA) along with The Tamil Nadu Coastal Aqua Farmers Federation (TANCAFF), the Coastal Aqauculture Authority of India (CAA) and Annamalai University's Centre for Advanced Studies in Marine Biology (Annamalai University is one of the first University's in the postcolonial era of India) conducted a day long Farmer's Conclave.

More than 500 participants attended the meeting and the deliberations went on till 7pm.

The highlights were

1. A candid presentation by MPEDA on the production, market trends for the farmers for understand why shrimp prices are low. and the interventions needed to sustain our sector.
2. A young scientist from CIBA Dr Satish Kumar who is pursuing his PhD on the pathogen EHP, presented his findings

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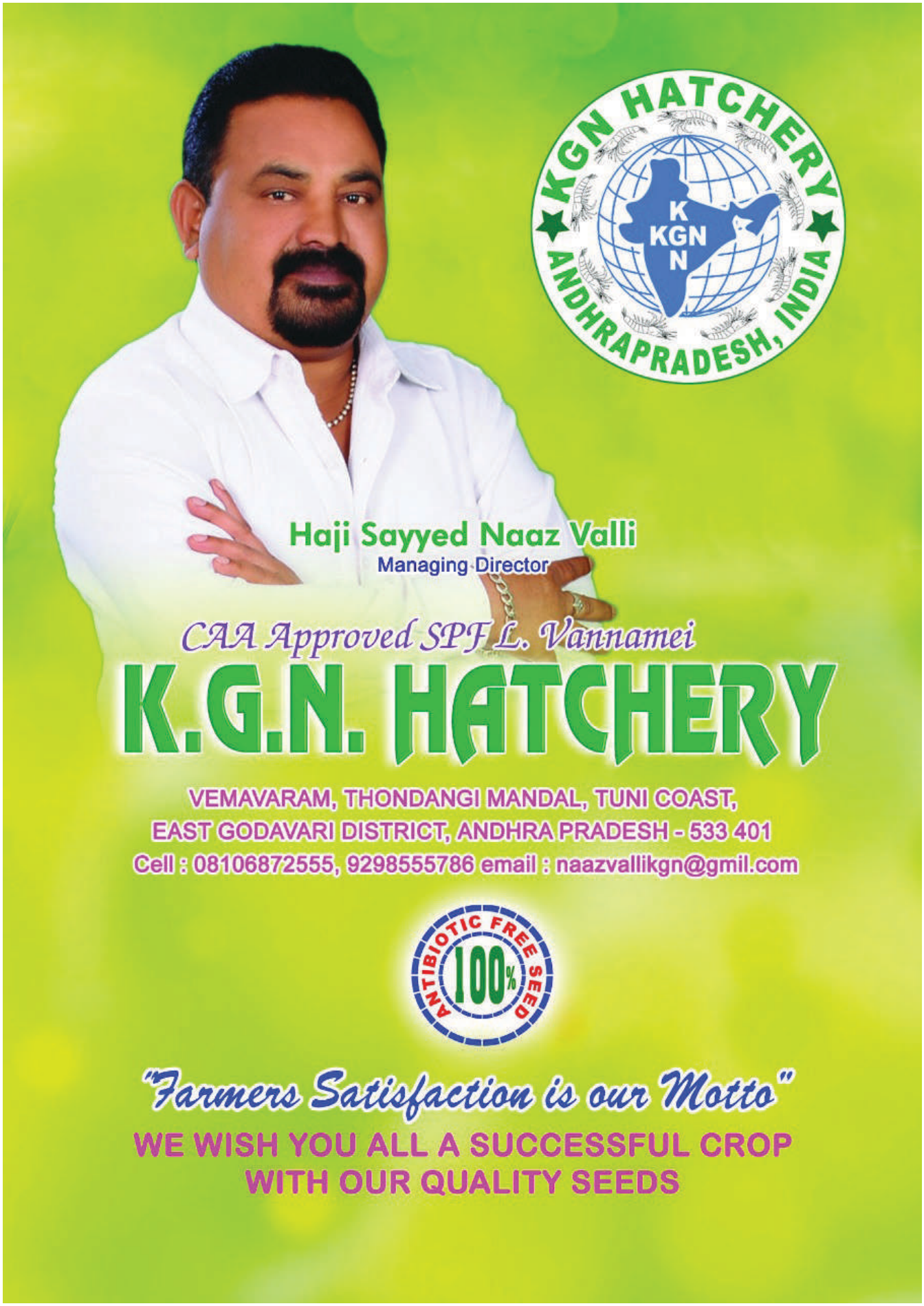
and his invention of a product to restrict the efficacy of the EHP spores. He informed that the product has given promising results in the early farm trials and that CIBA has entered into a MOU with a private company to take up more field trials and to commercially produce the product.

3. The details of CIBA's flagship program "P. Indicus Genetic Improvement Project" (our native species) was presented and deliberated.
4. Launch of ICAR's "Report Fish Disease" App for mobile phone through which farmers can upload photos and share information of the disease incidents.
5. Discussions on the shrimp crop insurance products.
6. Experiences and expectations shared on stage by farmers from the various parts of the region.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Decline Trend in Fish Catch of River Mahanadi ICAR CIFRI Study

Bhubaneshwar (KCN): ICAR Central Inland Fisheries Research Institute, Barrackpore, conducted an exploratory study during the month of October and November 2022 to study the fish catch estimation from the river Mahanadi system in the concept of a fishing village with the set of pre- designed questionnaires under the guidance and leadership of Dr B. K. Das, Director, ICAR-CIFRI, Barrackpore River Mahanadi has one of the largest drainage basins on the east coast of India. 45% of which lies in the Odisha and 55% in Chhattisgarh. It originates from Sihawa hills in the Dhamtari district of Chhattisgarh and traverses nearly 857 km before opening into the Bay of Bengal of Paradip (Odisha). Previous studies were conducted by ICAR-CIFRI, Barrackpore between 1965 and 2007 on the ecological status and production dynamics of the reverine and estuarine system of Mahanadi. According to the existing studies, the river was in good condition compared to other Indian rivers and its quality is excellent for greater fish production. It also has a variety of fish species in abundance. However, limited information is available regarding fish landing and catch data of river Mahandi, to bridge the gap of knowledge the scientific team surveyed a total of 146 fishing villages along the entire river Mahanadi of which 90 fishing villages from 8 districts of Chhattisgarh and 56 fishing villages from 6 districts of Odisha.

During the study, the fish catch data was gathered from the local fishermen and the fish markets on the bank of river Mahanadi. In addition, data on the fishermen population, different types of fishing gear, craft and their modes of operation were collected village-wise and region-wise. The landing pattern of fish catch from river Mahanadi revealed that catfishes were dominating (36.4%) followed by major carps (22.6%), murrels (12.5%), minnows (9.3%), other small indigenous fishes (8.5%), exotics (8.3%) and prawns (2.4%). In the recent periods, there is an increment in the exotic species landing such as Tilapia and Exotic pangas, which may be due to the escape from the culture area nearby riverbank.

The data collected on the species landing were used to study the seasonal patterns in fish landing and catch per unit effort (CPUE). The anuual fish catch landing ranged from 169.93 t Kanker (Chhattisgarh) to 2560.95 t in Jagatsinghpur (Odisha) and total catch from river Mahanadi was estimated as 15134.43 tonnes per annum. Comparatively the middle and lower stretch (Odisha) is more productive (54%) than the upper stretch (46%). The highest CPUE was recorded at Raipur Chhattisgarh as 10.85 kg/fishermen/day and at Sambalpur. Odisha as 7.19kg/fishermen/day to 9.84 kg/fishermen/day. The average CPUE from river Mahanadi varied from 0.18kg/fishermen day to 9.84 kg/fishermen/day during summer, 1.89 kg/fishermen/day to 6.87 kg/fishermen/day in winter and 1.83 kg/fishermen/day to 18.88 kg/fishermen/day in monsoon.

The fishing crafts operated in river Mahanadi were wooden boats (plant built and dug out) locally known as Donga or naav and inflated by tyre tubes. The tube fishing was mainly observed in the upper stretch of the Mahanadi river in Chhattisgarh. The inflatable rubber tube operates by a single person, mainly in thelow-depth region of the river. These fishing crafts are mostly used for the gill net operation. Fishing gears comprised gillnet, trammel net, cast net, dragnet, scoop net, book and line and traps used in river Mahanadi. In the upper stretch, the traditional scoop net, locally knowns as pelna mostly use for the prawn fising. Spearfishing, locally called chiran or loha is an indigenous gear used in the middle stretch of the river in Odisha. The fishes like Bagarius murrels and other catfishes are caught using the spear. Traps are very common gear used in the entire stretch of the river during monsoon and post-monsoon season. Bamboo-made traps are cylindrical, rectangular, square and truncated cone-shaped baskets predominantly used for prawn fishing and catching small fish.

According to the socioeconomic diversification indices study, the fisher households are mainly dependent on fishing activities with a monthly income of Rs. 5715.5. The dangerous and illegal act of fishing using exploding dynamite and poisoning water bodies was witnessed in the middle and lower stretch of Mahanadi, Odisha. Such illegal activities in the river have also affected fish production, particularly in the lower stretch (18% reduction), with no substantial growth recorded in recent years. This decline in catch has been attributed to indiscriminate fishing irrespective of species, fishing with small mesh sizes, lack of recruitment, lack of a closed fishing season etc. To overcome these issues, the concerned officials should strictly enforce the law to prevent illegal and destructive fishing methods in the river Mahanadi. Regular stocking of indigenous fish seed in the anicuts and barrages may promote to reived the fishery along the river stretch. The establishment of fishing cooperative societies its essential for the effective management of the riverine system. The outcome of the present study may help the stakeholder and policy makers to formulate management guidelines towards achieving sustainable development goals.


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CLFMA organises its 64th National Symposium with the theme 'Livestock Sector: Looking Beyond the Present'

CLFMA Chairman Suresh Deora, Nadir B. Godreg, Diviya Kumar Gulati and Abhay Shah with the Union Minister Purushottam Rupala lighting the lamp at the inauguration of 64th CLFMA Symposium at Delhi on August 18.

New Delhi: The inaugural session I of the CLFMA of India symposium concluded on a high note on Friday, August 18, 2023. The event, held at Hotel Le Meridien in New Delhi, witnessed the participation of esteemed dignitaries and industry leaders, who shared valuable insights on the future of the animal husbandry, dairying and fisheries, sectors in the country.

The session began with an auspicious lighting of the lamp by esteemed guests, including Guest of Honour Parshottam Rupala, Minister of Fisheries, Animal Husbandry & Dairying, Government of India, and CLFMA Chairman Mr Suresh Deora along with Mr Divya Kumar Gulati, Convenor, CLFMA, Secretary Mr Abhay Shah. The chairman felicitated Parshottam Rupala with a bouquet, shawl and memento to mark the occasion.

Mr Divya Kumar Gulati, the convenor of the event, delivered a warm and welcoming address, setting the tone for an engaging and informative session. This was followed by a thought-provoking address by Mr Suresh Deora, Chairman of the CLFMA of India, who highlighted the industry's potential and challenges.

The highlight of the event was the prestigious CLFMA Lifetime Achievement Award. It recognized two exemplary individuals for their significant contributions to the livestock industry. The award was announced and presented recognizing their achievements and dedication to the sector. Nadir B. Godrej, Past Chairman, CLFMA OF INDIA and Chairman and MD of Godrej Industries Ltd., and Tarun Shridhar, IAS (Retd.) were honoured with the CLFMA Lifetime Achievement Award. The awards were presented by Parshottam Rupala.

Nadir B. Godrej thanked CLFMA for the award with full heart and spoke

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about his journey in the animal feeding business. The glimpses he shared were not only fascinating but inspiring too. Tarun Shridhar, IAS (Retd.) humbly thanked for the honour and nostalgically remembered how the sector has given him the vast knowledge, experience, insights and friends he adores today.

The much-awaited Livestock Survey Report (Volume - II) was also launched at the event. minister Parshottam Rupala, Chairman Mr Suresh Deora, Mr Nadir B. Godrej, Tarun Shridhar, Mr Divya Kumar Gulati and honorary Secretary Mr Abhay Shah, were present on the dais to unveil the report. The report provides valuable insights into the current state of the livestock sector and outlining future opportunities and challenges. The report is expected to serve as a guiding resource for industry stakeholders, policymakers, and researchers.

Union Minister of Fisheries, Animal Husbandry & Dairying, Government of India, Parshottam Rupala, delivered an address at the event. As they say storytelling is the best way to communicate life experiences, our guest of honour shared his life insights with stories of inspiration and success.

He shared valuable insights into government policies and initiatives aimed at promoting the growth and development of the livestock sector. He also highlighted the government's commitment to the development and growth of the fisheries, animal husbandry and dairying sectors in the country.

The minister emphasised that the "Livestock holds an ancient tradition that connects us to our roots. Before we became an agricultural nation, we were herders, showing the deep- rooted connection we have with animals. Animals once relied solely on nature for their sustenance, grazing from morning till afternoon, trusting in their fate. But with amendments in animal feeding practices, we have become the top milk producer in the world contributing 24% of global milk production, emphasizing the importance of conscientious farming."

