



PROCEEDINGS

of the

XVI AGRICULTURAL SCIENCE CONGRESS 2023 & ASC EXPO

Transformation of Agri-Food Systems for
Achieving Sustainable Development Goals

10-13 October 2023 | Kochi, Kerala, India



Hosted by ICAR-Central Marine Fisheries Research Institute, Kochi
Organised by National Academy of Agricultural Sciences, New Delhi



PROCEEDINGS

XVI AGRICULTURAL SCIENCE CONGRESS
10-13 OCTOBER 2023, KOCHI





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16ASC2023 in a Gist



The XVI Agricultural Science Congress (16ASC2023), organized by the National Academy of Agricultural Sciences (NAAS) and hosted by the ICAR-Central Marine Fisheries Research Institute (CMFRI) Kochi from October 10 to 13, 2023, took place in Hotel Le Méridien, Kochi, Kerala. The Congress revolved around the main theme "*Transformation of Agri-Food Systems for Achieving Sustainable Development Goals*" covering 10 Technical Sessions with 25 sub-sessions viz., Ensuring Food and Nutritional Security, Climate Action for Sustainable Agri-food Systems, Frontier Science and Emerging Genetic Technologies, Livestock-based Transformation of Food Systems, Horticulture-based-Transformation, Aquaculture and Fisheries-based Transformation of Food Systems, Next Generation Technologies, Policies and Institutions and International Partnerships. The inaugural ceremony was graced by the Chief Guest, Honourable Union Minister for Fisheries, Animal Husbandry, and Dairying, Shri Parshottam Rupala. Dr. Himanshu Pathak, Secretary of the Department of Agricultural Research and Education (DARE) and Director-General of the Indian Council of Agricultural Research (ICAR), presided over the event. Dr W.S. Lakra Secretary, NAAS welcomed the luminaries and the delegates. Dignitaries such as Shri. P. Prasad, Hon. Minister for Agriculture, Kerala; Shri. Hibi Eden, Hon. Member of Parliament, Ernakulam; Dr Anil K Singh and Dr K Bujarbaruah, Vice Presidents, NAAS; graced the occasion as Guests of Honour.

The 16ASC2023 aimed to foster a scientific discourse on transforming India's agri-food systems into sustainable enterprises for the benefit of future generations. The Congress brought together more than 1607 registered and invited participants (eminent Scientists, Academicians, Researchers, Policy makers, Secretaries from Government Departments, eminent speakers from 12 nations, 121 Students delegates), 176 farmers from Agriculture, Animal Husbandry, Poultry, and Aquaculture sectors and about 90 industry representatives to exchange and share ideas and experiences, research findings and planning for a sustainable development road map for agri-food systems. A Book of Abstracts featuring 668 abstracts, conveying the results of R&D programs in India, was released. The Presidential Address on the topic "*Indian Agriculture in the Amrit Kaal*" was delivered by Dr. H. Pathak President, NAAS and Secretary, DARE & DG, ICAR. Prof. Panjab Singh, Former President of NAAS, delivered the Dr AB Joshi Memorial Lecture.



Four Plenary Lectures, chaired by eminent figures such as Dr. Channing Arndt, Senior Director for Transformation Strategies of CGIAR and IFPRI; Prof. Stuart Smyth, Agri-Food Innovation and Sustainability Enhancement Chair, The University of Saskatchewan, Canada; Dr. T. Mohapatra, Chairperson, PPVFRA; and Dr. Essam Yassin Mohammed, Director General, WorldFish.

Dr Vijay Paul Sharma, Chairman of the Commission for Agricultural Costs and Prices; Dr Rishi Sharma from FAO; Dr Kadambot Siddique, Hackett Professor of Agriculture Chair and Director at the University of Western Australia Institute of Agriculture; Dr. Eric-Jan Lock, Research Director, Nutrition and Feed Technology NOFIMA, Norway; Dr. Morten Rye, Director of Genetics, Benchmark Genetics, Norway; Prof. (Dr.) Soottawat Benjakul, Professor, Prince of Songkla University, Thailand; and Dr. Holly Hapke, Director of Research Development School of Social Sciences, University of California, USA added prestige to the event.

The Congress also featured three Panel Discussions and four Symposiums, covering topics like coastal agriculture and livelihood, mainstreaming millets, and youth empowerment and gender equity. A special Session on the Role of PPV&FRA in the Transformation of Agri-Food Systems for Achieving Sustainable Development Goals and a Workshop on Advancements in Research for Marine Mammal Conservation in India were notable highlights.

The Farmer-Scientist Interface session facilitated direct knowledge exchange between the farming community and leading researchers, with 176 farmers from 17 states, (including 5 Padma Awardees, ICAR Best Farmer Awardees, Progressive Farmers, Farmer Producer Organization Members, Farmer Entrepreneurs). The Congress witnessed the participation of 1607 delegates from India and abroad. An Industry Interface brought together prominent industrialists and ICAR for discussions on initiatives, interventions, and innovations. An Agri-Expo featuring 104 pavilions and 5 interactive kiosks showcased innovative agricultural technologies.

