

**Technical Report of
Conference
on
1st Indian Fisheries Outlook 2022**

Base Theme:
Priming Indian Fisheries in Attaining Sustainable Development Goals

**22-24 March 2022
ICAR-CIFRI, Barrackpore**



**Jointly hosted by
Professional Fisheries Graduates Forum
&
ICAR-Central Inland Fisheries Research Institute**

Organizing partners





**Technical Report of
Conference
on
1st Indian Fisheries Outlook 2022
Base Theme:
*Priming Indian Fisheries
in Attaining Sustainable
Development Goals*
held at
ICAR-CIFRI, Barrackpore
during
22-24 March 2022**



Technical Report of Conference on 1st Indian Fisheries Outlook 2022

Base Theme: *Priming Indian Fisheries in Attaining Sustainable Development Goals*

22-24 March 2022, ICAR-CIFRI, Barrackpore

ISSN : 0970_616X

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Citation

B. K. Das et al. 2022, Technical Report of Conference on 1st Indian Fisheries Outlook 2022
Base Theme: *Priming Indian Fisheries in Attaining Sustainable Development Goals*
22-24 March 2022. pp: 54.

Published by

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Technical Report of Conference on 1st Indian Fisheries Outlook 2022

Base Theme:

Priming Indian Fisheries in Attaining Sustainable Development Goals

Background

Fisheries and aquaculture offer ample opportunities to reduce hunger and improve nutrition, alleviate poverty, augment economic growth and ensure better use of natural resources. Aquaculture is the fastest-growing food production sector and has the potential to produce the fish needed to meet the demands of a growing population. The contribution of the Indian fisheries to the global food basket is substantial. India is the 3rd largest fish-producing country and is 2nd largest in aquaculture production. The Blue Revolution in India demonstrated the importance of the Fisheries and Aquaculture sector. The sector is considered as a sunrise sector and is poised to play a major role in the Indian economy in near future. In the recent past, Indian fisheries have witnessed a paradigm shift from marine-dominated fisheries to inland fisheries. However, the sector is facing challenges due to climate change, pollution, water abstraction, loss of biodiversity, overfishing, unmanaged aquaculture expansion, etc. Conservation and sustainable use of these resources is a prime challenge. In this scenario, this seminar will deliberate on the Priming Indian Fisheries in Attaining Sustainable Development Goals.

About the Organizers



Professional Fisheries Graduates Forum (PFGF): Professional Fisheries Graduates Forum (PFGF) was nurtured in 2001, it was registered as a de facto national body of Fisheries graduates (Registration number: 251/2002) in the office of Charity Commissioner, Mumbai under the Society Registration Act on 14th February 2002. The support extended by Dr. S. Ayyappan, the then DDG, ICAR along with wholehearted guidance of eminent scientists like Dr. Panjab Singh, former DG, ICAR, Dr. H. P. C. Shetty, Dr. K. V. Devaraj, Dr. J. V. H. Dixitulu laid a strong foundation for the organization. The forum functions with its headquarters at Central Institute of Fisheries Education, Mumbai-the national fisheries university, and has regional chapters in 12 states across the country.



Inland Fisheries Society of India (IFSI): It is one of the oldest scientific societies in India. The Society promotes fisheries research and development in Asia. It regularly organizes national and international scientific events and has the distinction of uninterrupted publication of Journal of the Inland Fisheries Society of India, a leading journal in the field of fisheries, since 1969.



ICAR-Central Inland Fisheries Research Institute: This is the first Institute in India in the field of inland fisheries research, extension and training, and is celebrating 75 years of dedicated service to the nation. The Institute has an impressive track record of providing research support for the country's inland

fisheries development since its inception in 1947. Technologies developed by the Institute have paved the way for aquaculture development and blue revolution, sustainable production enhancement from reservoirs and wetlands, health management of rivers and associated ecosystems, fisheries resource assessment and database development, human resource development of the country, etc.



All India Agricultural Students Association (AIASA): It is an organization represented by professionals of present-day and ex-students of Agriculture, Fisheries, Veterinary Science, Dairy, Horticulture, Forestry, Home Science, Sericulture, ABM and other allied sectors. AIASA is registered under Societies Registration Act 1860. This Association was formally launched on 10th May 2011 by the then Hon'ble Union Minister of State for Agriculture and Farmer's Welfare. It is established with a mission of strengthening the voice of passionate agro-professionals, veterinarians, at the state, national, and international levels. AIASA-Fisheries Chapter envisages a common platform for Fisheries graduates and Bureaucrats to work together, towards the development of the fisheries sector overall.

Important Sessions in the Conference

Many sessions and programmes were conducted within the two days of the Conference as follows:

1. Inaugural session
2. CIFRI Platinum Jubilee Program
3. Prof. P. C. Thomas lecture series
4. The six theme-wise Oral and Poster Presentations
5. Satellite symposium on “Hilsa Dialogue: A Bay of Bengal (BoB) Perspective”
6. Industry-Institute Interfacia: Policy imperatives, Research Needs and Manpower Requirements of the Aquaculture Sector in India- SHRIMP DIALOGUE
7. Brainstorming Session on Challenges and Opportunities in Processing, Distribution and Consumption of Domestically Marketed Fish
8. Special Session “ICT and Precision farming”
9. IFSI Award presentations
10. Dean's meet : Professional Fisheries Educationd : A way forward
11. PFGF meet and award sessions

Six Conference Themes

Theme 1: Recent advances in Indian aquaculture for attaining SDGs

Theme 2: Fisheries resource management for sustainable fisheries

Theme 3: Biotechnological interventions for improving fisheries production

Theme 4: Health and environment management for sustainable fisheries

Theme 5: Fisheries post-harvest technology and value addition

Theme 6: Fisheries extension, governance, and policies in respect to climate change

Abstract Submission & Registration

Abstracts were received from interested delegates online through the conference email id fisheriesoutlook1@gmail.com. There was overwhelming response for the Conference and more than 430 abstracts were received. The reviewed abstracts were compiled into a Book of Abstract, which was released in the Conference Inaugural ceremony and distributed to all delegates in their registration kit in Pen Drive. For online participants, the Book of Abstract was sent by email.

The Inaugural Ceremony

Indian Fisheries Outlook 2022 Priming Indian Fisheries in Attaining Sustainable Development Goals conference was inaugurated in the forenoon of 22nd March 2022 at ICAR-CIFRI, Barrackpore, Kolkata.

Shri Bankim Chandra Hazra, Honourable Minister of Sundarban Affairs and Development, Government of West Bengal graced as Chief Guest; Swami Suparnanada Maharaj, Honorary Secretary, Ramakrishna Mission Institute of Culture, Kolkata, Dr. Riji John, Vice Chancellor, Kerala University of Fisheries and Ocean Studies (KUFOS) graced as Guest of Honour. The inaugural function was presided over by Dr. J. K. Jena, Deputy Director General (Fishery Science). Dr. B. B. Nayak, General Secretary PFGF, briefed about the conference and its theme. He said that ICAR-CIFRI, Barrackpore, IFSI Barrackpore, and PFGF, Mumbai have come together and organized this important conference which aims to focus on priming Indian fisheries in attaining Sustainable Development Goals.





Dr. B. K. Das, Director, ICAR-CIFRI, Barrackpore and President, PFGF welcomed the dignitaries and highlighted the importance of the theme of the conference. In his address, he briefed about the status of inland fisheries in India. He stressed that this conference will deal with important fisheries and aquaculture related topics and provide an inter-disciplinary forum for interaction among experts, researchers, consultants, students and other stakeholders to exchange ideas, share information, build common platforms, and formulate a consensus on how best fisheries and aquaculture sector help in achieving sustainable development goals.



Dr. J. K. Jena, DDG (Fishery Science) ICAR, New Delhi and Chief Guest in his address emphasized on the importance of fisheries sector in Indian agricultural and rural economy.

He highlighted that for fisheries and aquaculture, SDG goal 2 zero hunger, goal 3 good health & well being, goal 14 life below water, and goal 15 life on land are more relevant. He said that inland fisheries and aquaculture contributes more than 65% to the fisheries basket of India. He said that aquatic ecosystems, their biotic communities and fisheries are stressed due to increasing water maneuvering, pollution, erratic rainfall, global warming, over-exploitation of aquatic resources, and over-fishing. He stressed that, with the target of 22 million tons fish production under Prime Minister Matsya Sampada Yojana, time has come for more investment and bringing more entrepreneurs in this sector. Dr. Riji John, Vice Chancellor, KUFOS and Guest of honour in his address spoke on the importance of fisheries sector in India. He said in 1969, there was only one fishery college in India but now there are thirty colleges. He stressed that fish is now not only recognized as cheap protein but also as healthier food. With development of technologies, the subject fisheries have changed from capture science to production science.



Shri Bankim Chandra Hazra, Honourable Minister of Sundarban affairs, Government of West Bengal in his address as Chief Guest of the inaugural session highlighted the important role played by fisheries sector in the economic development of West Bengal and India. He said that with important themes like Recent advances in Indian aquaculture for attaining SDGs, Fisheries resource management for sustainable fisheries, Biotechnological Interventions for Improving fisheries production, Health and environment management for sustainable fisheries, Fisheries post-harvest technology and value addition, hopefully this conference will discuss and brain storm on prospering sustainable fisheries and aquaculture in India. Swami Suparnanada Maharaj, Honorary Secretary, Ramakrishna Mission Institute of Culture, Kolkata in his address as Guest of Honour hoped that this conference will bring useful guidelines for future.