Although he raised concerns that "Livestock farmers are currently facing challenges with fodder availability. This affects health of animals which directly impacts the income of cattle herders. So the industry needs to address this issue on a large scale along with the need for proper care and attention of livestock." He added "The government's efforts to merge technology with livestock are commendable. The introduction of vaccination and mobile veterinary units revolutionized the care of livestock."

Mr Rupala is very hopeful for the fisheries sector as well. In his speech he brought everyone's attention to inspiring numbers. "India has tremendous potential to lead the world in the fisheries sector. From a mere Rs 3680 crore expenditure from independence till 2014, to a 20,000 crore Pradhan Mantri Matsya Sampada Yojana today, the transformation in fisheries sector is astounding. With the volume of aquaculture soaring from 30,000 crore in 2014 to 63,000 crore today, the potential to lead the world in this sector is within our grasp. Together, let us unlock the immense potential within our communities, industries and government to become global leaders in fisheries."

The session concluded with a vote of thanks delivered by Mr Abhay Shah, Secretary of the CLFMA of India, expressing gratitude to all the distinguished guests, esteemed speakers, delegates and participants for their valuable contributions and making the inaugural session a resounding success. This was followed by a networking lunch.

Mr Nadir B. Godrej, Past Chairman, CLFMA of India and Chairman & MD of Godrej Industries Ltd and Mr Tarun Shridhar, IAS (Retd.), Former Secretary, Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry & Dairying, GoI were honoured with Life Time Achievement Award. CLFMA Awards were also given two scientists Dr Anand Kumar Pathak and Dr Pankaj Kumar Singh.

The CLFMA of India conference had set a strong foundation for the subsequent sessions, and discussions that would take place over the following days. With the enthusiastic participation of industry experts, policymakers and stakeholders, the symposium aimed to explore strategies and solutions for the sustainable growth of the fisheries, animal husbandry and dairying sectors, contributing to the overall development of the country.

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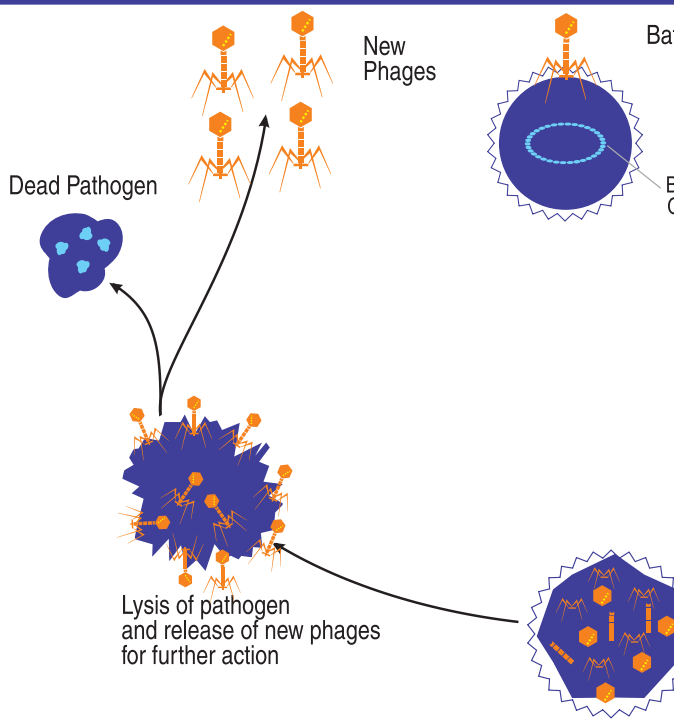

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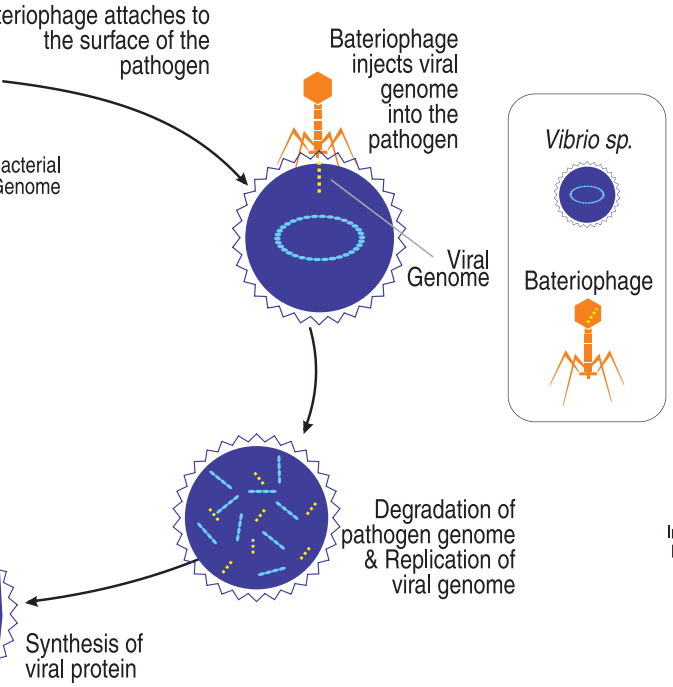

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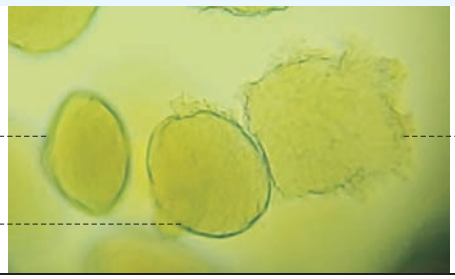
Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope

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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The CLFMA of India (Compound Livestock Feed Manufacturers Association) concluded its highly anticipated Inaugural Session - II event, marking a significant milestone in the organization's journey on Day 1 of 64th National Symposium 2023. The event was held at Hotel Le Meridien in New Delhi. The event witnessed the presence of esteemed dignitaries from the government, industry leaders and key stakeholders. The event centered on the theme "Livestock Sector: Looking Beyond the Present"

Divya Kumar Gulati

and aimed to bring together industry leaders, policymakers and experts to discuss the future of the livestock sector in India.

The event commenced with the lighting of the lamp ceremony, where all the dignitaries were invited to the dais. Dr O. P. Chaudhary, Joint Secretary (NLM/PC),

Suresh Deora, Chairman, CLFMA of India

Department of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India graced the occasion as the Guest of Honour Nadir B Godrej, Past Chairman of CLFMA of India and Chairman & MD of Godrej Industries Ltd; Tarun Shridhar, IAS (Retd.); CLFMA Chairman Mr Suresh Deora; Deputy Chairman Mr Sumit Sureka; Convenor Mr Divya Kumar Gulati and Hon. Secretary Mr Abhay Shah were present on the dais with the guest of honour.

Dr O. P. Chaudhary was felicitated by Mr Suresh Deora with a bouquet, shawl and memento to mark the occasion. Mr Sumit Sureka, Deputy Chairman, CLFMA felicitated Nadir B Godrej and Shri Tarun Sridhar was felicitated by Mr Divya Kumar Gulati.

Mr Divya Kumar Gulati, Deputy Chairman of CLFMA of India, delivered the welcome address, highlighting the importance of the event and expressing gratitude to all participants. Following the welcome address, Mr Suresh Deora, Chairman of CLFMA of India, addressed the audience.

A key highlight of the event was the CLFMA Audio Visual Presentation which showcased the achievements and initiatives undertaken by CLFMA of India in the past year. The presentation highlighted

Dr O. P. Choudhary

the organization's efforts in promoting animal health, welfare and sustainable practices in the livestock sector.

Mr Nadir B. Godrej, Past Chairman of CLFMA of India; Chairman & MD of Godrej Industries Ltd., and CLFMA Lifetime achievement awardee

Tarun Sridhar

delivered the keynote address. For a change this time the keynote address was in the form of a long poem. The poem showcased the glimpses of his journey, discussing serious issues of agriculture, livestock, dairy, poultry, animal feed and fodder, alternate feed, rising prices, challenges faced, factors like environment, economics, carbon footprints, efficiency improvement and our future.

His poetic keynote address gave us a lesson that in the tapestry of agriculture and livestock, we must weave the threads of innovation and sustainability, for only then can we create a future where abundance coexists with harmony and where the well-being of our planet is nurtured alongside the progress of our industries. His speech focused on the current trends and future prospects of the livestock sector, emphasizing the

Dr O. P. Choudhry prersenting CLMFA Award to the Scientist.

A view of Participants

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importance of technological advancements and the role of industry stakeholders in driving sustainable growth.

In the 64th National Symposium, CLFMA Lifetime achievement awardee Shri. Tarun Shridhar, IAS (Retd.) shed light on the theme 'Livestock Sector: Looking Beyond the Present' and shared valuable insights. The livestock sector encompasses various aspects such as animal husbandry, fisheries and aquaculture. This sector has witnessed impressive growth since its establishment.

"One notable development in this sector occurred in February-March 2019 when the decision was made to separate the Department of Fisheries from the Department of Animal Husbandry. This move recognized the distinct nature and importance of each sub-sector within livestock."

He even emphasised that "It is remarkable that animal husbandry contributes over 30% to the agricultural GDP, despite receiving less than 5% of total investment in comparison to agriculture. To further emphasize the significance of this sector, the Ministries of Fisheries were separated from Animal Husbandry and Dairy, highlighting the need for dedicated focus and attention. This separation from the agriculture ministry was a significant step towards recognizing the unique challenges and opportunities present in the livestock sector. It also paved the way for targeted investment in terms of both financial resources and appropriate policies."

In his address he remembered, "In fact, the first agenda item discussed in the first cabinet meeting of the new government was a 15,000 crore project aimed at eradicating disease control and improving the food processing system within the livestock sector. This demonstrates the government's commitment to prioritize and support the growth and development of this sector."

"Moreover, the livestock sector has proven to be beneficial to our economy, as evident in the export of fish and buffalo meat. These products, derived from livestock, contribute to our nation's economic growth and provide opportunities for international trade."

He even foresees "The Livestock sector plays a crucial role in our economy, and it is time we look beyond the present and invest in its growth. With appropriate policies and infrastructure development, this sector has the potential to create entrepreneurship opportunities and contribute significantly to our GDP. Let us encourage our children to consider careers in agriculture, fish farming and animal husbandry, and pave the way for a sustainable and prosperous future."

In conclusion, Tarun Shridhar's insights highlight the immense potential of the livestock sector and the need to look beyond the present to harness its full capabilities. "CLFMA has the potential to become a powerful advocate for the industry, taking a strong stand and voicing the concerns and aspirations of its members."

The address was followed by the presentation of the prestigious CLFMA Award. The CLFMA (Compound Livestock Feed Manufacturers Association) Award is a prestigious recognition given to livestock feed manufacturers who

have made significant contributions to the industry. This annual award aims to acknowledge the hard work, innovation and excellence demonstrated by livestock feed manufacturers in India.

CLFMA award serves as a catalyst for the growth and development of the livestock feed industry. By acknowledging and celebrating excellence, it encourages manufacturers to continue striving for higher standards and innovation in their products. Ultimately, this

benefits not only the manufacturers but also farmers, consumers and the entire livestock

farming ecosystem.

CLFMA recognized the exemplary contributions of Dr Anand Kumar Pathak, Senior Assistant Professor (Animal Nutrition) in SKUAST Jammu and Dr Pankaj Kumar Singh, Professor and Head of Animal Nutrition Department of Bihar Animal Sciences University, Patna with the prestigious CLFMA Award. The awardees were felicitated by Dr O. P. Chaudhary, Joint Secretary (NLM/PC).

The event also saw the launch of the official souvenir, marking a significant milestone in the symposium with key dignitaries Dr O. P. Chaudhary, Mr Nadir B. Godrej, Mr Suresh Deora, Mr Divya Kumar Gulati, Mr Sumit Sureka, Mr Naveen Pasuparthy, Mr Sandeep Kumar Singh, Mr Abhay Shah, present on stage. All office bearers were invited on stage to be an auspicious part of the prestigious moment.

Dr O. P. Chaudhary addressed the audience, highlighting the initiatives undertaken by the Department of Animal Husbandry & Dairying to promote the growth of the animal feed industry. He highlighted the government's initiatives and policies to support the livestock sector, encouraging industry players to leverage these opportunities for the sector's growth. He highlighted 3 major points in his speech.

1. "The government officials are now realizing that they are facilitators, and it is their responsibility to come upfront to guide and help people in the animal feed industry. This includes making policies that support the growth and development of the feed industry."
2. "Additionally, there is a need to address the issue of providing nutritious and balanced food to the poor section of the society. By innovating and balancing the feed and fodder, we can reduce the cost and make it accessible to the weaker sections. For those associated with CLFMA, it is important to explore new ways to earn and fulfil their needs. Exporting to other countries, particularly those that are economically weaker than us, can be a viable option. It is crucial to seek support from the government in this regard. It is also important to focus on increasing the purchasing power of the people and ensuring that the needs of those who do not have sufficient financial resources are also fulfilled. To achieve this, efforts should be made to include the unorganized sector in the organized sector."
3. "Currently, the capital subsidy in Animal husbandry for structural development fund will see a significant growth with an increase from 3 to 5 percent, making it 15,000 crores to 25,000 crores.'

"Overall, there are several opportunities and challenges in the animal feed industry. By working together, government, industry, and stakeholders can create a favourable environment for growth and development." At the end of his speech, he congratulated all the CLFMA awardees as well.