Prof. P. C. Thomas Lecture Series



On the occasion of inauguration of IFO-2022, a special lecture was arranged as part of Prof. P. C. Thomas Lecture Series in the Conference. Prof. P. C. Thomas Lecture Series was founded by the alumni of College of Fisheries Odisha along with PFGF to pay respect to the excellent teacher, a mentor and the first Director of College of Fisheries, Odisha, whose

students have excelled in various fields of fisheries science. The lecture series is a celebration of the teaching profession in general and a tribute to the octogenarian Professor whose knowledge, dedication, and sincerity to the profession is very rare.

Swami Suparnanada Maharaj, Honorary Secretary, Ramakrishna Mission Institute of Culture, Kolkata delivered 4th P. C. Thomas lecture on Civilization, Culture, Science and Religion. In this lecture he discussed about the various thoughts of civilizations, science and religion. He emphasized that Science and Culture are two shades while Science and Religion are two opposite poles.



Civilization, science and technology hold all together. Culture is growth of mind while Science is to find out nature external. He spoke about various teachings of Swami Vivekanada.

On this occasion, Honourary Fellowship of Inland Fisheries Society of India (IFSI) was awarded to Prof. P. C. Thomas, Ex Director, College of Fisheries, OUAT and Dr. A. Eknath,



Ex Director General, NACA. Five researchers namely Prof. J. Abraham, Dr. P. C. Das, Dr. M. A. Khan and Dr. J. K. Sundaray were awarded IFSI fellow. On this occasion conference souvenir, book of abstracts and several books were released by the dignitaries. More than 500 researchers, academicians, scientists, students, representatives of industries and 100 farmers of West Bengal participated in the conference. Dr. B. K. Behera, Acting HoD and organising secretary of IFO 2022 presented the vote of thanks.





Theme I: Recent advances in Indian Aquaculture for attaining SDGs.

The session was chaired by **Dr. A. E. Eknath** and co-chaired by **Dr. N. P. Sahu** and **Dr. S. K. Swain**. The rapporteurs were Dr. Sona Yengkokpam and Dr. Pranab Das.

Keynote presentation was made by **Dr. K. R. Salin**, Chair, aquaculture program, Asian Institute of Technology (AIT, Thailand) in virtual mode. He highlighted different advanced technologies practiced in Asian countries like nanobubble technology, multi-tier vertical farm, floating farm, IMTA, cluster farming and sea-based coastal farming,

Five eminent personalities gave presentations on diverse fields as lead speakers.

Dr. N. P. Sahu, Joint Director, ICAR-CIFE, Mumbai enlightened on the different advances in fish nutrition and technologies. He emphasized on cheaper protein sources for sustainability in the aquaculture sector.

Dr. M. Kailasam, Principal Scientist, ICAR-CIBA, Chennai gave a brief account of the technologies developed by ICAR-CIBA on brackish water fin fish seed production and farming. Future strategies for its development were also highlighted.

Dr. S. K. Swain, Director, ICAR-CIFA, Bhubaneswar briefed about the freshwater aquaculture technologies for sustaining the aquaculture sector. He also highlighted the PMMSY which is the highest investment by the Govt. of India in fisheries sector. He also discussed CIFA's approach to sustainability through various technologies and 'Matsya Setu' which is a virtual learning app of ICAR-CIFA.

Dr. Imelda Joseph, Principal Scientist, and HoD, ICAR-CMFRI, Kochi discussed, in brief, the mariculture technologies developed by ICAR-CMFRI. She also briefed about the captive breeding and brood stock development of 9 marine finfishes and shellfishes.

Dr. R. K. Saha, Professor and Dean, College of Fisheries, Lembucherra discussed the implementation of national education policy 2022 in fisheries institutes. He also emphasized on entrepreneurship development in the fisheries sector.

In the oral presentations, there were a total of 7 presentations out of which 2 were in online mode and 5 in offline mode.

Dr. Tincy Varghese (AQ-21) presented in online mode on Alanine supplementation in *Penaeus Vennamei*. **Ms. K. Sabnam Siddique** (AQ-62) presented online on dietary Arginine effect in *Channa punctata*.

Dr. S. K. Udgate (AQ-04) presented offline mode on the biofloc aquaculture system. **Dr. Prem Kumar** (AQ-09) presented offline on the use of an osmotic pump for hormone delivery in *Liza parsia*. **Dr. Pronob Das** (AQ-16) presented offline about the cage culture trial in Umiyam Reservoir, Meghalaya.

Dr. A. T. Ramachandra Naik (AQ-27) presented offline on primary productivity in shrimp culture systems in Karnataka. Lastly, **Dr. S. S. Mahanand** (AQ-56) presented offline on biofloc technology as a tool for sustainable aquaculture.

The session was summed up by the chair, **Dr. A. E. Eknath** on the important points discussed. He appreciated the presenters for the wonderful work carried out in the diverse fields of aquaculture. He urged the researchers to translate their findings for the benefit of the farming communities. He appreciated the organizers for the great work done by bringing together the fisheries fraternity on this one platform after the pandemic.





Theme II: Fisheries Resource Management for Sustainable Fisheries

The session started with a keynote presentation (online) by **Dr. C. V. Mohan**, Principal Scientist, World Fish, Malaysia on “Why contribution of inland small-scale fisheries and small indigenous species (SIS) is undervalued and overlooked?”. In his talk, he stressed the hidden harvest of fishes, which is an eye-opener to appreciate the true contribution of inland capture fisheries, aquatic food systems, etc. In this key message, he stressed the small indigenous fishes as a superfood, investing in the analysis of nutrient content, and recognizing the utilization of fish as a superfood for the poor.

Mr. Purushottam Dhiman, Managing Director, Madhya Pradesh Fisheries Federation Cooperative Ltd., Bhopal talked about their cooperative societies during his presentation in offline mode.

As a lead speaker **Dr. B. K. Das**, Director, ICAR-CIFRI, Barrackpore, spoke about “small scale fisheries in achieving SDGs”. He spoke about the contribution of small-scale fisheries and SWOT analysis of inland fisheries. He also spoke about the SSF in floodplain wetlands, reservoirs, and their issues and management strategies. ICAR-CIFRI's effort in addressing SDGs, ranching programme, hilsa fisheries development, e-flows, SSF in canal fisheries, restoration of Chilka fisheries, intervention in oxbow lakes in Bihar, grass carp model for weed choked wetlands, climate change, ornamental fishes, etc. were also been highlighted.

Dr. W. Viswanath, Professor, National Institute of Technology, Manipur talked about “Freshwater fishes of Eastern Himalayan region and their conservation” in online mode as the lead speaker. He said that there are 6 freshwater eco-regions and talked about fish boundaries and drainage systems. A total of 512 fish belonging to 40 families and 128 genera were reported from the northeastern states of India. He elaborated on the conservation status of fishes, and biodiversity crises.

Dr. T. S. Nagesh, Professor, Faculty of Fisheries, WBUAFS talked on “Emerging trends in sustainable fisheries management” in offline mode as a lead speaker. He emphasized on sustainable development, fisheries co-management, and community-based fisheries management. He also stressed the emerging trends in fisheries management like e-DNA, ecolabelling, etc. This was followed by 9 oral presentations (6 offline and 3 online).

Dr. Preetha Panikkar: (FRM-01 offline) presented on the topic “Food web structure and trophic interactions in Stanley reservoir, Tamil Nadu”. She talked about the evaluation of ecological groups (functional groups) in 15 components with 1 non-living and 14 living groups. She also stressed upon the ectotrophic efficiency.

2nd presentation was delivered by **Dr. Dibakar Bhakta**: (FRM-05 offline) on “Population dynamics of flathead grey mullet, *Mugil cephalus* Linnaeus 1758 from Narmada estuary, west coast of India”. The maximum sustainable yield (MSY) of the





species was estimated at 970.218 t in the studied environment. The fishing pressure was found slightly excessive for the current stocks, which should be considered for proper management of the fishery in the Narmada estuary.

3rd oral presentation was delivered by **Dr. Geetanjali Deshmukhe:** (FRM-13 offline) on “Aquatic plant resources- future fisheries resource of Indian coast”. She talked about several ecosystems such as coastal wetlands, coral reefs, mangroves, intertidal/subtidal and seagrass ecosystems and stressed on about 844 marine algal species are recorded from the Indian coast, comprised of 434 red, 194 brown, and 216 green seaweed species. She said that only a few species are being utilized for commercial purposes.

4th presentation was by **Dr. B. K. Bhattacharjya:** (FRM-19 offline) on “Ichthyofaunistic diversity in relation to habitat characteristics in Bor Beel, an unexplored floodplain wetland of Arunachal Pradesh”. He said that a total of 52 fish species belonging to 22 families and 8 orders were recorded from the beel. Order Cypriniformes contributed to the highest number (19 species) followed by Perciformes (12 species), Siluriformes (10 species), and others and the physicochemical parameters assessed in different seasons (monsoon, post-monsoon, and winter) indicated a suitable environment for fisheries.

5th Presentation was by **Dr. Syed Talia Mushtaq:** (FRM-39 online mode) on “Ichthyofaunal biodiversity of a Ramsar site in Kashmir Himalayas -Wular Lake”. She said during her sampling a total of 738 fishes were sampled representing 2 orders, 2 families, 4 subfamilies, and 6 genera. Cyprinidae was observed to be the most dominant family followed by Cobitidae. Her study revealed that there was a drastic decline in the native Schizothorax due to encroachment.

Dr. Dipesh Debnath: (FRM-45 online) presented as 6th presenter on “Prioritization of management options for floodplain wetland fisheries: A case study of two ecologically different beels of Assam”. He talked about the framework developed for qualitative impact assessment of management options on various aspects of wetland fisheries and tested in Dandua beel (closed; 50 ha; 26°14’75” N & 92°21’82” E) and 46- Morakolong beel (seasonally open; 76 ha; 26°14’72” & N 92°19’35” E) of Morigaon district, Assam.

7th speaker was **Dr. Subir Kumar Nag:** (FRM-63 offline). He talked about the “Floodplain wetlands as a carbon sink – an objective assessment of some beels of middle Assam, Northeast India in the context of global warming and climate change”. In his talk, five different wetlands in the middle Assam viz. 47- Morakolong, Jaliguti, Charan, Chatla, and Urmal were assessed for estimating C-capture and its accumulation in soil.

8th presentation was made by **Dr. Sandhya K. M.:** (FRM-67online) on “Causes and mitigation measures for trap loss and ghost fishing: studies from Enayam coast, Tamil Nadu”. She said that the major reasons for trap loss were bad weather conditions (35%), currents or tides (34%), gear damage or corrosion of parts (17%), collision with other shipping vessels (5%), bottom obstruction (5%), and vandalism (4%).

The 9th and final presentation was made by **Dr. Sona Yengkokpam:** (AQ-17 offline) on “ITK-based floating pens for fish culture in wetlands of Manipur: a case study of Takmu pat”. She talked about the floodplain wetlands (pats) in Manipur experiencing an increase in water levels during southwest monsoon (June-September) that reduces thereafter. Such a condition often leads to the submergence of fish pens during the monsoon. To overcome this problem, circular floating pens were designed based on indigenous technical knowledge using floating macrophyte-mass (phumdi) with the active collaboration of the local Meitei fishers' community of Keibul Makha Leikai.



Theme III: Biotechnological Interventions for Improving Fisheries Production

The session with the theme 'Biotechnological Interventions for Improving Fisheries Production' was chaired by **Dr. W. S. Lakra**, Ex-Director and VC CIFE, Mumbai and co-chaired by **Dr. B. P. Mohanty** ADG (IFy) ICAR New Delhi, & **Dr. J. K. Sundaray**, Principal Scientist & Head, ICAR-CIFA, Bhubneshwar. The rapporteurs were **Dr. J. J. Parhi**, Ass. Professor, CAU, Lembuchera and **Dr. Md. Absar Alam**, Scientist, CIFRI, Prayagraj. The chairs were welcomed by **Dr. B. K. Behera**, Principal Scientist, Head, Aquatic Environmental Biotechnology & Nanotechnology (AEBN) Division, ICAR-CIFRI, Barrackpore. In this session a keynotes address, four lead lectures and nine papers were presented in offline and online mode.

The keynote address was given by **Dr. W. S. Lakra** on "Excitement in Fisheries Biotechnology". In his highly informative address, he emphasized that biotechnological tools have the potential to accelerate growth in fisheries that will play a pivotal role in accelerating growth in many frontiers of fisheries sector of the country. He discussed in length about biotechnological intervention in genetic selection of *Labeo rohita*, *Macrobrachium rosenbergii* and *Labeo catla* and suggested the inclusion of more fish species for the aquaculture to be more vibrant and sustainable. He also talked about GMO, biomarker application and nano-techniques to further the pace of growth in aquaculture and conservation of the endemic species in the country.

There were four lead speakers, who enlightened the participants with their lectures. The ADG (Inland Fy), **Dr. B. P. Mohanty** delivered his speech on the topic “Proteomics in Fisheries and Aquaculture’. He discussed in detail about the various promising application of proteomics in fisheries and aquaculture that can help in mitigating the negative impacts of climate change and also help to alleviate the problems of arsenicosis and environmental hazards impacting various ecosystems and aquaculture systems. He also discussed the role of the nutrigenomics and fish nutrition database.

Dr. J. K. Sundaray, Principal Scientist, ICAR-CIFA, Bhubneshwar delivered his speech on the topic “Fish genetics & biotechnology for food and nutritional security”. He briefed about the resources of the fish species that need to be tapped for the genetic improvement which is very imperative for the aquaculture improvement, poverty alleviation and mitigation. He emphasized that the fishes have significantly more nutritional value than other animal sources of protein and opined that India as a country has a much greater scope for higher fish production than its current level of production. He suggested the re-mapping of the aquatic resources and wisely employing proper technological options to overcome constrains of slow growth and outdated farming practices. He stressed that the investment in genetic improvement programmes in the country are not at par with other countries and recommended a larger investment in these areas for attainment of realistic growth and another blue revolution in the country.



The next lead speaker was **Dr. K. S. Sobhana**, Principal Scientist, ICAR-CMFRI, Kochi. She spoke on the topic “Development and application of fish cell lines and stem cell lines in fisheries and aquaculture”. She explained the cell culture, its methods of propagation and authentication of developed cell lines. In her lecture, she covered the various constraints and precautionary measures involved in the development of the cell line culture and also highlighted its importance for the attainment of growth in aquaculture and conservation of the endemic species of the country. She said that the stem cell research in the country is in its nascent stage and suggested that lines for more fish species need to be developed both in marine and fresh water sectors.

The fourth and last lead lecture was delivered by **Dr. P. Swain**, National Fellow, ICAR-CIFA, Bhubneshwar on “Applications of Nanotechnology in aquaculture”. In his highly informative lecture, he discussed about the various applications of nanotechnology imperative for the attainment of food and nutritional security in the country and talked in depth about its usage in water treatment, water quality improvement, removal of contaminants, enhancement of hatching and survival of fry and spawn, feed additives, immune-modulation, colour enhancement of the ornamental fishes. He recommended the thrust areas of research in fisheries nano-technology as nano-nutrients, nano-fertilizers, nano-lime and nano-biosensors, remediations of water quality issues, feed supplement, and pond productivity. A progressive farmer from Andhra Pradesh Mr. Hussain Ali enquired about the ways and means by which he can get access to those nano-technologies for improving his farming practices, and the query led to fruitful discussion on the topic among the experts and delegates.

Nine oral presentations were delivered by delegates from India as well as abroad. **Dr. O. M. Popoola** spoke on “Molecular integrity and anti-oxidants status of Nile tilapia exposed to *Indigofera tinctoria*”. His present findings have established that sub-lethal doses of *Indigofera tinctoria* induced biochemical changes in Nile tilapia. The chairperson **Dr W. S. Lakra** enquired about the application of his study, he replied that his investigation will play an important role in highlighting the damage the dyes are causing to the aquatic life and ecosystems in harnessing for the eminent capital gains in Nigeria and will be helpful to the policy makers in controlling this environmental threat.

Dr. Janmejy Parhi presented on the topic 'Analysing the molecular framework of sperm release in a freshwater teleost *Cyprinus carpio*'. He emphasized that his investigation will be helpful in understanding the reproduction process and will also be useful in identifying constraints in the reproductive process to tap breeding potential of aquaculture species in the country. **Dr. Manorama Patri** talked on the topic titled “*Lactobacillus rhamnosus* GG (LGG) modulates alcohol-induced learning and memory impairment through gut microbiome in adult zebra fish *Danio rerio*”. Her findings showed a very significant impairment of memory and learning in *D. rerio*. The third presentation was on 'Enhancement of major traits in *Colisa lalia* by sesame seeds as dietary compounds’ by **Dr. Sagar C. Mandal**. He explained that at 10% dosage of



sesame seeds, a significant growth and colouration was documented in *C. lalia*. To the query of Chairperson about the availability of sesame seeds for undertaking the improvement of colouration in ornamental fishes at a large scale, he replied that it is available in plenty at reasonable price. **Dr. Kavita Kumari** presented on the topic “Species identity of *Osparius bendelisis* (Hamilton, 1807) from widespread geographical location based on integrated taxonomic approach”. Her finding showed that *O. bendelisis* which is a widely distributed species has got a significant phylogeographic structure. **Dr. B. K. Behera** Principal Scientist, Head, Aquatic Environmental Biotechnology & Nanotechnology (AEBN) Division, ICAR-CIFRI, Barrackpore delivered his speech on the topic entitled “Metagenomics of river sediments for microbial diversity and their putative function”. He explained that he and his team members have documented interesting and significant finding among which a number of them are the first reports. The chairperson asked Dr. B. K. Behera about the abundance of the bacteriophage along the length of the river Ganga, he said that its abundance were higher at places where the pollution load was higher and lower where the pollution load was lower. The last presentation was by **Mr. Koustav Ghosh** on the topic “The biosensor for detecting Endocrine Disrupting Chemicals (EDC) in aquatic ecosystem”. He presented about the work of his team on design of a machine that can predicts the safe/unsafe levels of pesticides in the aquatic waters and food instantly.

At the end of the session, the chairs of the session **Dr. W. S. Lakra, Dr Bimal Mohanty and Dr. J. K. Sundaray** gave their finals remarks. The chairs were profusely thanked by

Dr. B. K. Behera, Principal Scientist, Head, Aquatic Environmental Biotechnology & Nanotechnology (AEBN) Division, ICAR-CIFRI, Barrackpore for their valuable input and for sparing their precious time. **Dr B. K. Behera** honoured **Dr. W. S. Lakra** with a memento as a token love and appreciation.

There was separate sessions for offline poster presentation and online poster presentation. **Dr. A. Panigrahi**, ICAR-CIBA, Chennai and **Dr. K. S. Sobhana**, ICAR-CMFRI, Kochi chaired and evaluated the posters.

Theme IV: Fish Health & Aquatic Environment Management

The technical session on Fish health and aquatic environment management was held at main building auditorium at 3.00 pm 22/03/2022. It was started with a welcome address by **Dr. Preetha Pannikar**. This was followed by presentation of keynote speaker, **Dr. Iddya Karunasagar**, Consultant Nitte university Bangalore (Senior Director, International relations, NITTE). He addressed the issues, and status of aquatic animal health management. The presentation was comparative elaboration of various messages on control and management programme of COVID-19 pandemic, national disease eradication programme (polio and Foot & mouth disease) and how to implement such programme for aquatic animal health management. He also raised concern over the misinterpretation of multi drug resistant microbes and intrinsic resistance and how the gene acquisition corroborates to drug resistance and new disease emergence was also illustrated in his presentation.