As the event drew to a close, Mr Abhay Shah, Honorary Secretary of CLFMA of India, delivered the vote of thanks, expressing gratitude to all the dignitaries, eminent speakers, participants, sponsors, and organizers who made the event a success. He emphasized the importance of collaboration and knowledge sharing in driving the growth of the livestock sector. The evening was followed by an enjoyable networking dinner and live performances. This provided an opportunity for the participants to unwind, connect with industry peers and build lasting relationships.

The CLFMA of India is proud to have organized such a successful event, bringing together industry leaders and stakeholders for insightful discussions and networking opportunities. The 64th National Symposium of CLFMA of India proved to be a significant platform for knowledge exchange, discussion and collaboration in the livestock sector. The event successfully shed light on the challenges and opportunities beyond the present, encouraging stakeholders to work towards a sustainable and prosperous future for the industry.

About CLFMA of India:
CLFMA, also known as The Compound Feed Manufacturers Association, was established in June 1967. Over the years, it has gained recognition and support from various stakeholders including the Central and State Governments, livestock farmers and related organizations. With a membership of 250+, CLFMA represents all sectors of the livestock industry. This includes entities involved in feed manufacturing, poultry, dairy, aquaculture business, animal nutrition and health, veterinary services, machinery and equipment, as well as processing, distribution and retailing of meat and ancillary services such as banking in addition to its domestic recognition, CLFMA is also acknowledged by international sectors. It is highly regarded by government departments, agricultural universities, veterinary colleges and national research institutes within India. Furthermore, CLFMA is respected by related industries outside the country.

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VISION: Build global partnerships to help feed the world ethically and sustainably.

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- India based Integrated food company
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- Setting International standards in aquaculture-based food production

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- Make food available and affordable across borders
- Build a success story for all our stakeholders, based on trust, integrity and love

Road Map to the future:
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Infini Foods is rolling out 2 categories of QSR chains under the brand name of "Captain Shrimp" and "Shrimply". Captain Shrimp will be positioned as a premium QSR brand primarily with focus on large metropolitans whereas Shrimply will cater to tier 3 cities and towns giving access to shrimps at affordable prices.
Frozen is the "New Fresh"
HoReCa
The company is rolling out a range of value added ready to cook and read to eat products for the HoReCa Industry.
Retail
For the first time Indian market will see an upsurge in the acceptance and consumption of frozen, value added ready to cook and ready to eat food products. Infini Foods is all geared up to drive and be a leader in the RTC/RTE segment by enabling last mile connectivity across the geographies.
Infini Foods is promoted by a group of stakeholders in Indian aquaculture like Mr K. Ravi Kumar and others.

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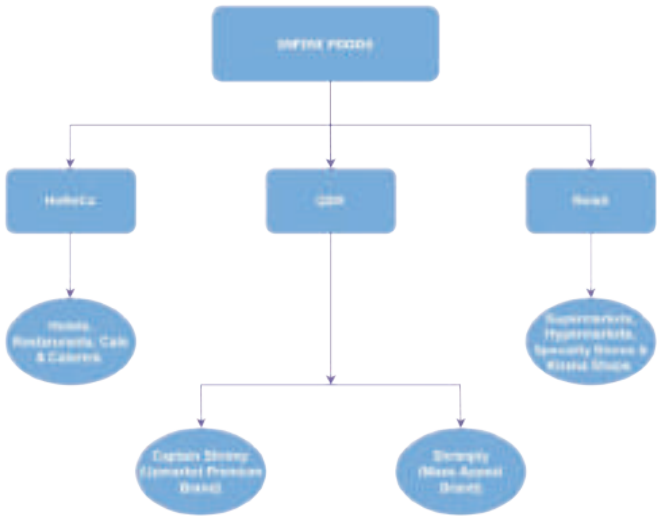
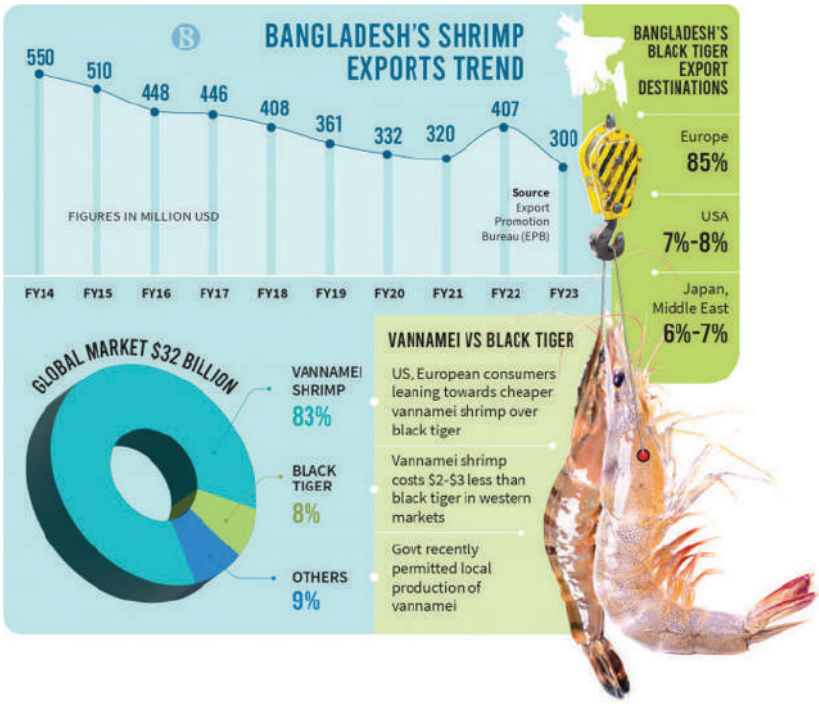


Shrimp exports sink as western consumers tighten spending

Stakeholders expect commercial production of vannamei shrimp in Bangladesh by next March-April



The demand for Bangladesh's black tiger shrimp export is fast losing ground in western markets, prompting the government to approve the commercial production of vannamei, a cheaper top-selling shrimp variety.

Bangladesh's shrimp export fell by 26.27% to $300 million in FY23, according to data from the Bangladesh Export Promotion Bureau. The export was 40% lower than the target of $500 million.

To prevent further erosion in the exports, which mostly comprise black tigers, the Department of Fisheries recently gave preliminary permission for vannamei production in the country.

To quickly get commercial production up and running, fisheries company Desh Bangla has been granted permission to experimentally produce vannamei juveniles.

Exporters said Bangladesh's shrimp shipments are badly hurt by the global economic recession induced by the Ukraine war, forcing western consumers to lean more towards vannamei shrimps which cost $2-$3 less than black tigers in retail markets in the US and Europe.

According to the Bangladesh Frozen Food Exporters Association (BFFEA), vannamei's market share has increased from 77% to 82%-83% of the $32 billion global shrimp market within a year. The rest of the market is occupied by black tigers, lobsters and some marine fish.

Almost 85% of Bangladeshi shrimp is exported to Europe, 7%-8% to the US and the rest to Japan and the Middle East.

Exporters said the biggest slowdown in the export of shrimps was in November, December and January when orders had come down to rock bottom.

During that period, European consumers saw their electricity bills triple during the winter, as a result, they cut down on restaurant visits.

There is no alternative to vannamei farming to increase shrimp exports, stakeholders said. It is no longer possible to compete in the market with black tigers.

Many consumers want to buy vannamei and black tiger shrimp together. When there is only one kind in this country and not the other, then the order does not come to Bangladesh, they observed.

In this situation, after the trial production for more than two years, the Department of Fisheries has started granting permission for the commercial production of vannamei from the beginning of this year.

Alok Kumar Saha, deputy director (aquaculture), Department of Fisheries, told TBS that 8-9 companies have been given permission for commercial production of vannamei shrimp.

Mentioning that another company was granted permission for the production of vannamei seedlings two weeks ago, he said, "Much will depend on how quickly commercial farming expands on seedling production."

Companies that have received permission expect seedlings to be available by November-December. If farming starts with them, there is a possibility of getting commercial production of vannamei running by March-April next year.

Shyamal Das, managing director, MU Sea Foods informed TBS that his company got permission for commercial farming by bringing fries from India.

"However, vannamei juveniles are produced locally, there will be no need to import any more," he said.

He further said they are using only 15%-20% of their capacity because of the shortage of raw materials.

"Once farming of vannamei begins, both our processing and exports will continue to increase. That's why we are giving importance to fast vannamei farming," he added.

West Bengal's Chaital turns a new leaf with mangrove plantation for sustainable aquaculture

About 35 farmers in the Chaital village in West Bengal's North 24 Parganas district have been guided by experts to plant more mangrove trees for dense foliage leading to high shrimp yield

Unlike most of the bheries (shallow fish ponds) spread over the Minakhan block in West Bengal's North 24 Parganas district, the 12 bigha pond of Pintu Das in Chaital village is dotted with trees. Rows of trees form clusters at various places in the pond and occupy the raised earthen embankments, which become slippery after every spell of monsoon rainfall.

A group of experts visiting Chaital village on the eve of the International Day for the Conservation of the Mangrove Ecosystem, observed on July 26, were impressed by the flourishing trees. "In just three years, the tree has outgrown me," K. Kathiresan, Honorary Professor at Annamalai University, Tamil Nadu, an expert on mangroves, said pointing at a bain tree (Avicennia marina).

Explaining that the Avicennia is the best suited among mangrove species for plantation in the region, Dr Kathiresan said the salinity under the root of the Avecinia plant is higher than the salinity in the water and soil, and the plant absorbs salinity from the soil. Other mangrove species with which the shrimp cultivators are experimenting include Heritiera fomes (sundari tree), Nypa fruticans (nipa palm) and Rhizophora mucronata (garjan tree).

Shrimp cultivators testing salinity level at a fish pond at Chaital village in Minakhan block of West Bengal

As the shrimp farmers calculated the salinity of water at different places in the fish pond, Ravi Shankar Thupalli, an international mangrove management specialist, said that not only the leaf litter from the mangroves but the presence of more trees will invite more birds to the pond, and bird droppings would increase the yield of shrimp.

Both the experts told the shrimp farmers to plant more mangrove trees for dense foliage and high shrimp yield.

About 35 farmers in the Chaital village have turned a leaf in sustainable aquaculture by integrating shrimp cultivation with mangrove plantation. "For the past three years, we are not purchasing fish feed — the leaf litter from the mangroves is turning out to be food for the shrimp," Mr Pintu Das said.

Another shrimp farmer, Ashok Das, who has about four bighas of fisheries, agreed that using mangrove leaf litter has helped farmers save money without affecting the yield of shrimp.

For shrimp farmers, the biggest challenge has been a viral infection that hit shrimp yield. Both Mr Pintu Das and Mr Ashok Das said that after they started using mangrove leaf litter, there had been no viral infections in the shrimp.

The fish species cultivated by the shrimp farmers in Chaital include Penaeus monodon (tiger prawn), Penaeus indicus (chapra chingri) and Macrobrachium rosenbergii (golda chingri), which bring high economic benefits to farmers along with local fish like parshe and bhangon.

After the interaction, the experts were invited to the house of the fisherfolk, where a young girl performed a song on the sundari tree, which gives Sundarbans its name. Locals emphasised that mangroves are the key to the lives of people in the Sundarbans.

"This is a very good initiative and can be implemented in other parts of the country as well," Dr Kathiresan told The Hindu.

Animesh Roy, another fisherman with about 20 years of experience, said the biggest challenge in shrimp cultivation in the Sundarbans was frequent cyclones and high tides during which sea water breached the embankments, resulting in high losses. Mangrove trees with their elaborate root system hold the soil and abate the storm surges in the region dotted with shallow fish ponds, Mr Roy added.

Conservationists have been stressing the importance of sustainable shrimp cultivation in the ecologically fragile Sundarbans for a long time. Earlier this month, during a national symposium in Kolkata on 'Building synergies for healthy mangroves and robust value chain around the mangrove ecosystem in Sundarban', an entire day was dedicated to sustainable aquaculture in

the mangrove ecosystem.

The initiative of integrating shrimp cultivation with mangrove plantation was taken up by the Nature Environment and Wildlife Society (NEWS), an NGO working for the protection of natural ecosystems under the SAIME (Sustainable Aquaculture In Mangrove Ecosystem) project started in 2020 and funded by the Government of Germany (BMZ) and the Global Nature Fund.

Prasanta Kumar Biswas, Professor, Food Technology and Biochemical Engineering, Jadavpur University, said that with the nature-based attempts at Chaital, shrimp cultivation in Mina khan was coming full circle. Prof. Biswas, who hails from the region, said aquaculture had begun with paddy cultivation in the region in the 1980s, following which paddy farming was replaced with shrimp cultivation by locals, ignoring traditional methods.

"When we expanded aquaculture in the Sunderbans, it came at the cost of the mangroves as we cleared the mangroves and excluded the plants from fishery farming. Under this initiative, we are going for nature-based solutions and trying to integrate mangroves with fisheries again," Ajanta Dey, joint secretary of NEWS, said.

How to Increase Soybean Meal Use in Aquafeeds

Researchers said that insect meal could be considered as a complementary ingredient to enhance soybean meal utilization in aquafeeds.

Soybean meal has long been a staple of diets in the aquaculture industry. A researcher from the University of Idaho, funded by the South Dakota Soybean Research & Promotion Council, is testing just now soybean meal feed formulations can include in aquaculture diets without compromising the growth of gut health of the fish.