1ST INDIAN FISHERIES OUTLOOK 2022
Date : 22-24 March 2022
Fish Health & Aquatic Environment Management
 ICAR- Central Inland Fisheries Research Institute,
 Barrackpore, Kolkata- 700 120

Dr. Iddya Karunasagar **Dr. Riji John**

The programme was followed by a presentation of keynote speaker, **Prof. Dr. Riji John**, Vice-Chancellor, Kerala University of Fisheries and Ocean Studies, who revealed his vast experience on emerging pathogens in India i.e. Koi RNA virus, Rhabdovirus, Cyprinid herpesvirus, TiLV, NNV etc. The gold standard diagnostics i.e. Nanopore sequencing, field PCR, NGS, CRISPR, RNAi were his key point of discussion. He ended his presentation with a brief message on how to manage the fish health with implementation of common BMPs i.e. water quality, zero water exchange, stocking density, proper nutrition and routine health check up and gut microbiome study.

The keynote presentations were followed by invited lectures of **Dr. U. K. Sarkar**, HoD, Reservoir & Wetland Fisheries (RWF) Division, ICAR-CIFRI and **Dr. Akshya Panigrahi**, PS, ICAR-CIBA. The presentation of **Dr. U. K. Sarkar** was on “Research advances in climate change and inland fisheries: Impact, vulnerability and adaptation assessment”. He briefed on topic i.e. climate change and inland fisheries, vulnerability assessment (ecological, species, reproductive, geomorphological and stakeholder) and impact of climate and environmental anomalies on tiny plankton in floodplain wetlands. **Dr. Pranigrahi** gave detailed knowledge on biofloc microbiome management.

A total of 4 delegates participated in oral presentations. The different aspects of fish health were presented like incidence of tilapia lake virus, characterisation of *Klebsiella pneumonia* isolated, water quality parameters and microplastics contamination in freshwater environment. This was followed by offline poster presentation and online poster presentation. **Dr. B. B. Pal**, Microbiology Division, Regional Medical Research Centre (RMRC), Bhubaneswar and **Dr. K. N. Mohanta**, ICAR- CIFA, Bhubaneswar evaluated the posters. A total of 41 participants presented the posters. There were 27 offline and 14 online presenters.

Theme V: Fisheries Post Harvest Technology and Value Addition

Processing and value addition of fishery products are one of the most promising sectors of Indian fisheries. In the technical sessions of theme V: “Fisheries Post Harvest Technology and value addition” detailed discussion was carried out. The session was chaired by **Prof. G. Jayasekaran**, Former Director of Research, TNJFU and Co-Chaired by **Dr. M. Karthikeyan**, Director, MPEDA. The session was conducted on hybrid mode i.e. both online and offline. **Prof. G. Jayasekaran** delivered his keynote address on the topic “Emerging quality management system in seafood”. He emphasized on the importance of fish as a source of nutrients and its health benefits. He stressed upon to maintain the quality standard procedures by following safety protocols and quality certifications. He also stated about food born diseases, fish related hazard-physical, biological and chemical and food safety organizations of world and India-USFDA, FSSAI, EU Guidelines, ISO, PPCA Model. He concluded HACCP is a key instrument and WTO, WHO/FAO, ISO, USFDA, EU, Japan, Codex are the major players in seafood safety.



Besides, two lead lectures were delivered. First lead lecture was delivered by **Dr. M. Karthikeyan**, Director, MPEDA on topic “Present status of seafood exports and future perspectives”. He highlighted the issues and solution in seafood export from India. He emphasized on the resources available such as laboratories, certification of aqua centers in India to improve our trade in export market. **Dr. Leela Edwin**, Director, ICAR-CIFT, Kochi delivered lecture on the topic “CIFT initiatives for Indian fisheries, advances in harvest and Post-harvest management”. She highlighted the technological interventions of ICAR-CIFT for improving life of fisheries stakeholders, fish product formulations and post-harvest utilization. She has stressed upon the value addition of fish and fisheries products and the usability of fish waste to generate income and empower fisheries stakeholders.

Following it, the session progressed with 10 oral presentations. Seven delegates presented their paper offline and three of the delegates presented online. The first presentation was by **Dr. Amjad K. Balange** (PHT-32) on “Application of seaweeds in fish and fishery products”. He delivered details on the design and development of a solar tent dryer for hygienic fish drying. **Dr. Parvathy U.** (PHT-17) presented on “Bioactive and storage properties of astaxanthin-cow milk encapsulate”. She has explained the importance of astaxanthin and its bioactive properties, extraction methodology from shrimp shell waste and astaxanthin fortification in milk products. **Dr. A. Jeyakumari** (PHT-29) presented on “Physicochemical and functional properties of freeze-dried fish protein isolate from selected fishes”. She explained the importance

of fish protein isolates, preparation, functionality, quality analysis and development of protein isolate fortified Pasta.

Dr. Amjad K. Balange (PHT-32) presented on “Application of seaweeds in fish and fishery products”. He shared his experience on application of seaweeds in fish and fishery products and intensification of development of seaweed in last 10 years and their various utilization patterns. **Dr. Bahni Dhar** (PHT-44) presented on the topic “Use of selected bacterial starter cultures for accelerating salt fermentation of pangas”. **Dr. Vijay Kumar Reddy Surasani** (PHT-48) presented on “Utilization of protein isolates and by-products obtained from pangas processing waste by incorporating into fish sausages; effect on quality attributes and acceptability. **Dr. Vikas Kumar** (PHT-50) presented paper on “Ultrasound assisted enzymatic extraction of ACE inhibitory peptides from rohu fish waste. **Dr. Oishi Das** (PHT-58) presented paper on “Biological utilization of shrimp waste”. **Dr. B. B. Nayak** (PHT-59) discussed on the topic “Controlled fish fermentation”. The session was interesting, informative and the participants interacted during the session.

In line with the theme V, separate poster presentations were also organized. The poster presentation includes various topics related to fish processing technologies viz. quality enhancement of the fish products, different drying technologies, nutrient profiling, and value-added products preparation from seaweed, fish products from different food fishes like rohu, tilapia, pangas, amur carp, common carp, shrimp etc, waste utilization, fortification of fish products, fermented products, nutraceutical products from fish byproducts and products etc.

After the discussion the following points came out as recommendations:

1. Promoting consumption of fish through advertisement, value addition, and marketing channels.
2. Seaweed can make an excellent source for food and bioactive substances (bioactive pharmaceuticals and food supplements). The utilization of seaweed should be supported by a culture of useful seaweed to sustain the supply of high-quality raw materials.
3. The fish and shellfish waste have shown as a promising raw material for bioactive substances. Scaled studies and pilot-scale production is the need of the hour.
4. A large proportion of the population consumes dried, cured and fermented fish. These items need more standardization, development of SOPs and production at an industrial scale.

Theme VI: Fisheries Extension, Governance and Policies

1st Indian Fisheries Outlook 2022 was organized at ICAR-CIFRI, Barrackpore during 22-24 March 2022 with the base theme *Priming Indian Fisheries in Attaining Sustainable Development Goals*. Among the technical sessions' Fisheries Extension, Governance and Policies' was the sixth theme and was chaired by **Dr. Dilip Kumar**, Former VC and Director, ICAR-CIFE. The session Co-Chair was **Dr. Gopal Krishna**, Former VC and Director, CIFE, Mumbai. The session was conducted in hybrid mode: both online and offline. **Dr. Dilip Kumar**, Former Director, ICAR-CIFE, Mumbai and Chairman of the session delivered his Keynote address on the topic "Development of fisheries sector for food, nutrition, livelihood and income security". **Dr. Dilip Kumar** in his Keynote address presented the performance of the Indian fisheries sector and mentioned that the overall development objective of Fisheries and Aquaculture is the sustainable use of aquatic resources for economic growth, nutritional security, and improved livelihoods while preserving the health of the ecosystem. He opined that the major two strategies for development of this sector are: fish production by masses and mass production of high-value and quality fish. **Dr. Dilip Kumar** also suggested measures like 1. Efficient and effective extension services 2. Integration of institutions / functional cooperation among various institutions 3. Enabling policies to shift focus from enhancing productivity and productivity to income and well-being.





There were three lead lectures under this session

Special Theme Lecture on PMMSY: “Tools to gear up Second Blue Revolution through sustainable, responsible, inclusive and equitable manner” was delivered by **Dr. Aparna Roy**, Senior Scientist, ICAR-CIFRI. Dr. Roy highlighted the objectives, key reforms and initiatives taken under the PMMSY. **Dr. Nikita Gopal**, Principal Scientist, ICAR-CIFT, Kochi delivered her lead lecture on “Why gender matters in fisheries and aquaculture” on virtual platform. **Dr. Nikita Gopal** in her lecture mentioned that gender should be an integral part of all fisheries research and development activities to generate sufficient data and evidence to empower women at all managerial levels in fisheries and aquaculture that are mostly at disadvantaged positions in the value chains.

Another lead lecture was delivered by **Dr. Shyam S. Salim**, Principal Scientist, ICAR-CMFRI, Kochi on “Probing the Indian marine fisheries sector through a socio-economic lens : reflections and paradigms” on virtual platform. **Dr. U. S. Sethi**, Entrepreneur and former Ph.D. scholar of ICAR-CIFE presented a success story of his own, “From a fisheries graduate to a successful entrepreneur”. It was very motivating and thought provoking also. The success story may inspire the youth and students to take up fisheries as a venture.

After these lead lectures, the session progressed with oral presentations. Around six

delegates presented their paper offline and two of the delegates presented online. The first presentation was by **Dr. D. N. Jha**, I/C RRC Prayagraj, ICAR-CIFRI on “Use of artificial neural network for prediction of riverine fish landing at Prayagraj, India”. The second paper was presented by **Dr. Chayna Jana**, Scientist, ICAR-CIFRI on “Application of stratified multistage sampling methodology for fish catch estimation of small inland open water bodies (< 0.5ha)”. “Delineating impact of climatic variable(s) on commercial fish landings in a Himalayan River through multi-species modelling” was presented **Dr. Anil Kumar Yadav**. **Dr. Malay Naskar**, Principal Scientist, ICAR-CIFRI presented on “A model-based geostatistical framework for mapping of fish species richness in a river network system”. **Dr. Suhas Mahadeo Wasave** presented on “Early impacts of COVID-19 lockdown on the fisheries livelihoods: A case of Maharashtra state of India with special reference to the marine sector for Indian Fisheries Outlook” through online mode. **Dr. Honnananda B. R** also presented his paper through online mode. He presented the “Fish consumption pattern and its association with household characteristics in Kawardha, Kabirdham district of Chattisgarh”. **Dr. Arun Pandit**, I/C Economics and Policy Unit, ICAR-CIFRI presented on “Consumption of fishes among the households of inland capture fishers”. Last presentation of the session was by **Dr. C. Lloyd Crispin**, he presented his paper on “Fisheries and its management in Krishnagiri reservoir”.

In the poster sessions of theme VI, various presentations were made on fish consumption pattern, gender equality, women empowerment, SHG, marketing issues of ornamental and other fish products, fisheries Co-operative societies' governance



and issues, vulnerability assessment of coastal fishers, policy-related issues in protected areas, land use patterns, ecosystem services from various inland water bodies like reservoirs and mangroves, model-based frameworks for fish mapping, fish production, land use pattern, frameworks to check the alien fish introduction, different mobile based application like FFMA and e Matsya.

The sessions were very fruitful and informative and the following points came out as recommendations from this theme

- Fisheries extension services should not only target increases in fish production and productivity; it should integrate efforts directed to increasing fishers' and fish farmers' income and well-being.
- There has to be close-knit collaboration among all the stakeholders in fisheries management encompassing the Government, public and private players through appropriate governance and institutional mechanism.
- Policy support to the small and marginal farmers and its outreach needs to be continuously monitored and examined so the neediest beneficiaries of the society are not excluded in taking advantages of governmental schemes.
- Nutritional security of the fishers' household and also of a larger section of the rural populace should be ensured to harness national gains from increased productivity and well-being of the country's population, especially the youth.
- Gender should be an integral part of all fisheries research and development activities to generate sufficient data and evidence to empower women at all managerial levels in fisheries and aquaculture that are mostly at disadvantaged positions in fisheries value chains.

Satellite symposium on “Hilsa Dialogue: A Bay of Bengal (BoB) Perspective”

ICAR-CIFRI, Barrackpore organized a 'Satellite symposium on Hilsa Dialogue: A Bay of Bengal (BoB) Perspective' as a part of 1st Indian Fisheries outlook 2022 and Azadi ka Amrit Mahtav on 23rd March 2022. The symposium was conceptualized to develop a regional policy and management plan towards Hilsa conservation and propagation through exchange of scientific intellectuals among hilsa experts representing from India, Bangladesh, Myanmar and Norway. **Dr. B. K. Das**, Director, ICAR- CIFRI welcomed all the delegates, experts and scholars and provided opening remarks on the hilsa research activities carried out by the institute since last five years. Dr. Das majorly highlighted the Hilsa improvement programme in the river Ganga taken up by ICAR-CIFRI in association with National Mission for Clean Ganga (NMCG). Dr. Das mentioned that more than 55000 adult hilsa fish have been ranched in the upstream of Farakka Barrage towards restoration of hilsa in upstream of Ganga. In order to understand the



migratory path, more than 2200 adult hilsa have been tagged and released. It was interesting to record that the study observed hilsa could migrate 225km in 5 days. Furthermore, Dr. Das informed that ICAR-CIFRI is working for cyro-preservation of hilsa spermatozoa towards successful breeding programme. Dr. Das suggested that a long term, possibly 10 years programme is required for effective monitoring and bringing out visible impacts.

Prof. Abdul Wahab, Advisor, Worldfish (Bangladesh), presented on the current status of hilsa in Bangladesh and Policy towards conservation in Inland waters. Prof. Wahab, said the current hilsa production in Bangladesh is 690000 metric ton/year. Prof. Wahab highlighted that in Bangladesh the legal mesh size of net for hilsa catch is 6.5 cm and ban period of hilsa is 22 days during October–November in every year and minimum 500 g of hilsa is allowed to catch. Prof. Wahab informed that awareness and hisla action plan have major role in hilsa production in Bangladesh.

Dr. Michael Akester, Country Director (Worldfish), Myanmar highlighted the management policy towards hilsa fishing in Myanmar. Dr. Akester explained that hilsa fishery has two main components a) artisanal and b) industrial. It has been documented that 1.6 million hilsa fishers involved in Myanmar mostly artisanal fisheries. Dr. Akester also highlighted on the hilsa spawning season in Myanmar i.e one main spawning peak in August- September (particularly September), with potential

smaller peaks in January- February and April-May. Dr. Atle Mortensen, KANAKVA, Norway, suggested that picking up useful scientific knowledge of Salmon culture for hilsa aquaculture. Dr. Atle shared the scientific knowledge and experiences on Salmon breeding and captive bloodstock development. Dr. Atle emphasized on land based salmon farming and successful selective breeding programme. Dr. Atle said that the larval stages of hilsa is much similar to the Cod larvae, hence training and capacity building on the larval feed and development is important towards hilsa aquaculture. Dr. P. Krishnan, Director Bay of Bengal Project, India, briefed the role Bay of Bengal Project in hilsa fishery management. Dr. Krishnan focused on the global hilsa production scenario and research activities needed at a regional approach as these countries share a common water of Bay of Bengal. Furthermore, Dr. Krishnan suggested for conservation and management of hilsa fishery in the BoB as a single stock.

Dr. B. P. Mohanty, Assistant Director General (Fishery Science), ICAR, New Delhi, India, addressed that the nutrient contents of Hilsa possess not only rich in oil and PUFAs, but also rich in protein, fat soluble vitamins A, D, E K and macro and microelements. Dr. Mohanty expressed that many aspects of the biology of hilsa are still not understood and becomes bottleneck in its domestication and large-scale farming like salmon.

Dr. Md. Jalilur Rahman, Scientist (Ecofish II) Worldfish, Bangladesh, highlighted the importance of policy and successful implementation of brood hilsa ban period i.e 22 days every year to improve the spawning success in Bangladesh. Dr. Rahman expressed that average spawning success of hilsa were 48%, 56% and 33% in 2017, 2018 and 2019 respectively in Padma and Meghna rivers. Dr. Rahman showed that an annual incremental growth of the production increased from 5% to 9.2 % per annum due to the increased spawning success and Jatka conservation in Bangladesh.

Prof. Ashim Kumar Nath, Professor of Zoology, Sidho Kanho University, said major reasons for declining of hilsa production in Hooghly estuaries. Prof. Nath suggested for a complete ban on illegal jatka fishing, fishing ban period enforcement, and declaration of hilsa sanctuary could be possible ways towards hilsa conservation for Indian rivers. Dr. Arnab Biswas, MD, Director, Alo Eye Hospital, Kolkata, presented the social, cultural and mythological linkage with Hilsa. A total of seven e-posters were selected for the presentation. These posters were majorly covered on hilsa transportation, stock characterization, migration physiology, hilsa aquaculture and socio-economic on hilsa fisheries.

Dr. K. K. Vass, former Director of ICAR-CIFRI, and chairman of the symposium brought out important suggestive measures and recommendations from all the presentations and highlighted the importance of the symposium. Dr. Vass urged that regional approach could be the fundamental for the icebreaking in the hilsa fisheries conservation and propagation in the Ganga-Brahmaputra-Meghna (GBM) basin.

The major recommendations were

- 1) Regional approach on Hilsa fisheries management through BOBP programme considering the state fisheries departments and central fisheries research institutions in a holistic approach
- 2) Regional research activities on the hilsa stock characterization, hilsa migration and artificial propagation should be initiated
- 3) For increasing hilsa fisheries in the Indian rivers proper investigation must be carried out and role of fish passes installed across the major rivers should brought to the public domain
- 4) Strict adherence of law and order towards fishing ban period as indicated in the Bangladesh should be followed. Dr. Vass proposed for developing conservational hilsa aquaculture in India.

Dr. R. K.Manna, Pr. Scientist proposed the vote of thanks. More than 70 delegates including experts, scholars and students participated in symposium. The programme was coordinated by **Dr. A. K. Sahoo** and **Dr. D. K. Meena**.