Current Situation

Only a small amount of soybean meal is used in aquaculture a diets when animals are young according to Vikas Kumar, assistant professor of research in fish nutrition and nutrigenomics, University of Idaho. Once fish research the fingerling and adult stages, more soy is added to the diet. Aquafeed producers supplement the diets with fishmeal, which has excellent digestibility but is a costly ingredient with limited supply.

Aquaculture diets have

changed significantly since the 1990s. In the 1990s, fishmeal was a major source of protein in aquafeed, but since then, the use of soy products in aquaculture has significantly increased. Plant proteins, mostly sourced from soy, only comprised about 20% of aquaculture diets. Today, that amount has more than doubled. Kumar's team anticipate that the proportion of plant protein could expand another 15%, to make up nearly three-quarters of the protein in aquaculture diets.

Why soy?

Soy is an excellent protein source for aquaculture diets, being les costly than fishmeal and sustainably produced. "At commercial levels, in general, we don't add more than 10-20% soybean meal for salmonids," Kumar said. "Previous research has shown that using more than 20% soy in aquaculture diets usually causes a lot of problems, such as gut inflammation in rainbow trout. There's one section of the animal's gut where most of the nutrients are absorbed and that's where the most inflammation has been found."

Kumar's team designed an experiment evaluating seven Atlantic salmon diets, each with varying levels of soybean meal, up to 40%. Other diets in the experiment contained various amount of soybean meal combined with whole insect larval meal made from black soldier fly larvae, which provides valuable fat and protein to the fish. The insect meal has a high protein content while also offering lauric acid and antimicrobial properties to the fish.

Outcomes and future research

We found that the diet with 30% soybean meal and 5% insect meal had the best feed efficiency and growth for the fish," he said. "The diets with high amount (40%) of soybean meal with high inclusion (10%) of whole insect larval meal werent's so good."

Once parameter that didn't statistically change during the experiment is the protein efficiency ratio, which estimates protein quality based on the increase in the fish's body mass.

"While the soy causes inflammation, the insect meal reduces inflammation in Atlantic salmon," Kumar said. "The growth of the fish was still good." Kumar's past and current research indicate that insect meal could be considered as a complementary ingredient to enhance meal utilization in aquafeeds.

The next research goal for kumar's team is to explore how consumers may respond to eating farmed seafood that has been fed insect meal. They also plan to examine the food quality of those fish.

Lok Sabha passes amendment bill to decriminalise offences in coastal aquaculture business

Union Minister Parshottam K. Rupala said that the fishermen community of the country will welcome the bill

Proceedings of Lok Sabha underway during the Monsoon Session of Parliament, in New Delhi on 7 August 2023

The Lok Sabha on August 7 passed an amendment bill to decriminalise the offences committed in carrying out the coastal aquaculture activities and ensure ease of doing business.

Union Minister Parshottam K. Rupala said that the fishermen community of the country will welcome the bill.

He said that through this, "we can send a message from parliament that we stand with the fishermen".

The bill was passed by voice vote.

The Coastal Aquaculture Authority (Amendment) Bill, 2023, which was introduced in the lower house on April 5, also seeks to expand the scope, remove regulatory gaps and reduce the compliance burden without diluting environmental protection rules in the coastal areas.

To decriminalise the offences, the bill seeks to remove the jail term of up to three years and impose only a penalty of up to ₹1 lakh.

It also seeks to fine-tune the operational procedures of the Coastal Aquaculture Authority to make it more responsive to the needs of the stakeholders, promote newer forms of environment-friendly coastal aquaculture like cage culture and seaweed culture, and usher in global best practices in this sector, including mapping and zonation of aquaculture areas, quality assurance and safe aquaculture products.

The bill also seeks to encourage the establishment of facilities in areas having direct access to seawater to produce genetically improved and disease-free broodstocks and seed for use in coastal aquaculture besides preventing the use of antibiotics and pharmacologically active substances, which are harmful to human health in coastal aquaculture.

Mr Rupala said that after its introduction in the Lok Sabha, it was sent to the standing committee.

The Ministry has accepted 45 amendments of the committee out of 56.

Citing data, he said that there was an expenditure of only ₹3,680 crore for the sector during 1947 and 2014.

But the Modi-led government has the Pradhan Mantri Matsya Sampada Yojana with an investment of ₹20,050 crore in fisheries sector.

During the last nine years, shrimp production in the country has increased to 11.84 lakh tonnes in 2022-23 from 3.22 lakh tonnes in 2013-14.

The government has removed a number of provisions, where imprisonment was there for minor offences, the Minister said.

"We can send a message from parliament that we concerned about the fishermen community," he added.

Distinguished Ornamental Fish Farmer of India Kripan Sarkar Passed Away

A part of Rainbow Ornamental Fish Farm

Jalpaiguri, West Bengal: Back in February 2004, in National Seminar on 'Prospects of ornamental fish breeding and culture in eastern and north-eastern India', organized by ICAR-CIFE Kolkata Centre, it was discussed in detail about ornamental fishes as an important component in Indian fisheries and aquaculture and that this sector has potential to generate income, employment and export earnings. In this context, considered as an expert and authority in India and Nepal in scientific breeding in captivity, larval rearing, domestication, propagation and research on commercially-important freshwater ornamental fishes, that includes both aquarium fishes (almost all sorts of common exotic fishes and less-familiar high-valued ones) and small attractive indigenous riverine fishes of north Bengal and north-eastern states, Sri Kripan Sarkar breathed his last on 2 August 2023 at about 11am at his home near Jalpaiguri town, West Bengal, at 58 years of age. He was the owner of Rainbow Ornamental Fish Farm at Bakshipara village in Jalpaiguri Sadar Block, Dist. Jalpaiguri, West Bengal. Late Kripan Sarkar was involved in production of marketable-sized ornamental fishes since 1995; also widely known as an exporter and supplier of ornamental fishes, advisor, trainer, good speaker in disseminating knowledge to ornamental fish farmers, women SHGs and aquari-entrepreneurs.

After 9 April 2017, News communicator Subrato Ghosh visited Sri Sarkar's home-cum-fish farm on 15 August 2023 and saw quite a few established commercial ornamental fish farmers, younger in age to Sri Sarkar, from distant places in Darjeeling and Jalpaiguri districts of West Bengal, Guwahati and Darrang districts of Assam and Nepal paying homage and heartfelt respect to late Kripan Sarkar on his 'Shraddho onusthan' ceremony. Sri Sarkar motivated and helped many others to rise and prosper, shared his inventions and technologies with them without any vanity. As a sound intellect person and expert physician, he could speak about health management of fishes, the remedies and solved problems in connection with captive breeding and rearing of ornamental fishes, in big glass tanks, rectangular cement cisterns and ponds. He

Late Kripan Sarkar

was known to many Senior Scientists and Principal Scientists working in fishery and aquaculture institutes under ICAR, to well-established and progressive elderly fish farmers in many parts of India and University teachers in Zoology/Fishery in West Bengal, Assam, Meghalaya, Arunachal Pradesh. He also possessed considerable knowledge in induced breeding technique of air-breathing catfishes and production of live minute fish food organisms.

The ideas and legacy, which Late Kripan Sarkar has left behind, will remain immortal and he will continue to remain in hearts of many fish farmers in north Bengal and north-eastern India.

Goldfishes at Sri Sarkar's farm

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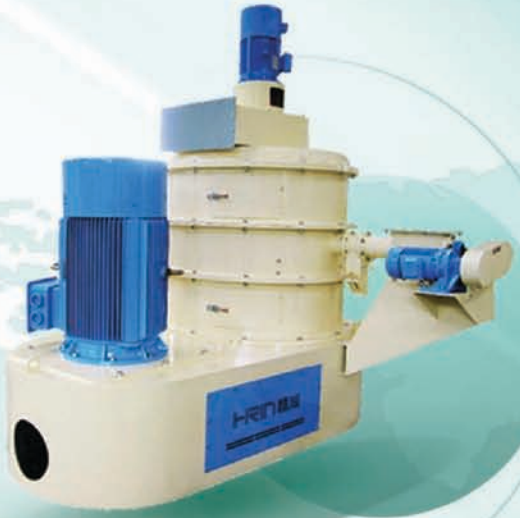

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Fish: An Emerging Experimental Model in Biomedical Studies

- Fishes are being explored as novel 'biological models' in biological research and development.
- The diversity in their species, habitat, and biology, along with characteristic developmental patterns, makes fishes futuristic biological models with widened scope.

Introduction

Biomedical research is a branch of applied science that studies human diseases by analysing biological samples and attempting to develop diagnosis and treatment methods for them (Mullane et al., 2018). The nature and mechanism of human diseases are initially studied in some non-human biological organisms possessing distinctive behavioural and physiological characteristics and are referred to as models. Such models are also used to determine the efficacy, implications and side-effects of novel substances like drugs, supplements, or chemicals on their target organism(s) and its environment. Biological models are also used to study various physiological systems such as the function of biomolecules (e.g., yeast model), the development of higher vertebrates (e.g., zebrafish model), nervous system development (e.g., fruit fly model), cell divisions (e.g., *Escherichia coli* model), human diseases (e.g., non-human primates), etc. An organism is declared a scientific model if it possesses desirable features such as a simple structure, an easy and short multiplication pattern, is accessible for genetic manipulations, adapts well to the laboratory environment and represents a diverse group of organisms.

Conventional biological models like mice, rats, guinea pigs, dogs, cats, zebrafish, etc., are successfully used in scientific research and development. However, there are always technical or ethical limitations for every model organism, creating a window for exploring novel animals in biomedical studies. Among many emerging models, fishes are proven to be the best models for biological studies and they have led to breakthroughs in developing disciplines like embryology, neurology and endocrinology (Powers, 1989). Fish produce a large number of eggs, reproduce shortly and are easy to expose to desired conditions. Fish respond to environmental and ecological cues through molecular, biochemical, physiological and morphological changes that involve the coordination of many tissues and cell types. The application of fishes as novel biological models for studying human diseases and disorders are depicted in figure 1.

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The goldfish (*Carassius auratus*) is the oldest model used in toxicological studies. Zebrafish (*Danio* rerio) was the first fish model used for studying developmental genetics in 1960s. Among fish models, zebrafish and medaka (*Oryzias latipes*) are extensively studied in scientific studies. The standard fish models also include *Xiphophorus sp*, other poecilids, and cyprinodontids. This article briefly discusses the utilisation of fish-based experimental models in current scientific research and their future potential.

1. Modeling Human Diseases

Fishes are being used as evolutionary mutant models (EMM) in exploring human diseases. These EMM models possess conserved physiological mechanisms for various body disorders that are in line with higher vertebrates. For instance, fish EMMs include Mexican cavefish models for the heart and pancreas, Antarctic icefish models for bones and blood, a turquoise killifish model for the whole-body dynamics, platyfish and swordtail models for the skin, an electric fish model for the whole body dynamics, a three-spined stickleback model for the intestines, and a mummichog model for the brain. These EMMs have been used to study human diseases such as anemia, diabetes, skeletal dysplasia, cardiac regeneration, metabolic disease, inflammatory bowel disease and others.

Fish models are also useful in screening chemicals and drugs against various diseases in a high-throughput manner. For example, leflunomide, an FDA-approved arthritis treatment, was developed and validated using a zebrafish model. Similarly, certain genetic mutations cause improper regulation of ions in the human body. These mutations are related to diseases such as epilepsy, cystic fibrosis and cardiomyopathy. The electric organ-bearing electric eels are perfect models for such diseases, as they have peculiar ion regulation mechanisms in their specialised electric organs. Similarly, other electric fishes, e.g., elephant fish and knife fish, have been found suitable for modeling skeletal diseases in humans.

2. Apoptosis in Mammals

Apoptosis is the programmed death of living cells when they are affected by extracellular stressors like radiation, chemicals, or heat shock. Apoptosis is a major indication of diseases like diabetes, Alzheimer's disease, immune degeneration and more importantly, cancer development in humans. Invertebrate model organisms for studying apoptosis, such as nematodes and fruit flies, have the limitation of being very evolutionary distant from mammals.

Fish, on the other hand, is an important novel tool for studying mammalian apoptosis. For example, caspase proteins are an essential part of the apoptotic pathways of living creatures. Research in fish genomics has revealed that the diversity of fish caspases found in fishes such as zebrafish, salmon, and sturgeon and their transgenic forms are orthologous with mammalian caspases. For example, stressors like low and high dissolved oxygen, low water temperatures, UV exposure and toxicants induce caspase-promulgated apoptotic pathways in fish as well as in their specific tissues. Caspase 3, Caspase 6, Caspase 7 and Caspase 9 are by far the major apoptotic regulators in fishes. Thus, studying the pattern of such molecules in governing apoptosis in fish further strengthens our knowledge of the process.

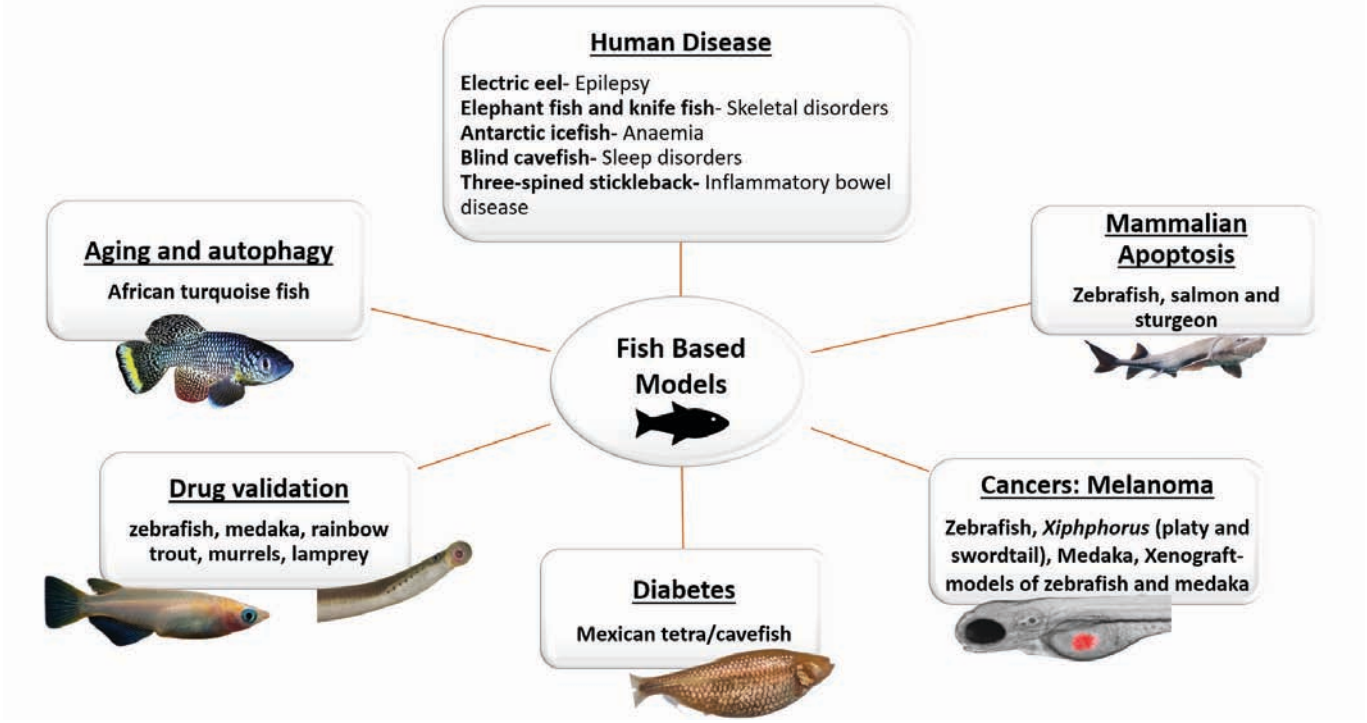

Fig 1: Fishes are used as novel biological models for studying human diseases and disorders.

3. Cancer: Melanoma in mammals

Cancer is an uncontrolled multiplication of cells that leads to abnormal development and ultimately, to the death of a living organism. Melanoma is a type of skin cancer that develops due to the abnormal proliferation of melanin-producing skin cells, melanocytes.

Zebrafish, *Xiphophorus* (platyfish and swordtails) hybrids, and medaka are important candidates for studying melanoma among various animal models. These fishes and their mutant forms possess scalable features that could be tracked optically and genetically. Human cancer cells are merged with zebrafish and *Xiphophorus,* and such xenograft models are used to study the development and progression of melanoma and its susceptibility to drugs. These fishes are thoroughly tracked and visualized in all their life stages to understand the patterns of melanocyte growth and abnormalities. Their transparent mutant forms allow the tracking of cellular development by labelling fluorescent molecules such as green fluorescent protein (GFP) with them (Patton et al., 2010). Thus, fish models are the most amenable and convenient models for elucidating melanoma and its pathways in real-time and testing the efficacy of therapeutic therapies against it.

4. Diabetes in mammals

Diabetes is a failure of blood sugar regulation and a chronic threat to the wellness and life of an organism. The role of the pancreas and hypothalamus in regulating blood glucose and appetite is conserved in fishes and humans. A cave-dwelling fish, the Mexican tetra/cavefish (*Astyanax mexicanus*), is well adapted to extreme dietary conditions and is thus an apt model for diabetes study. Due to the binge-eating behaviour of this fish, it shares many similarities with human metabolic diseases. The fish has a point mutation in its insulin receptor gene and is naturally insulin-resistant similar to a type 2 diabetic human, but shows no symptoms of diabetes. Further, diabetes causes the abnormal prevalence of advanced glycation end products (AGE) (glycated proteins and lipids) in blood and is a prime cause of artery blockage, i.e., atherosclerosis and retinopathy in humans. Cave-dwelling fishes have similar GEPs in their blood and possess coping mechanisms to keep them in check. Understanding such coping mechanisms will be crucial for strengthening the medical treatment of mammalian diabetes. Thus, their role in modelling diabetes in humans is unique and precise. This is the best strategy to understand "learning from nature."

5. Pharmacological studies

Zebrafish are an important model for medium- to high-throughput drug screening and pharmacological research. This model has been used to develop screening techniques for a range of small molecules for treating various disorders, such as those of the cardiac system, nervous system, intestinal tract, visual functions, pro-convulsing potential and osteogenesis. Nowadays, research on the use of plant-derived substances (phytochemicals) as medicine and prophylactic agents is in vogue and such substances need reliable, cost-effective and compatible models for their validation. Recent studies have found a broad range of fish species like tilapia, rainbow trout, rohu fish, etc., for screening phytochemicals for their role in immunomodulation, antioxidative potential, toxicity and ability to replace chemical antibiotics.

Fishes like zebrafish, medaka, rainbow trout, murrel, and lamprey are currently used to study the pharmacology of various drugs. For instance, drugs like visangin and diphenyl urea nullify the toxic side effects of a cardioprotective drug, doxorubicin, in the zebrafish heart.

6. Organogenesis and organ-modelling in higher animals

The developmental pattern of the nervous system and gonadal tissue in fish is closely related to that of higher vertebrates. Moreover, tracking such development at tissue and molecular levels is relatively convenient in fish models. Metamorphosis patterns of fishes such as the pronephric kidney, the onset and reversal of secondary sexual characters, sex-reversal, and larval development are some handy tools for studying the development and remodeling of organs in mammals *in vivo*. Moreover, the ability of fish to survive long periods of starvation provides insight into the studies of aging and autophagy in mammals. For example, the African turquoise killifish (*Nothobranchius furzeri*) is an excellent model for studying aging. The fish is short-lived, and its old age advances with fertility loss, cancer and cognitive loss, the same as in an aging human. Thus, the fish is an excellent model for studying aging-associated changes because of its short life span.

7. Conclusion

In biomedical research, fish models can bridge the gap between preliminary *in vitro* studies and expensive *in vivo* screening of novel drugs and therapies for higher vertebrates. By far, only a few fishes have been adopted as routine experimental models in biological research, like zebrafish, *Xiphophorus*, and medaka, owing to the availability of their whole genomic information and standardized laboratory protocols. However, other relevant fish models, such as the African turquoise killifish, notothenioid, the Antarctic icefish, the Mexican cavefish, the three-spine stickleback, transgenic fishes, etc., lack proper guidelines for their application in scientific studies.

With the advent of diverse research on these excellent study models, more of them will find their way into scientific methodologies and conventions, such as the Institutional Animal Care and Use Committee (IACUC) (Harikumar et al., 2022). By taking these measures, not only will the dynamic engagement of novel animal models be facilitated, but the limitations of the traditionally employed ones will also be salvaged.

References can be provided on request.

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Fish Farmer Producers Organisations – its genesis and growth

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Abstract

Fish Farmer Producer Organizations (FFPOs) have emerged as a successful model for promoting sustainable fish farming practices and improving the socio-economic conditions of small-scale fish farmers. These collective organizations provide a platform for fish farmers to access technical, financial, and marketing support, which would be difficult to obtain individually. The Indian government has been actively promoting FFPOs through schemes like the Pradhan Mantri Matsya Sampada Yojana (PMMSY). This articles documents the genesis and growth of FFPOs and compares effectiveness of four FFPOs in Odisha using a set of seven indicators - viz., a) Functioning efficiency b) Increase in income c) Increase in farmers share on consumers' rupee d) Inclusiveness e) Sustainability of Farmers Producer Company f) Level of satisfaction about the performance of FPC and g) Empowerment. FFPOs are confronting several challenges - limited awareness, insufficient resources, capacity gaps, and lack of supportive policies etc. A concerted effort by government agencies, research institutions, development organizations, and the private sector is crucial to support and sustain the growth of FFPOs and the fisheries sector as a whole.

- Fish Farmer Producer Organizations (FFPOs) have emerged as a successful model for promoting sustainable fish farming practices and improving the socio-economic conditions of small-scale fish farmers.
- FFPOs engage in various activities such as production enhancement, post-harvest management, infrastructure development, and marketing of fish products.
- Government is promoting FFPOs through schemes e.g., Pradhan Mantri Matsya Sampada Yojana (PMMSY) and One District-One Product (ODOP) etc.
- Research studies have shown that FFPOs have a positive impact on farmers' income, empowerment, and overall effectiveness.
- Challenges such as limited awareness, insufficient resources, capacity gaps, and lack of supportive policies need to be addressed for the long-term success of FFPOs.

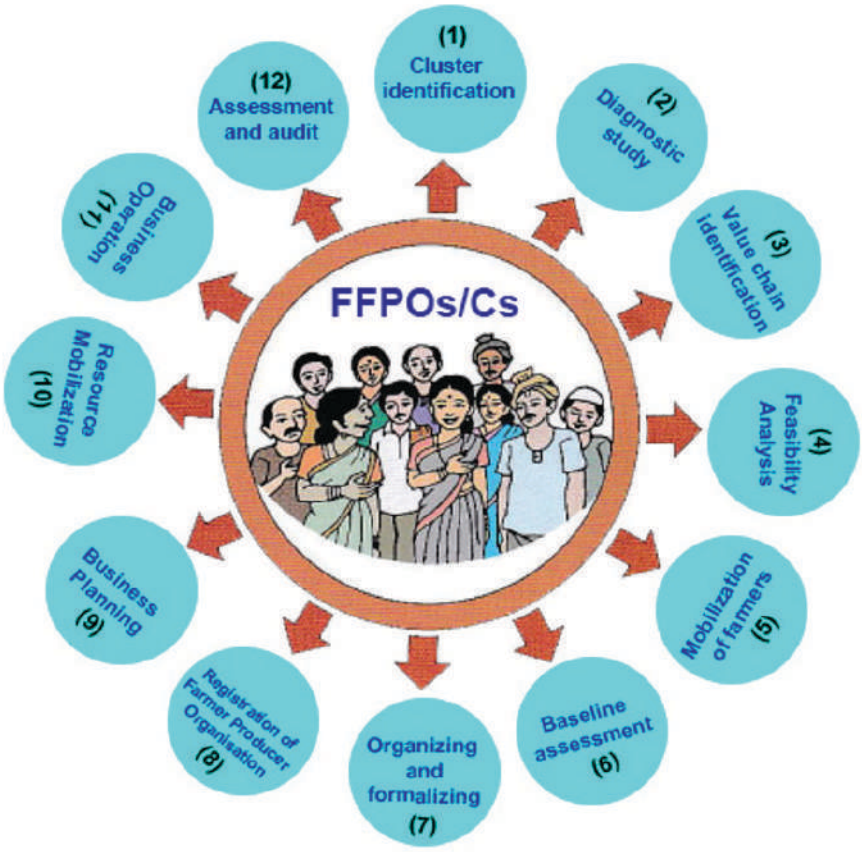
Introduction

Fish farming is a rapidly growing industry across the world, with an increasing demand for fish and seafood products. In recent years, the concept of Fish Farmer Producer Organizations (FFPOs) has emerged as a popular model for promoting sustainable fish farming practices and improving the socio-economic conditions of small-scale fish farmers. FFPOs are collective organizations of fish farmers who come together to achieve common goals related to production, marketing, and value addition of their fish and seafood products. These organizations aim to provide small-scale fish farmers with a platform to access technical, financial, and marketing support, which they would otherwise find difficult to access individually.

Presently, there are several FFPOs operating across the world, which have been successful in improving the livelihoods of small-scale fish farmers. In India, for example, the National Fisheries Development Board has been promoting the establishment of FFPOs as a means to improve the socio-economic conditions of small-scale fish farmers. The PMMSY, to be implemented over a period of five years from FY 2020-21 to FY 2024-25, seeks to ensure the socio-economic development of fishers, fish farmers, and fish workers with the goal of doubling their incomes. The scheme includes the establishment of 500 Fish Farmers Producer Organizations/ Companies (FFPOs/Cs) to empower fishers and fish farmers and enhance their bargaining power. Among these, 300 FFPOs will be set up under PMMSY, while the remaining 200 will be established through convergence with the Department of Agriculture, Cooperation, and Farmers Welfare's ongoing FPO Scheme. Additionally, the Department aims to establish a total of 720 FFPOs through convergence with other schemes and programs of the central and state governments, in collaboration with the Department of Agriculture, Cooperation, and Farmers Welfare, Ministry of Agriculture and Farmers Welfare (Guidelines on Formation and Promotion of Fish Farmer Producer Organisations). Ministry of Food Processing Industries, Government of India has launched the scheme of "One District-One Product" (ODOP) to reap the benefits of scale in terms of procurement of inputs, availing common services and marketing of products. Under this scheme, Khordha district of Odisha has been identified for fishery-based products as the district has ample scope for enhancing production and marketing opportunities and creating business avenues for the fish farmers and rural youth (De et al. 2021). In order to boost farmers' income in fishery sector, ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar facilitated formation of Bhargabi Fish Farmers Producers Company Limited in Balipatna block as a part of Farmer FIRST project. This company was incorporated on 27th March 2019 with an authorized capital of Rs. 10 Lakh. Technical back up and training were provided to the members about scientific fish culture practices (Sashani et al. 2018).