Industry-Institute Interfacia : Policy imperatives, Research Needs and Manpower Requirements of the Aquaculture Sector in India

SHRIMP DIALOGUE

Expert Speakers	Mode
Dr. Victor Suresh , Technical Director, Growel Feeds & President, Society of Aquaculture Professionals Topic: <i>Research needs and manpower requirements of the aquaculture sector</i>	Offline
Mr. Ravi Kumar Yellanki , Managing Director, Vaisakhi Bio-Marine Pvt. Ltd. & Vaisakhi Bio-Resources Pvt. Ltd. Topic: <i>Sustainable development of the shrimp farming sector in India</i>	Offline
Mr. Shrinibas Mohanty , General Manager, Avanti Feeds Ltd & Dr. Patchala Srinivas , Senior Technical Manager Avanti Feeds Ltd Topic: <i>Challenges in extension service in aquaculture with special reference to shrimp farming</i>	Offline
Mr. S. Chandrasekar , United States Soy Export Council Topic: <i>Escalating cost of raw material and management of aqua feed cost</i>	Offline
Dr. Manoj Sharma , Managing Director, Mayank Aqua Farms Topic: <i>Reducing risk in shrimp farming using multi stagerearing technology</i>	Online
Dr. N. K. Barik , Senior Scientist, ICAR-CIFA, Bhubaneswar Topic: <i>ICAR technologies for industries & farmers – ICAR-CIFA</i>	Offline
Mr. Ganesh Chandra , Scientist (SS), ICAR-CIFRI, Bhubaneswar Topic: <i>ICAR technologies for industries & farmers – ICAR-CIFRI</i>	Offline



RECOMMENDATIONS FROM THE SOCIETY OF AQUACULTURE PROFESSIONALS REPRESENTING SHRIMP AQUACULTURE AT THE INDIAN FISHERIES OUTLOOK 2022, MARCH 22-24, 2022

Farmed shrimp production has been expanding in India ever since the introduction of *Litopenaeus vannamei* and has propelled the country into the league of the top three suppliers of frozen shrimp to the world. However, the competitive position of shrimp produced in India is declining due to a lack of powerful global branding and the rise of competitiveness by Ecuador which can offer its shrimp at lower prices than India. Year-round occurrence of bacterial and viral diseases also impact shrimp farming efficiency. If allowed to go unchecked, farmer incomes and the profitability of every company in the value chain (hatcheries, feed and other input manufacturers, and processors and exporters) would be significantly affected. To stem this gradual decline of the shrimp farming sector, the Society of Aquaculture Professionals advocated the following:

TO THE INDUSTRY

1. Forge alliances to develop and market a positive narrative about the shrimp from India. Seek all opportunities to ensure best quality of shrimp exported and proactively exceed consumers' expectations.
2. Staggered production and plan crop holidays to control disease outbreaks and get the best market prices.
3. Orient products to the domestic market, especially taking advantage of the rise in retail e-trade of seafood and other animal proteins.
4. Critically review the use of nurseries as tools to manage risk of diseases, reduce crop cycles and lower cost of production and promote the right practices for nursery management.
5. Always operate within the carrying capacity of the production systems and water supplies. Lower stocking densities if necessary to increase production sustainability and profitability.
6. Form collaborative alliances within the sector that would improve industry scale and efficiency. For instance, there is a need for Breeding companies and Feed companies to form alliances to develop feeds that are appropriate for the breeds that are commercially available.

TO THE GOVERNMENT

1. Improve marketability of shrimp from India. Support efforts by farmers and other players in the sector for certification by international agencies. Intensively promote every effort to improve the quality and sustainability of shrimp produced in India.
2. Increase competitiveness through improved productivity and efficiency by specifically addressing continued challenges due to diseases. Repeated

requests to the government to roll out a shrimp-specific surveillance program may be considered.

3. Critically review and revise policies on imported ingredients for use in shrimp feeds. Hikes in the import tariff of fishmeal and other marine proteins may be revised to conserve our domestic sources of forage fish as well as to help the industry to meet certification requirements that call for the use of only certified sources of fishmeal in shrimp feeds. Imports of soybean meal should be liberalized and tariffs lowered to produce feed at an affordable price for the farmers.
4. Ensure that regulations enforced on the sector are effective and practical to implement.
5. Create an independent board for domestic marketing of shrimp.
6. Facilitate cost-effective and meaningful insurance schemes to reduce the risks in shrimp farming.
7. The state of Andhra Pradesh, despite being the topmost producer of both shrimp and fish in India, is not home to any of the major aquaculture research organizations or major educational institutions in aquaculture. Remedy this situation.
8. Provide additional quarantine facilities for imported broodstock including one dedicated to *Penaeus monodon* and one to stocks imported from regions that have significant shrimp production, which have higher risk of introduction of pathogens.
9. Facilitate local breeding programs for *L. vannamei* and *Penaeus monodon* by providing appropriate policy guidelines and designating an isolated region like the Andaman islands where the projects could be located.

TO THE INSTITUTIONS OF RESEARCH

1. Prioritize work in shrimp health. Causative factors for many disease related problems in practical shrimp culture remain a mystery while well-established pathogens like the White Spot Syndrome Virus continue to affect the sector.
2. Work on improving the knowledge of feed ingredients used in or have potential for use in shrimp feeds. Using classical feeding trials combined with genomics approaches, the impact of ingredients on shrimp growth and health needs to be understood better.
3. Improve understanding of nutrient requirements, feed intake and utilization by shrimp in pond systems.
4. Come up with methods to scientifically evaluate shrimp farm management practices and provide practical advice to the farmers on the practices that should be followed for a successful crop.
5. Develop extension methods that can reach farmers most effectively and reach out to the sector with proven methods.

TO THE INSTITUTIONS OF HIGHER EDUCATION

1. Develop infrastructure for high impact teaching and training in the institutions.
2. Review and revise curriculum to meet the needs of the aquaculture sector. If necessary, offer undergraduate degree programs in aquaculture. Also, offer diploma and certificate programs to produce skilled technicians and workers.
3. Work with the private sector to develop internship and training programs for students who pursue their educational programs in aquaculture.
4. Encourage students to become a part of organizations like the Society of Aquaculture professionals that offer mentorship opportunities and access to a number of other resources.

Brainstorming Session on Challenges and Opportunities in Processing, Distribution and Consumption of Domestically Marketed Fish

A brain-storming session was held on Challenges and Opportunities in Processing, Distribution and Consumption of Domestically Marketed Fish as a part of the 1st Indian Fisheries Outlook 2022: Priming Indian Fisheries in Attaining Sustainable Development Goals at ICAR-CIFRI, Barrackpore. The session was chaired by **Dr. I. Karunasagar**, FAO Senior Fisheries Officer and **Dr. B. B. Nayak**, Principal Scientist and Head, Division of Fisheries Resources, Harvest and Post-Harvest, ICAR-CIFE, Mumbai. India's domestic fish marketing sector is larger than its export counterpart. In



view of this, deliberations were held by experts from different institutes and organizations of the country.

Dr. B. B. Nayak, Principal Scientist and Head, Division of Fisheries Resources, Harvest and Post-Harvest, ICAR – CIFE, Mumbai stressed on the fact that it is necessary to bring about a change in the present status of domestic fish marketing in the country. Therefore, the major issues should be identified in this regard and then the solutions should be placed according to region-specific requirements in the country. These would have to be achieved within the next two years. It has to be assessed how safe fish are produced from inland aquaculture systems for the consumers. Requirement of consumers, traders and retailers should be analyzed. To ensure safe and quality supply of fish to the domestic market, health hazards have to be kept in check as an integral part of domestic fish marketing.

Dr. L. N. Murthy, Senior Executive Officer, National Fisheries Development Board (NFDB) expressed the aims of NFDB in strengthening the fisheries sector of the country. He said that NFDB is also looking forward to increase the per capita consumption of fish in the country because of the health benefits. He narrated the benefits of Farmer Producer Organization (FPO) formation, and urged fish farmers to organize themselves in FPOs for harnessing the benefits of corporate way of functioning by FPOs. The benefits and facilities available through schemes such as Fisheries Infrastructure Development Fund (FIDF) and PMMSY were explained. He also asked the farmers to take advantage of the subsidies offered by NFDB schemes. According to him, vertical expansion of fish markets along with value addition kiosks is also a lucrative option for modernization of fish markets. In the near future, cluster-based aquaculture will be promoted by NFDB. Star hotel concepts need to be promoted in fish marketing. Fish waste utilization also needs to be taken care.

Dr. R. K. Majumdar, Professor and Head, Dept. of Fish Processing Technology and Engineering, College of Fisheries, Lembuchhera, Central Agricultural University, Tripura expressed that there should be enhanced focus on strengthening the marketing of smoked and fermented fish products in the north-eastern region of India. Fresh fish and ethnic fish products have the highest demand in the North-Eastern Region.

Dr. G. Jeyasekaran, Former Director of Research, Fisheries College and Research Institute, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Nagapattinam, remarked that there should be survey-based reassessment in fish markets to improve the facilities in fish landing centres in terms of handling, infrastructure development and supply chain management. Fish landed should be immediately kept in thermocol boxes and not on floor and sand. Ice plants should be installed on-board on all fishing crafts.



Dr. R. Jeya Shakila, Professor and Head, Department of Fish Quality Assurance and Management, Fisheries College and Research Institute, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Tuticorin, mentioned that quality assessment should be based on major target species in inland fish marketing. AMR studies have to be conducted on fish produced through biofloc system such as GIFT Tilapia. It was found that tilapia produced through biofloc has distinct quality issues and odour which is sometimes not at par with that produced through other systems which renders biofloc produced fish unacceptable by consumers.

The Secretary of Fisheries of the Madhya Pradesh Fisheries Federation remarked that there has to be more value addition in post-harvest management of inland fish. This is particularly relevant for fish produced by fish farmers and that harvested by inland fishers from reservoirs and wetlands in central India where domestic fish marketing is an important issue.

Dr. Armaan U. Muzaddadi, Principal Scientist, Fish Processing Technology, ICAR – Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab outlined that marketing interventions need to be undertaken in all three major forms in which domestic marketing channel operates, which are live fish, fish in frozen and iced condition and processed fish and fish products. In the transportation of live fish, mortality is a prime issue. In this case, research leading to advancement of transportation system for live fish is an important requirement. He mentioned that

post-harvest and marketing intervention in inland fish marketing in the country has been addressed for the first time in ICAR – CIFRI at this Session.

Mr. Sheikh Ali Hussain, fish farmer from Andhra Pradesh said that they face problems in inter-state marketing.