The PMMSY represents a significant investment in the fisheries sector, focusing on the socio-economic development of stakeholders and the establishment of FFPOs to support fishers and fish farmers. By enhancing their bargaining power and economic empowerment, the scheme aims to bring about positive transformation and sustainable growth in the fisheries sector in India. In addition to providing a platform for accessing technical, financial, and marketing support, FFPOs also promote sustainable fish farming practices. They encourage the adoption of eco-friendly farming practices that reduce the impact of fish farming on the environment. FFPOs also promote the use of high-quality fish feed and the adoption of good aquaculture practices to improve the health and productivity of fish farms.

Promotion and Development of FFPO



Source:- Formation of farmer producer organisations and implementation of business development guidelines pdf. Karnataka Government-2020 https:// watershed.karnataka.gov.in/ new-page/ Farmers+Producers+ Organization+(FPO)/ en

There are over 33711 FPOs across India with 28.2 lakh stakeholders with over Rs 4000 crore revenue in 2022-23 (Source: - FPO Platform for India, Tata Cornell Institute). Government of India has launched Formation & Promotion of 10,000 FPOs Scheme with a clear strategy and committed resources in order to form and promote 10,000 new FPOs across India. Rs 6866 crore have been allocated for this scheme. (Source: -Formation and Promotion of 10,000 Farmer Producer Organizations (FPOs), Operational guideline)

It aims at providing holistic and broad based supportive ecosystem to form new 10,000 FPOs to facilitate development of vibrant and sustainable income oriented farming and for overall socio-economic development and wellbeing of agrarian communities. It would also provide handholding and support to new FPOs up to 5 years from the year of creation in all aspects of management of FPO, inputs, production, processing and value addition, market linkages, credit linkages and use of technology etc.

Broad services and activities undertaken by FFPOs:

1. Production and Productivity:
- Supplying quality inputs for fish production at reasonable rates.
- Undertaking various fish culture activities using different techniques.
- Disseminating technology and innovations, and ensuring quality control.
- Aggregating smaller lots of farmer-members' produce.

2. Post-Harvest Management and Infrastructure:
- Providing machinery and equipment for storage, transportation, and logistics.
- Offering value-added services like cleaning, sorting, grading, and packing.
- Establishing fish farm level processing facilities and promoting high-value addition.
- Undertaking activities like cold chain development and traceability interventions.

3. Marketing and Branding:
- Creating brands, packaging, and standardizing products.
- Marketing the aggregated produce with better negotiation strength.
- Providing market information for informed decision-making.
- Operating fish vending kiosks and exploring domestic and export sales opportunities.

These activities collectively contribute to the development and growth of FFPOs, ensuring sustainable fish farming practices, improved market access, and increased income for fish farmers. (Source: - Guidelines on Formation and promotion of fish farmer producer Organisations (FFPOs)

Source: - Formation of farmer producer organisations and implementation of business development guidelines pdf. Karnataka Government- 2020 https:// watershed.karnataka.gov.in/ new-page/ Farmers+ Producers+ Organization+(FPO)/ en

Producer companies vis-a-vis co-operatives

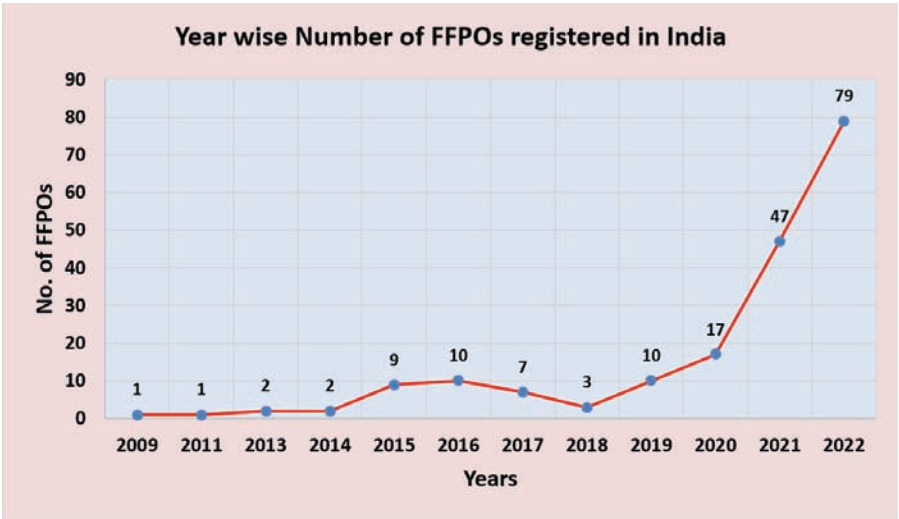
Fish Farmer Producer Organizations (FFPOs) and fish cooperatives are both collective organizations of fish farmers, but they have some key differences in their structure and operational models:

Table No. 01 Key differences between Cooperative Societies and Producer Companies

Features	Co-operatives	Producer Company
Registration under	Co-operative societies Act	Companies act
Membership	Open to any individual or co-operative	Only to producer members and their agencies
Professionals on Board	Not provided	Can be co-opted
Area of operation	Restricted	Throughout India
Relation with other entities	Only transactional based	Can form joint ventures and alliances
Shares Tradable within membership only	Not tradable	Tradable within membership only
Member stakes	No linkage with no. of shares held	Articles of association can provide for linking shares and delivery rights
Voting rights	One person one vote, but RoC and government have veto power	One member one vote
Reserves	Can be created if made profit	Mandatory to create reserves
Profit sharing	Limited dividend on capital	Based on patronage but reserves must and limit on dividend
Role of government	Significant	Minimal
Disclosure and audit requirements	Annual report to regulator	Very strict as per the Companies Act
Administrative control	Excessive	None
Borrowing power	Restricted	Many options
Dispute settlement	Through co-op system	Through arbitration

Source:- Farmer producer Organisation in Andhra Pradesh: A scoping Study Present Status of Fish Farmer producer organisations in India pdf. http:// oar.icrisat.org/ 9870/1/Research%20Report%20IDC%20-%2016%20-%20Rythu%20Kosam%20Project.pdf

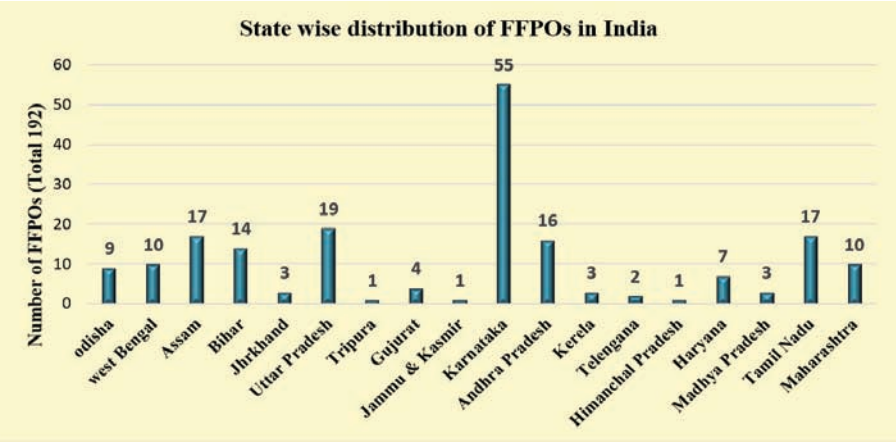
Figure No. 01 Year wise number of FFPOs registered in India



Source: - FPO Platform for India, Tata Cornell Institute

Figure No. 01 depicts the year-wise number of Fish Farmer Producer Organizations (FFPOs) registered in India. The graph shows a significant upward trend in the registration of FFPOs over the years. Initially, there is a gradual increase in the number of FFPOs from 2014 to 2017. However, from 2018 onwards, there is a steep rise in the registration of FFPOs, indicating the growing interest and recognition of the importance of collective organizations in the fish farming sector. This upward trend suggests a positive response from fish farmers towards FFPOs and their potential benefits in terms of improving livelihoods and sustainable fish farming practices.

Figure-2 State wise distribution of FFPOs in India



Source: - FPO Platform for India, Tata Cornell Institute

Figure 2 shows the state-wise distribution of Fish Farmer Producer Organizations (FFPOs) in India. It can be observed that Karnataka has the highest number of FFPOs, followed by Uttar Pradesh, Tamil Nadu and Assam. Other states such as Andhra Pradesh, Bihar, Maharashtra also has significant number of FFPOs. The distribution of FFPOs across states indicates the growing popularity and adoption of this model in different regions of India, contributing to the development and growth of the fisheries sector.

Table No.02 Distribution of FFPOs by paid-up capital (PUC)

PUC Category	No. of active FFPOs	% of total
PUC ≤50000	79	41.1%
PUC ≥50001 and ≤100000	65	33.9%
PUC ≥100001 and ≤500000	32	16.7%
PUC ≥ 500001 and ≤1000000	13	6.8%
PUC ≥1000001 and ≤5000000	2	1.0%
PUC >5000000	1	0.5%
Total	192	100.0%

Source: FPO Platform for India, Tata Cornell Institute

Table no. 2 presents the distribution of Fish Farmer Producer Organizations (FFPOs) in India based on their paid-up capital (PUC). The table shows that the majority of active FFPOs (41.1%) have a PUC of up to Rs. 50,000. The second-largest category consists of FFPOs with a PUC ranging from Rs. 50,001 to Rs. 1,00,000, accounting for 33.9% of the total. The proportion of FFPOs decreases as the PUC increases, with the lowest representation in the category of PUC greater than Rs. 5,00,00,000, which accounts for only 0.5% of the total. This distribution indicates that a significant number of FFPOs operate with relatively low levels of capital. It suggests that many FFPOs are small-scale organizations with limited financial resources, highlighting the need for adequate financial support and access to capital for their growth and sustainability.

Researches on FPOs – its performance, impact and constraints

FPO and its various dimensions has attracted lot of research attention. Saha et al (2023) calculated the performance index of four FPOs of West Bengal with index value ranging from 6.83 to 10.46. Technical efficiency score of the fish farmers, vegetable farmers and cereals crop farmers under the selected FPCs were also analyzed and found that the average measure of overall technical efficiency was 22.2 per cent for cereal crop farmers, 44.3 per cent for vegetable farmers and 63 per cent for fish farmers.

Roy et al (2022) in his study identified seven dimensions i.e. Social Mobilization, Capacity building, Production support, Marketing support, Technical support, Financial support & Legal Compliances to measure the role performance of the FPCs with marketing support emerging as the most important. It could be enunciated that marketing support plays crucial role in sustainability of any FPC, without proper marketing facility FPC will be unable to channelize the aggregated produce of the members for better price realisation. Stability index of FPO was developed by Gorai et al (2022) with - mutual trust, role clarity of the members, level of involvement of members in group works, satisfaction of the members, sense of attachment and conviction and sense of ownership as indicators. Significant difference between the mean scores of stability index of high and low performing FPOs were observed with respect to the dimensions like satisfaction of the members, mutual trust, role clarity and sense of attachment and conviction.

Input use in production of chilli was much less for the members of FPOs due to adoption of low inputs organic farming practices (Manaswi et al (2019). Despite a lower yield, the members could realize 13.86% higher gross returns primarily attributed to FPOs providing access to technology and markets. The farmers in the study regions were following three marketing channels for disposal of their produce. The channel that involved FPOs with member farmers on the one end and consumers on the other is found to have the highest marketing efficiency in organic chilli. Several researchers have identified constraints for FPOs. Important constraints are- Capital requirement (Kumar et al 2023; Gorai et al 2022); marketing (Mahapatra 2023, Gorai 2022, Kumar 2023). Lack of effective communication between office-bearers and farmers; mobilizing farmer for membership; delayed payment compared to local traders; lack of knowledge about latest farming technologies were also found to be hindering the growth of FPOs

How effective are the FFPOs?

For measurement of effectiveness of FPOs in freshwater aquaculture,

Mukherjee (2017) scale of effectiveness index has been used after suitable modifications. There are 7 components to measure the effectiveness viz., a) Functioning efficiency b) Increase in income c) Increase in farmers share on consumers' rupee d) Inclusiveness e) Sustainability of Farmers Producer Company f) Level of satisfaction about the performance of FPC and g) Empowerment. Data was collected from four FFPOs located in Kendrapara, Puri, Cuttack and Dhenkanal district of Odisha.

Table No.-03 Comparative effectiveness of four FFPOs in Odisha

Effectiveness indicators	K	P	C	D
Functioning efficiency	0.032	0.029	0.028	0.030
Increase in income	0.014	0.012	0.010	0.012
Increase in farmers share on consumers' rupee	0.011	0.011	0.012	0.012
Inclusiveness	0.070	0.070	0.064	0.071
Sustainability of Farmers Producer Company	0.160	0.130	0.128	0.132
Level of satisfaction about the performance of FPC	0.111	0.110	0.105	0.107
Empowerment	0.175	0.162	0.156	0.173
Effectiveness index	0.573	0.524	0.503	0.537

* K denotes Maa Kharakhai Farmer Producer Company, Kendrapara ; * P denotes Baba Alarnath Farmer Producer Company, Puri ; * C denotes Laxmi Narayan Agro Producer Company, Cuttack ; * D denotes Mahima Alekh Farmer Producer Company, Dhenkanal

Case study

1. Bhavi Aqua and Fish Farmer Producer Company (BAFFPC)

Mr G. Bhupesh Reddy is a Managing Director of Bhavi Aqua and Fish Farmer Producer Company (BAFFPC) situated in Nidimusali village of Nellore district, Andhra Pradesh, having 989 members engaged in the marketing of fish and prawns which was found to boost fisher folk's income and to mainly address the problem of getting a better price for their catch. To solve this problem, they started aggregating fish collected from all the farmers and selling them in bulk quantity to export companies, to get better margins for their produce. They sell their produce in Nellore city market and market outlets at Kavali, Kovuru, and Guduru. This technique helped them to overcome their immediate financial needs, before harvesting the whole crop. NABARD initially supported Bhavi Aqua with ₹4.42 lakhs. Later, ₹8.66 lakhs were given to them for business development and ₹5.16 lakhs to set up a small shop offering one-stop solution to farmers. Small Farmers Agribusiness Consortium (SFAC) gave financial aid of ₹8.07 lakhs for the BAFFPC's operation. To help the Joint Liability Groups, a loan of ₹40 lakhs was provided by Andhra Pragathi Grameena Bank (APGB). With the subsidy of ₹80 lakhs provided by the Department of Fisheries, Andhra Pradesh, BAFFPC distributed 500 aerators to its members. This new technology is being introduced to properly manage inland rearing and give better access to fish for oxygen. The FFPO prepared an action plan for their business activities subsequently, resulting in an increase in sales from ₹1.35 lakhs (2017-18) to ₹51.70 lakhs (2019-20) and 60% of turnover was from the sale of fish. Recently, they started branding their products under the brand name "Gunapatis" and trying to connect the farmers directly with the consumers. This move is also aimed at empowering farmers with digital marketing. To get better prices, BAFFPC is carrying out value addition activities like making fish pickles, fish chutneys, and fish manures as a by-product of fish waste. They offered capacity-building programs for their members by organizing 20 awareness programs, 5 Training of Trainers (ToTs), exposure visits, and a conclave at the World Brackishwater Aquaculture Conference. This helped them learn about scientific management of fish cultivation, and fish health management which increased their productivity. Regular convergence meetings with farmers, feed mills, and hatcheries are facilitated for easy availability of seed and feed. They are promoting awareness among farmers not to use antibiotics.

Source: Author's own survey

It is evident from the table no 03 above that Maa Kharakhai (57.3%) is the most efficient among the four FPOs studied. In terms of level of empowerment, level of satisfaction of members and increase in income, the score of Maa Kharakhai has left behind the other 3 FPOs. This is probably because of a sound business plan and collective marketing initiative of the FPO. Mahima Alekh FPO scored the highest among all in terms of inclusiveness. Enrolment of women members including women representatives in board of directors is high in this FPO. Baba Alarnath FPO (52.4%) and Laxmi Narayan FPO (50.3%) are yet to develop a robust plan for aggregation and marketing. FPOs will be able to draw more members to its fold and would retain their interest if it contributes to increase in producer's share in consumer rupee. This may happen through a right mix of business round the year and federating FPOs at the district level. The results are in line with the result of Mukherjee et al (2019) that the overall effectiveness score of the Madhya Pradesh Women Poultry Producer Company Pvt Limited (MPWPCL) was found 71.88 out of 100 indicates highly effective based on the index parameters.

FFPOs offer significant potential for increasing productivity in fish farming, several challenges need to be addressed. These include - Limited awareness and understanding of FFPOs among fish farmers; Insufficient financial and technical resources to establish and sustain FFPOs; Capacity gaps in governance, management, and leadership skills within FFPOs; Lack of supportive policies, regulations, and institutional frameworks for FFPOs. To overcome these challenges, it is essential to prioritize capacity building initiatives, provide technical and financial support to FFPOs, and foster an enabling environment through favourable policies and regulations. Collaboration among government agencies, research institutions, development organizations, and the private sector is crucial to ensure the long term success and sustainability of FFPOs.

Conclusion

The future of FFPOs looks promising, as the demand for fish and seafood products is expected to increase in the coming years. FFPOs have the potential to play a crucial role in meeting this growing demand, while also improving the socio-economic conditions of small-scale fish farmers. However, there are several challenges that need to be addressed, such as access to finance, technical expertise, and marketing channels. FFPOs are emerging as a popular model for promoting sustainable fish farming practices and improving the socio-economic conditions of small-scale fish farmers. They provide a platform for accessing technical, financial, and marketing support, and promote the adoption of eco-friendly farming practices.

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Potential Application of Biosensors in Fish Health Management

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The lucrative industry of aquaculture has been facing severe setbacks from diseases caused by infectious microbial pathogens. It is difficult to tackle this problem when compared to terrestrial animals and birds, because fishes remain underwater and the symptoms are difficult to judge most of the times. The current demand is thus for rapid diagnosis which can be done on-the-spot. Till date majority of the rapid diagnosis in fisheries is based on antibody-based assays which have several drawbacks. On the contrary advanced biosensos have been gaining popularity in human and animal sciences. These should be adopted for fisheries as well for better diagnosis. This article discusses the current available sensors and some advanced biosensors which can be used in fisheries.

Introduction

The ongoing expansion of aquaculture has been influenced by the rising need for protein-rich food. Aquaculture, as well as capture fisheries, have become more intense as a result of this demand. The world fish production in 2020 was estimated to be 178 million tonnes, to which aquaculture contributed 87.5 million tonnes and capture fisheries contributed 90.3 million tonnes. However, recent reports have shown that the capture fisheries have stagnated for the past few years. As a result, aquaculture can only continue to expand and become more sophisticated. The intensification has disturbed the equilibrium between the host, pathogen, and environment, which has also brought up several issues related to diminished water quality. The main setback in recent times in terms of death and growth retardation is the occurrence of sickness. Since fish are aquatic animals, it can be challenging to predict any symptoms or signs outside the water. Aquaculture has been transitioning from semi-intensive to intensive culture over time, necessitating better management techniques and quick identification of water parameters and diseases. However, due to the overlap in the signs and symptoms of fish diseases, it is imperative

to identify the causal agent using molecular and serological methods, the majority of which cannot be carried out on the spot and call for sophisticated equipment and qualified personnel. This has compelled the scientific community to develop point-of-care (POC) tools that can produce results right there in the field. In this area, biosensors can be extremely important for precise, effective, and rapid disease diagnosis. Biosensors are sensing systems or devices that can measure biological and chemical interactions to produce an output signal proportionate to the analyte concentration. Sensors are being created to replace conventional testing methods that demand specialized expertise, expensive equipment, scientific experts, and a lot of time and money. Additionally, the majority of testing methods frequently fail to yield results on-site. Sensors can therefore handle multiple problems at once.

What are biosensors?

Biosensors are sensing systems/ devices that can measure biological and chemical reactions, generating output signals proportional to the analyte concentration. Sensors are developed to substitute the traditional testing procedures, which require scientific personnel, specified knowledge, and costly equipment, thus representing significant cost and time. Moreover, most of the testing procedures often fail to produce results on-site. Therefore sensors can address several issues in one go.

A Biosensor primarily consists of a bioreceptor, a transducer, and a processing unit; a quantifiable signal gets generated upon the interaction of the target analyte with the bioreceptor. The common types of bioreceptor interactions involving: antibodies/antigens, enzymes/ligands, nucleic acids/DNA, cellular structures/ cells, or biomimetic materials can be used to classify biosensors.

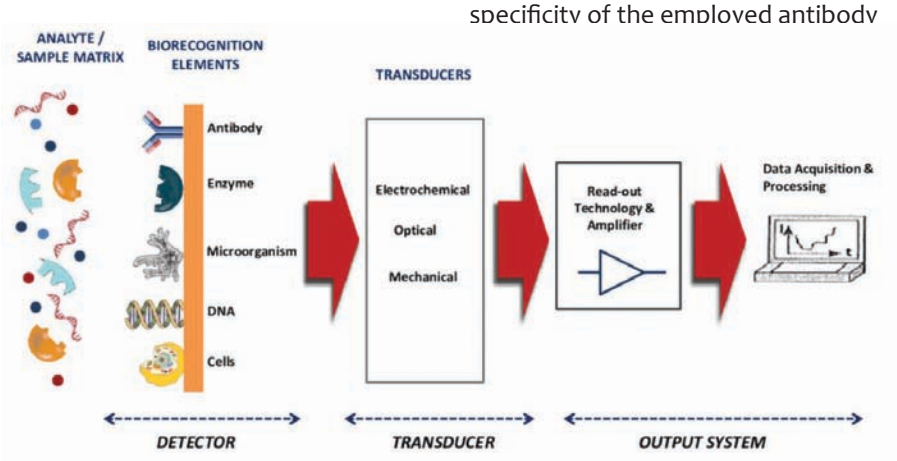

Fig. 1 Schematic representation of the working principle of a biosensor

Current status

The antigen-antibody reaction is the primary basis for the majority of the biosensors that are now in use. The scenario is identical in fisheries and aquaculture. However, a number of other varieties are being created that are even more sensitive and specific for diagnosing human diseases. Similar research and development in aquaculture is rare since the development process is more complicated. Some of the commonly used assays have been discussed.

1. Immunoassay: Enzyme-linked immunosorbent assays (ELISA)

In an ELISA test, an unknown bacterial antigen is identified by binding to a recognised antibody that has been joined to an enzyme. A noticeable colour change will result from a successful binding. The specificity of the employed antibody is a significant factor that influences ELISA. The antibody being used could impact the reaction process, resulting in low specificity and sensitivity and leading to false-positive results. ELISA is frequently used in conjunction with other detection methods to prevent this.

ELISA commercial kits are available for almost all the major fish and shellfish diseases, such as EHNV, IHNV, WSSV, TSV, *Aeromonas hydrophila* etc.

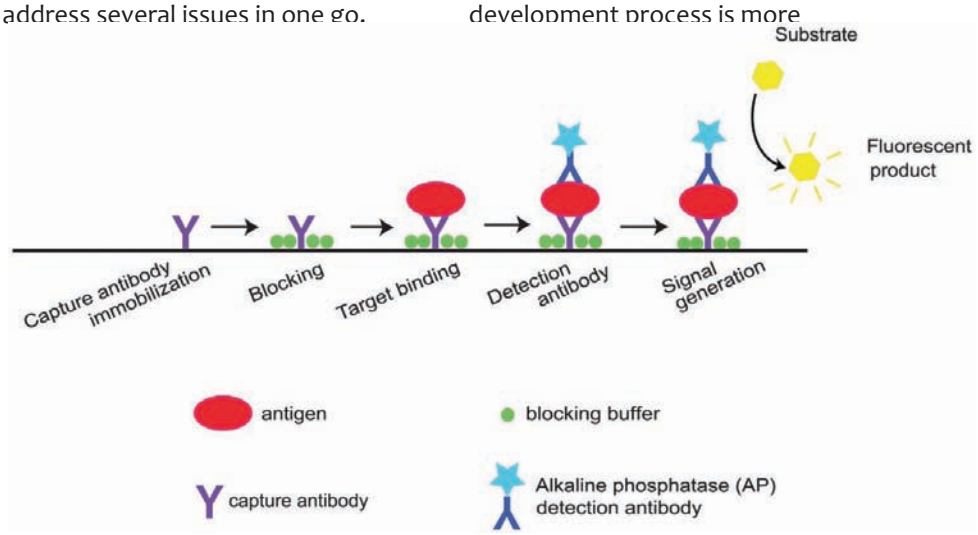

Fig. 2 Sandwich-ELISA technique used for detection of any analyte, most commonly any protein present in the pathogen.

Lateral Flow ImmunoAssay

This is one of the most important techniques which we have seen being frequently used in pregnancy test kits. This method is based on the biochemical interaction of probe DNA and targets DNA hybridization or antigen-antibody interaction. The four components of a lateral flow assay (LFA) are the sample pad, conjugate pad, reaction membrane, test line, and control line for target antigen-antibody interaction, and absorbent pad, which collects waste.

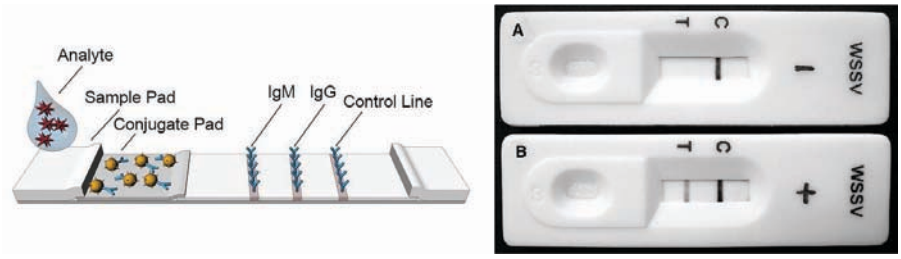

Fig. 3 Working principle of LFIA, Negative(A) and positive(B) results in WSSV LFIA test.