Dr. I. Karunasagar, FAO Senior Fisheries Officer, said that fish feed information should be available to farmers. This is because feed quality is reflected in flesh quality. There should be adequate data about quality changes and impact assessment of new and emerging technologies such as bio-floc need to be carried out.

Dr. Vikas Kumar, Scientist, Fish Processing Technology, Division of Transfer of Technology, ICAR-CIPHET, Ludhiana said that fish farmers and interested entrepreneurs can opt for custom-hiring of instruments and start their entrepreneurial ventures.

Mr. Sagar A. Joshi, Assistant Professor, College of Fishery Science, Nagpur opined that timely disbursement of money to the farmers is an issue.

There was a general view that fish farmers and entrepreneurs should take advantage of the different schemes and incubation centres set up for promotion of fish processing industries in the country. It has been also emphasized that fishers should form FPOs with NABARD's help to engage in bulk fish marketing to reduce marketing inefficiencies. There were also discussions about certification, potential agencies that would do certification, accreditation of certifying bodies and the related cost and price incentives. Universities should come up with awareness programmes for increasing outreach of PMMSY schemes. A compendium of available technologies for post-harvest processing should be available. PFGE has taken up the lead in publication of this compendium. There were further deliberations on reassessment of fish markets to improve hygiene, infrastructure and supply chain management. There were also discussions on the future prospects of certification of inland fish in domestic marketing and trade. Cluster-based aquaculture will be promoted by NFDB for facilitating access to credit, quality inputs, marketing and up-scaling of business in corporate lines to enhance domestic marketing of fish in India.

The following recommendations were chalked out from the brain-storming session:

- There has to be technology intervention in transportation system for marketing of fish, especially live fish in inter-state trade.
- Impact of emerging technologies such as bio-floc on organoleptic and other quality changes on fish and fishery products should be assessed for consumer acceptance.
- Awareness of PMMSY schemes for the beneficiaries should be taken up on priority basis so that the fishers and fish farmers can take help of credit and subsidies on time.

- Cadre strength on Fish Processing and Post-Harvest Technology in ARS should be introduced in ICAR-CIFRI, ICAR-CIFA and ICAR-CIBA. This is to strengthen the domestic marketing of inland fishes and augment post-harvest management in freshwater aquaculture.

The following interventions were recommended to be carried out in the near future as a result of the brain-storming session:

Policy Level Interventions

- Scientific cadre strength should be introduced in ICAR-CIFRI and ICAR-CIFA in the discipline of Fisheries Post-Harvest Management.

Technology Level Interventions

- Live fish transportation system

Extension Level Interventions

- Awareness on PMMSY schemes for the fishers and farmers

The following delegates attended the brainstorming session physically:

1. Dr. I. Karunasagar, FAO Senior Fisheries Officer
2. Dr. L. Narasimhamurthy, Senior Executive Director, National Fisheries Development Board
3. Dr. B. B. Nayak, Principal Scientist and Head, Division of Fisheries Resources, Harvest and Post-Harvest, ICAR – CIFE, Mumbai
4. Dr. G. Jeyasekaran, Former Director of Research, TNJFU
5. Dr. A. K. Balange, Principal Scientist, Fish Processing Technology Division, ICAR-CIFE
6. Prof. R. K. Majumdar, Head, Dept. of Fish Processing Technology and Engineering, College of Fisheries, Central Agricultural University, Lembuchhera, Tripura
7. Prof. Raman Kumar Trivedi, Director Students' Welfare, Bihar Animal Sciences University, Patna
8. Dr. K. C. Dora, Former Dean and Head, Dept. of Fish processing Technology, Faculty of Fisheries Sciences, WBUAFS, Kolkata
9. Dr. R. Jeya Shakila, Professor and Head, Department of Fish Quality Assurance and Management, Fisheries College and Research Institute, TNJFU, Tuticorin
10. Dr. T. J. Abraham, Faculty of Fisheries Sciences, WBUAFS, Kolkata
11. Dr. Vipul Gupta, Professor, FHPT, GBPUAT, Pantnagar (Uttarakhand)

12. Dr.Armaan U. Muzaddadi, Principal Scientist, ICAR – CIPHET, Ludhiana
13. Dr. Vikas Kumar, Scientist, Fish processing Technology, ICAR-CIPHET, Ludhiana
14. Dr. Manjappa N., Associate Professor, FRIC, Hesarghatta, Bangalore
15. Mr. Sheikh Ali Hussain, Progressive Fish Farmer, Andhra Pradesh
16. Mr. P. Ramakrishna Reddy, Ph.D. Scholar, ICAR – CIFE, Mumbai
17. Mr. Nikesh Hajare, M. F. Sc. Scholar, ICAR – CIFE, Mumbai
18. Ms. Sandhya V., M. F. Sc. Scholar, ICAR – CIFE, Mumbai
19. Ms. Suguna P., M. F. Sc. Scholar, ICAR – CIFE, Mumbai
20. Mohammed Akram Javith S., Ph.D. Scholar, ICAR – CIFE, Mumbai
21. Dr. Suman Kumari, Scientist, ICAR – CIFRI, Barrackpore, Kolkata
22. Dr. Piyashi DebRoy, Scientist, ICAR – CIFRI, Barrackpore, Kolkata
23. Dr. Shiva Kumar Magada, Dean, College of Fisheries, Mangalore
24. Dr. K. B. Rajanna, Associate Professor, FRIC, Hebbal, Bangalore
25. Dr. S. R. Senapati, Asst. Fisheries Officer, Odisha Fisheries Dept.
26. Dr. Pritijyoti Majhi, Scientist, ICAR – CIFRI, Barrackpore, Kolkata
27. Ms. Sayani Roy, Ph.D. Scholar, WBUAFS
28. Ms. Ashmita Pandey, Ph.D. Scholar, ICAR – CIFE, Mumbai
29. Ms. K. Vasanthi, Ph.D. Scholar, ICAR – CIFE, Mumbai



30. Dr. Jitender Kumar Jakhar, Associate Professor, College of Fisheries, Kawardha, Chhattisgarh
31. Dr. Vijay Kumar Reddy S., Scientist (Fisheries), College of Fisheries, GADVASU, Ludhiana, Punjab
32. Mr. Sagar A. Joshi, Assistant Professor, College of Fishery Science, MAFSU, Nagpur
33. Mr. Somnath Saha, Ph.D. Scholar, ICAR – CIFE, Mumbai
34. Ms. Fathima Salam, Junior Research Fellow, ICAR – CIFE, Mumbai

The following delegate attended the brainstorming session on-line:

1. Dr. Shine Kumar, Director, National Institute of Fisheries Post-Harvest Technology and Training, Kochi



Poster session

The poster sessions were conducted in both offline and online modes. A total of 13 judges from different ICAR institutes, and state universities did the evaluation process for 6 designated themes. The numbers of poster presenters both online and offline for the theme Recent Advances in Indian Aquaculture for Attaining SDGs (AQ) were 43, for Fisheries Resource Management for Sustainable Fisheries (FRM)-61, for Biotechnological Interventions for Improving Fisheries Production (BT)-23, for Fish Health and Aquatic Environment Management (FHM)-41, for Fisheries Post-Harvest Technology and Value Addition (PHT)-24, and for Fisheries Extension, Governance and Policies (FEX)-37.



Young Research Talent Search Award

To encourage the undergraduate students (B.F.Sc) to showcase and highlight their innovative ideas, and thoughts by presenting posters/models Young Research Talent Search Award was conducted. A total of 33 individuals/ groups submitted their innovative ideas through abstracts and, out of that 32 individuals/groups comprising 68 participants from different state and central universities participated in the same. A four member panel was constituted namely, Dr. M. A. Hassan, Principal Scientist, ICAR-CIFRI, Barrackpore; Dr. Geetanjali Deshmukhe, Principal Scientist, ICAR-CIFE, Mumbai; Dr. A. K. Balange, Senior Scientist, ICAR-CIFE, Mumbai, and Dr. Sreekanth G. B. Scientist, ICAR-CCARI, Goa for the evaluation of the participants. The best 4 individuals/groups were awarded in this category.





Deans meet at 1st Indian Fisheries outlook, ICAR-CIFRI, Barrackpore on 23rd March 2022

At the outset of 1st Indian Fisheries outlook, a interactive session among the Deans of different Fisheries Colleges across India was organised on 23rd March 2022 at the Conference room of ICAR-Central Inland Fisheries Research Institute. This session was chaired by Dr. Gopal Krishna, Former Director, ICAR-CIFE, Mumbai and PI of NAHEP.

At the beginning of the session, Dr. Gopal Krishna emphasized about the strengthening the fisheries education in India, including enhancing the quality of the education and professionalism among the students. He also thanked Dr. B. K. Das, Director, ICAR-CIFRI and the organisers for arranging such meeting in the conference.

In this meeting the following deliberations were made

- Allocation/ Acquiring funds from different source of funding (national and state sources) for strengthening the college facilities and infrastructure
- Formation /Constitution of national level regulatory body
- To ensure the fisheries education, minimum infrastructure facility, faculty requirement in all the colleges and setting up of new colleges

- Collaboration between ICAR research institutes, Industries and the SAU for improving the quality education, research outputs and exposure of B. F. Sc., M.F.Sc and Ph.D. students. Scientist of Research Institutes can be considered for the extended faculty members for the fisheries colleges
- A national level database of the research programmes that are completed and ongoing to avoid repetitive research programs across the colleges and research institutes
- Refresher Courses for the fisheries department officers regularly and the Heads of Fisheries Departments in all the States need to be fisheries professionals
- Formation of Research Councils in all Colleges (to guide the research work required for nation and also at Local needs)
- Industry linkage of Students for need based research and quality research output including International and Industry exposure of students
- Ensuring the exclusive B.F.Sc. eligibility criteria for recruitment in ARS, Asst. Professor and the state departmental job
- Organisation of B.F.Sc. Student convention every year (each year at a different fisheries college/ research institute)
- Development of facilities for enhancing the soft skills of students
- Deans meet to be arranged regularly and all should strengthen the linkages through WhatsApp, meetings and virtual platform discussions etc.