The sample pad is the area on which the sample is dropped. To increase the sensitivity of LFAs, gold nanoparticles, coloured latex beads, carbon nanoparticles, quantum dots, and enzymes are utilised as labels. These lateral flow-based immunoassays and several modified ones are developed against WSSV, EUS, EHP, NNV, etc.

Antibody-based electrochemical chemiresistive methods:

In an electrochemical cell with at least two electrodes—the working electrode and the reference electrode—an electrochemical measurement is carried out. The working electrode, which can be made of a number of materials including as platinum, gold, silver, glassy carbon, nickel and palladium, is where the redox of the analyte occurs. The reference electrode commonly consists of saturated calomel (SCE) or silver/silver chloride (Ag/AgC1) and its potential is known and constant. A third auxiliary electrode is frequently utilised in amperometric detection. To carry current flow away from the reference electrode, the auxiliary electrode (counter electrode) is used. Specific antibodies are immobilized on the surface of the electrodes and when the target analyte bonds with it, it forms a sizeable antibody-antigen complex. This complex then hinders the current flow, and the change is measured, which is directly proportional to the amount of antigen present.

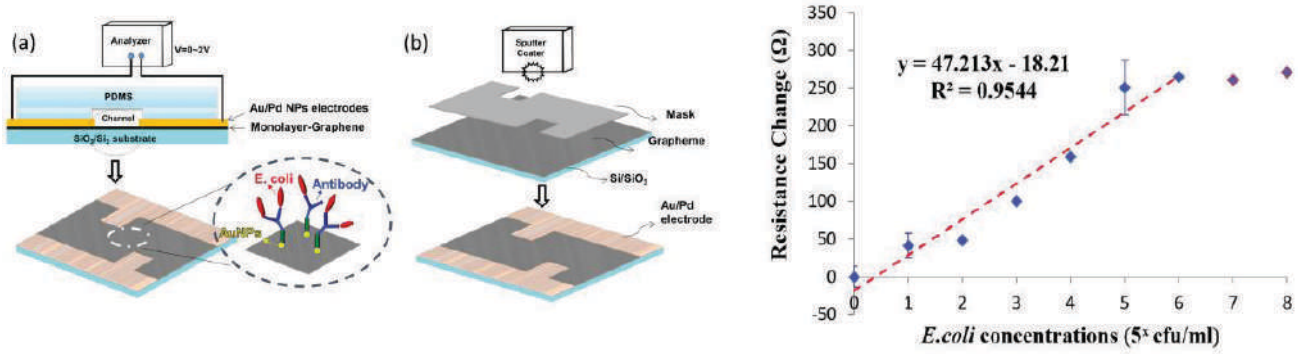

Fig. 4 Schematic representation of antibody-based chemi-resistive biosensor development (Left). Graph showing the increase in electrical resistance with an increase in bacterial quantity (Right)

2. Nucleic-acid-based assays: Gold-Nanoparticle based apta-sensors:

The use of biological systems (such as rabbit, horse, etc.), batch-to-batch variability, and low-temperature storage are some drawbacks of antibody-based detection systems. The latest generation of quick diagnostics has been concentrating on aptamer-based sensors to get around this. Single-stranded oligonucleotides called aptamers are highly selective for the target analyte. These aptamer sequences can be obtained through a procedure called SELEX (Systemic evolution of ligands by exponential enrichment). These aptamers can be utilised to create biosensors for detecting harmful microorganisms that cause illnesses in fish by conjugating them with nanomaterial.

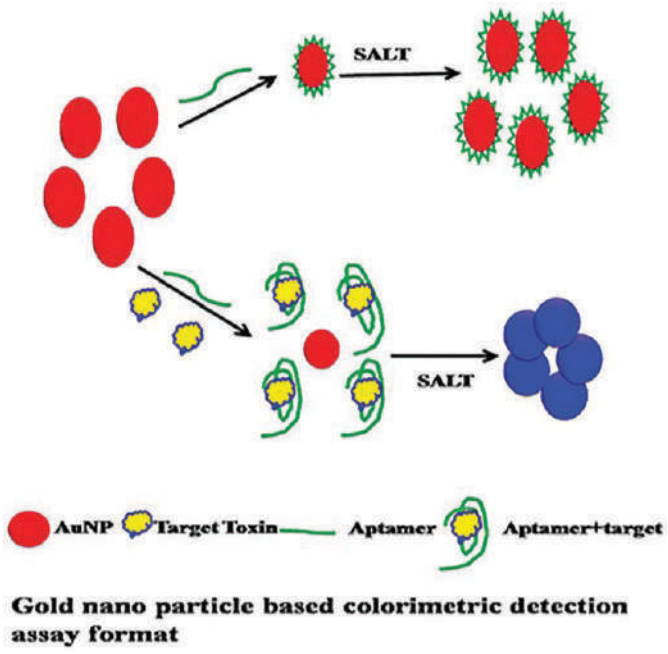

Fig. 5 Working principle of salt-aggregation based Au-NP apta-sensor

The surface activity of Gold Nanoparticles (Au-NP) plays a major role in the development where both their Nanozyme activity and salt-induced aggregation.

Key differences:
Antibodies and aptamers are both used for molecular recognition and binding. Proteins, known as antibodies, are created by the immune system in reaction to external agents like bacteria or viruses. Aptamers are artificial molecules that can be used to attack any target, even harmful or non-immunogenic ones. Aptamers have a smaller size of approximately 3 nanometers, which is in contrast to larger antibodies, measuring 10-15 nanometers. This size advantage enables aptamers to bind to cellular epitopes more densely within living cells. Unlike antibodies, aptamers have the ability to be chosen specifically for non-immunogenic substances such as proteins, peptides, and toxins. Also aptamers have a longer shelf life and are generally more stable than antibodies. Unlike antibodies, aptamers are synthesized via a cheap and simple process, and the time needed to produce aptamers is relatively short.

3. Mass-sensitive biosensors
The mass-sensitive biosensor technique uses an application of an alternating current of a specific frequency to induce piezoelectric effects in order to measure the mass of the adlayer on the sensor surface, even though these sensors are less frequently used than optical and electrochemical biosensors. These mass-sensitive biosensors evaluate variations in frequency caused by the interaction between a biorecognition element and an analyte because any chemical reaction will impact the oscillation frequency.

4. Electrochemical biosensors
Electrochemical biosensors translate the outcomes of the interaction between a biorecognition agent and an analyte into electrical signals that are proportionate to the analyte's concentration. Electrochemical biosensors can be classified as either amperometric, which detects a change in current following the binding of analytes and biorecognition agents. Impedimetric, which measures impedance, or potentiometric, which measures electric potential, depending on the parameter being evaluated.

Conclusion:
To create mitigation strategies and take appropriate action, it is critical in the current environment to obtain immediate, rapid and accurate information about the health status of fish and any pathogen. Because fish disease symptoms overlap and confirmative techniques require expensive equipment and time, prompt diagnosis is essential. While antibody-based sensors are widely used to monitor fish health, more sensitive, specific and robust approaches are now being developed to replace them. Research institutes are developing aptamer-based biosensors for fish ailments and this needs further attention. Utilising biosensors will aid farmers by allowing them to save their fish stock by making quick judgements and saving time and money.

References can be provided on request.

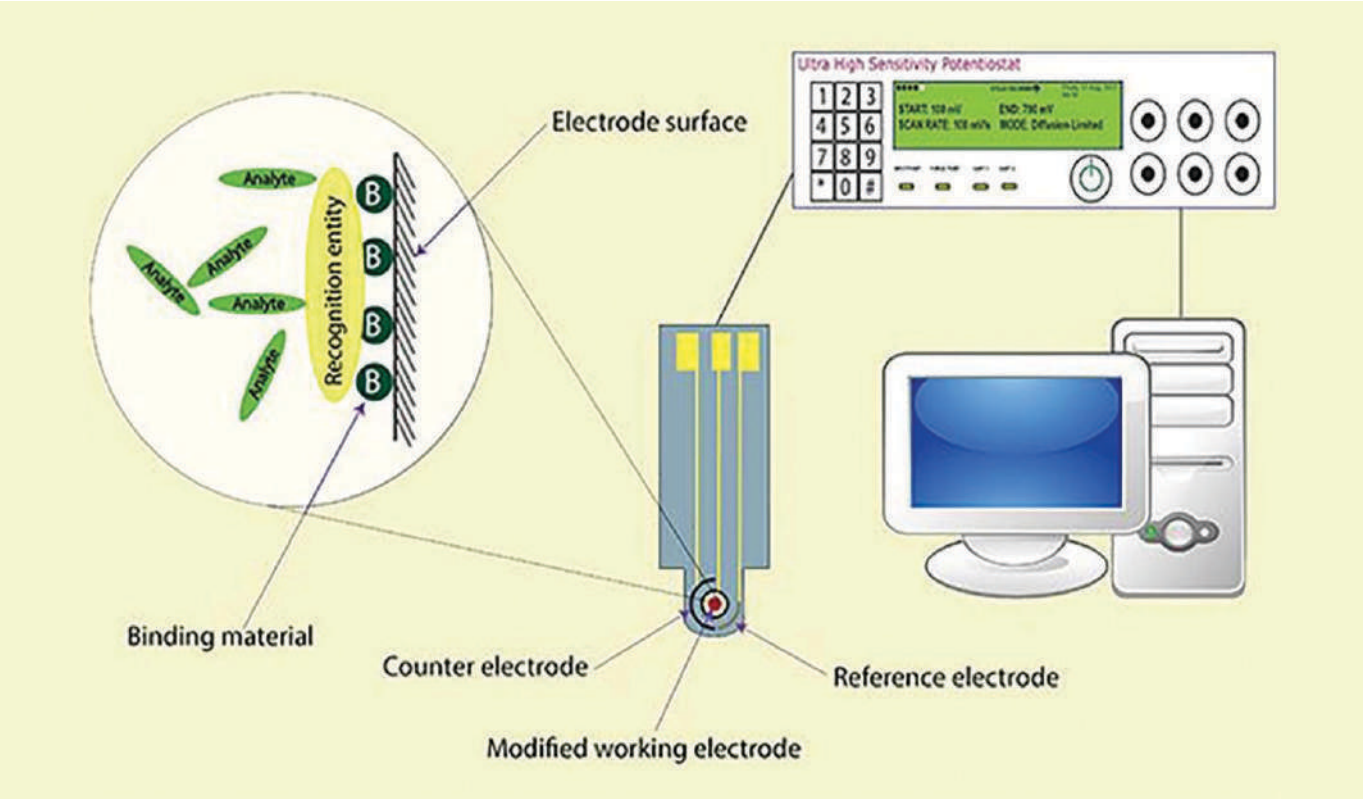

Fig. 6 Representation of Screen Printed Electrode (SPE) based sensor where the working electrode is modified by pre-application of binding material as well as recognition molecule. Electrical parameters are measured both before and after the addition of an analyte which indirectly gives the result.

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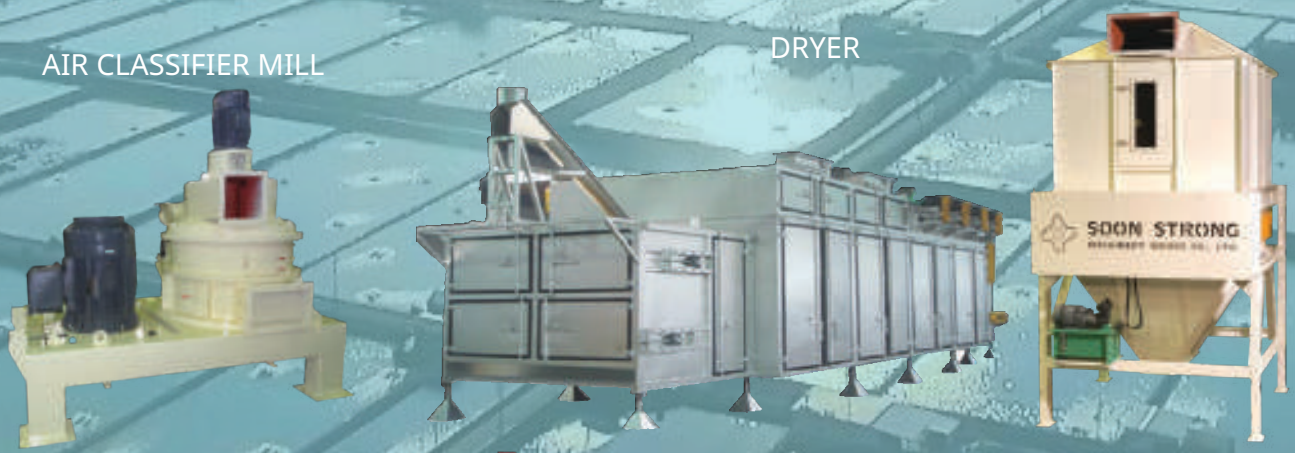

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FUBON
Angel Animal Nutrition

YeaMOS

Natural source of Beta-Glucan & MOS

- Relieve stress such as high density, water quality fluctuation(low oxygen, pH and temperature change) etc.
- Enhance non-specific immunity and reduce mortality.
- Regulate intestinal flora, reduce the risk of pathogens infection.

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