Dr. B. K. Das, Director, felicitated all the Deans present in this meeting.



Special Session “ICT and Precision farming”

The session on “ICT and Precision farming” was held on 22.03.2022 in 1st Indian Fisheries Outlook conference at ICAR-CIFRI, Barrackpore. The session was chaired by **Dr. Amitabh Bandyopadhyay**, Former ADG & National Coordinator (NASF), ICAR and Co-chaired by **Dr. R.N. Sahoo**, Coordinator (NePPA), IARI, New Delhi and **Dr. Rajib Bandyopadhyay**, Professor, Jadavpur University, Kolkata. In this session, three lead speakers have presented their research findings and thoughts in the field of drone technology and sensors and precision agriculture. After that four start-up companies briefly discussed and demonstrated their activities and products for further scaling up.

Dr. R. N Sahoo, Co-chairman has discussed about how drone technology, imaging system and IoT can facilitate to develop digital soil mapping which is capable of identifying dynamic soil fertility status and changes in different timescale. It is also possible to model crop responses through remote sensing and in-situ sensing and recommend variable rate application of fertilizer if variability is found in the cropped area. He also highlighted the role of Decision Support System or Expert System which coordinates among all the technologies and simulates the entire scenario for any further interventions or recommendation using cloud computing and bigdata technology. He has elaborately explained about the composite vegetation health index, automation of greenhouse tomato, IoT in precision aquaculture.

Dr. Rajib Bondyopadhyay, Co-chairman discussed about the application of electronics and ICT in agriculture. He explained about some of his significant achievements like development of formalin sensor, prediction of chemical composition of poultry excreta, rapid detection of melamine in milk, NIR probe for detection of protein, quality evaluation of finished tea, characterization of quality of leaf plucks etc. He expressed about Agri-Vision 2050 where electronics combined with ICT can act as a catalyst for improvement of agricultural process by facilitating soil fertility management, monitoring pollution in air etc.

Dr. Alokesh Ghosh, Associate Director, CDAC, Kolkata highlighted on the challenges in implementing IoT technologies in the farmer's field. Many times, farmers are not convinced in adopting or implementing the new technologies in their own field. He has also elaborated about the sensors developed by CDAC, Kolkata for measuring available N in the rice field.

After that, **Dr. Abhisek Burman**, CEO of General Aeronautics pvt. Ltd explained in detail how aerial solutions with drone technology developed by General Aeronautics deals with efficient pest and disease control in agriculture. The technology, GA Spray Drone – CA04 is an efficient and robust technology with better bio-efficacy, pre-set finer droplet size, spray technology with right quantity as compared to the conventional procedure. He has also worked on plant stress-based application using RS & GIS technologies and recommending variable rate applications based on the actual need of the plant. The technology was also applied in coconut orchard for pest and disease identification with 92% accuracy.

Dr. Ranjita Ghosh Moulick, CEO, Bionano Integra Healthcare OPC Pvt. Ltd., Kolkata presented and demonstrated their product. **Mr. Rajiv Mondal**, CEO, Arogyam Medisoft Solution Pvt. Ltd, Kolkata presented Agri-advisory portal and its different features. **Mr. Dilip Sing**, Ayudyog Pvt. Ltd, Kolkata also presented their products.

The CDAC-CIFRI product 'MEAN' was demonstrated by CDAC, Kolkata. After that, **Mr. Arab Khan**, CEO, Digital Drone has explained about the aerial drone customised for water sampling. The Chairman coordinated the overall session and highlighted the issues with following recommendations:

- An extensive review of biological process in the domain of inland fisheries is required to capture all the challenges faced by the fisher community which may require the intervention of IoT system for better efficiency and productivity. Therefore, a systematic document should be prepared within a time frame to address these issues so that various start-up companies /stakeholders may know the priority areas in the inland fisheries to work upon.

- Aquaculture mapping with exact location and size should be developed using IoT technologies. An appropriate land registration system for different waterbodies need to be established to communicate with the registered farmers for recommending any management plans.
- Artificial Intelligence (AI) based Prediction Model should be developed using cloud computing to forecast future scenario in the fish farming after detection of any ill symptoms in the fish health as well as farm.

The session was concluded with formal vote of thanks by Dr. B. K. Behera, Acting Head, ICAR-CIFRI.



Session: IFSI Gold Medal Presentations

Applications were called for four IFSI Gold Medals in connection with the Conference, under different age categories, and the applicants selected after the screening presented in the session.

Late Dr. Hiralal Choudhury Gold Medal:

The session for Dr. Hiralal Choudhury Gold Medal (more than 45 age group) was chaired by Dr. V. V. Sugunan and Prof. A. P. Sharma. There were six presentations in this category. Dr. Akshaya Panigrahi of ICAR-CIBA, Chennai and Dr. S. Samanta of ICAR-CIFRI, Barrackpore were selected for Dr. Hiralal Choudhury Gold Medal.



In this session, a new award, **“Dr. B. C. Jha Gold Medal”** in the memory of Late Dr. B. C. Jha, Former HoD of Reservoir and Wetland Fisheries division, ICAR-CIFRI, was initiated for scientists on the basis of their significant contribution in the field of fisheries sector. The awardees selected for Dr. B. C. Jha Gold Medals were Dr. Robinson Jeya Shakila of FCRI, Thoothukudi and Dr. Kedar Nath Mohanta of ICAR-CIFA, Bhubaneswar.



Padma Shri Dr. S. Ayyappan Gold Medal: Dr. Dilip Kumar and Dr. Ambekar Eknath chaired the presentation session for Padma Shri Dr. S. Ayyapan Gold Medal, which was meant for 35-35 age category of scientist. There were eight presentations in this category. Dr. Suman Kumari and Dr. A. K. Sahoo of ICAR-CIFRI, Barrackpore were selected for Padma Shri Dr. S. Ayyappan Gold Medal.



Dr. J. K. Jena Gold Medal & Prof. A. P. Sharma Gold Medal: Dr. M. Sinha and Dr. U. K. Sarkar chaired the session for the presentations for Dr. J. K. Jena and Prof. A. P. Sharma Gold Medals, which are for below 35 age group of researchers. There were nine presentations in this category. Dr. Sreekanth G. B. of ICAR-CCARI, Goa and Dr. Rahul Krishnan of Chonnam National University, South Korea were selected for Dr. J. K. Jena Gold Medal and Dr. Shamna N. of ICAR-CIFE, Mumbai and Mr. Santhana Kumar V. of ICAR-CIFRI, Barrackpore were selected for Prof. A. P. Sharma Gold Medal. The Gold Medals were presented to the awardees in the valedictory session of the Conference.



IFO 2022 Award Session



IFO 2022 Award Session



IFO 2022 Valedictory Session



Final Recommendations

- More emphasis must be given on hidden harvest of fishes, to corroborate the catch from inland capture fisheries and aquatic food production systems
- More stress on assessment and conservation of small indigenous fishes, analysis of nutrient contents to recognise and popularize them as a super food for poor in achieving SDG.
- There has to be close-knit collaboration among all the stakeholders in fisheries management encompassing the Government, public and private players through appropriate governance and institutional mechanism.
- Policy support to small and marginal farmers and its outreach needs to be continuously monitored and examined so the neediest beneficiaries of the society are not excluded from taking advantages of governmental schemes.
- In view of the global and national focus on promoting family farm based diversified food production system, small scale aquaculture and inland fisheries must be given highest priority for attaining food, nutrition and livelihood security.
- Nutritional security of the fishers' household and also of a larger section of the rural populace should be ensured to harness the national gains from increased productivity and well being of the country's population, especially the youth.
- Gender should be an integral part of all fisheries research and development activities to generate sufficient data and evidence to empower women at all managerial levels in fisheries and aquaculture that are mostly at disadvantaged positions in fisheries value chains.
- Seaweed can make an excellent source for food and bioactive substances (pharmaceuticals and food supplements) and hence the utilization of seaweed should be supported by culture of beneficial seaweeds to sustain the supply of high-quality raw materials.
- A large proportion of the population consumes dried, cured and fermented fish and these items need more standardization, development of SOPs and production at an industrial scale.
- There has to be technological intervention for developing transportation system for marketing of fish, especially live fish for inter-state trade.
- Regional approach and research activities on the hilsa stock characterization, migration and artificial propagation should be conducted in holistic approach and mission mode program must be carried out for increasing hilsa fisheries in the Indian rivers and the role of fish passes installed across the major rivers should be brought to the public domain.
- Artificial Intelligence (AI) based Prediction Model should be developed using cloud computing to forecast future scenario in fish farming and fisheries management in open waters.
- Increased focus on application of biotechnological tools and interventions for accelerating the growth of fisheries including the use of omics platform.

- More emphasis must be given on AMR, emerging pathogens and contaminants for ensuring sustainable and safe fish production.
- Development of climate resilient fisheries practices and identification of tolerant fish species should be a priority area in the context of changing climate and degraded ecosystem health.
- Under graduates to be given exposure in industries for making them Industry ready and entrepreneurs.
- Strong need for close linkages between Institute & industry for addressing sectoral needs and issues.
- Small / marginal farming and fishing households deserve highest priority which in turn require strengthening of research and extension services with new vigour and outlook incorporating climate change, environmental considerations and mainstreaming nutrition.
- Fisheries extension services should not only target the increase in fish production and productivity; it should integrate efforts directed to increasing fishers' and fish farmers' income and well being.
- Fisheries Council of India (FCI) to be established to regulate the standards of fisheries education in the country.





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