A total of 594 posters were presented under the 10 themes, and to engage youth in agriculture systems and policy research, NAAS sponsored 109 students from 24 agricultural universities. These students actively participated in various sessions and activities tailored to their specific interests, fostering learning and idea exchange. The Students' Elocution Contest featured twelve students representing six zones, with Ms. Shambhavi from GB Pant University of Agri. & Tech., Pantnagar, winning the First Prize. The ICAR-Indian Institute of Spices Research, Kozhikode, was honoured as the Best Stall in the Agri-Expo. The Congress concluded in the afternoon of 13 October 2023.

INAUGURAL SESSION



The XVI Agricultural Science Congress (16ASC2023), organized by the National Academy of Agricultural Sciences (NAAS) and hosted by the ICAR-Central Marine Fisheries Research Institute (CMFRI) Kochi from October 10 to 13, 2023, took place in Hotel Le Méridien, Kochi, Kerala. The Congress revolved around the main theme "*Transformation of Agri-Food Systems for Achieving Sustainable Development Goals*" covering 10 Technical Sessions with 25 sub-sessions viz., Ensuring Food and Nutritional Security, Climate Action for Sustainable Agri-food Systems, Frontier Science and Emerging Genetic Technologies, Livestock-based Transformation of Food Systems, Horticulture-based-Transformation, Aquaculture and Fisheries-based Transformation of Food Systems, Next Generation Technologies, Policies and Institutions and International Partnerships.

The inaugural ceremony was graced by the Chief Guest, Honourable Union Minister for Fisheries, Animal Husbandry, and Dairying, Shri Parshottam Rupala. In his inaugural address, Honourable Union Minister stated that there is an urgent need to transform agri-food systems into sustainable enterprises through scientific innovations, in view of the increasing food demand, environmental degradation and the challenges posed by climate change. He added that the agricultural scientists should strive to infuse greater mechanisation in the agriculture production process and develop and popularise specialised farm implements for women in agriculture. Emphasising the need to promote traditional farm products such as *pokkali* rice, Hon'ble Union Minister suggested that minimising post-harvest losses is equivalent to boosting production and said this could be achieved by focusing attention on advanced technological interventions. Shri. Parshottam Rupala further added that the future of India's agriculture depends a lot on how the accumulated scientific knowledge can be translated to commercial success. Hon'ble Minister presented Dr. B.P. Pal Award for Excellence in Agricultural Sciences, Dr. A.B. Joshi Memorial Lecture Award and several other NAAS awards to the recipients. He also inaugurated the Agri Expo held on the side-line of the event which showcased innovative agricultural technologies of public



and private sector research institutes, universities, agro-industries, extension agencies and NGOs.

Dr. Himanshu Pathak, Secretary of the Department of Agricultural Research and Education (DARE) and Director-General of the Indian Council of Agricultural Research (ICAR), presided over the event. He read out the message of the Honourable Prime Minister of India, Shri Narendra Modi, highlighting on living in harmony with nature, ending hunger and achieving productivity growth through chalking out a futuristic blue print to meet the sustainable development goals. The Hon'ble Prime Minister also conveyed his wishes for the successful conduct of 16 ASC 2023. Dr Pathak said that research on genomics and genome editing would be the core focus for technological breakthroughs in agriculture and commodities where traditional breeding cannot yield the desired results. Dr W.S. Lakra Secretary, NAAS welcomed the luminaries and the delegates.

Dignitaries such as Shri. P. Prasad, Hon. Minister for Agriculture, Kerala; Shri. Hibi Eden, Hon. Member of Parliament, Ernakulam; Dr Anil K Singh and Dr K Bujarbaruah, Vice Presidents, NAAS; graced the occasion as Guests of Honour. Shri. P. Prasad, Hon. Minister for Agriculture, Kerala stressed on ensuring food and nutritional security for all the citizen of the country, while maintaining the health of the ecosystem and environment intact. He also said that it is the time to turn to carbon neutral development pathways, to focus on newer technologies to augment production, and to pay attention to post-harvest handling. In his address, Shri. Hibi Eden, Hon. Member of Parliament, Ernakulam acknowledged the rich agricultural heritage of the central Kerala and emphasised the role of agriculture in the socio-economic development of the region. He also commended the scientific community for their advancements in agriculture sector.

Presidential Address - Dr. Himanshu Pathak, President, NAAS; Secretary, DARE & DG, ICAR

Indian Agriculture in the Amrit Kaal



Dr. Himanshu Pathak, Secretary, DARE and President of the National Academy of Agricultural Sciences highlighted the transformative shifts in India's agricultural research priorities in his presidential address at the 16th Agricultural Science Congress.

He emphasized India's commitment to international initiatives such as Panchamrit and achieving carbon neutrality, land degradation neutrality, biodiversity conservation, and regional agricultural development, aligned with the Sustainable Development Goals (SDGs). Genomics and genome editing emerged as pivotal research areas, offering breakthroughs in cases where traditional breeding methods fall short. The advent of precision agriculture, digital interfaces, and advanced technologies is facilitating real-time monitoring of weather, plant, and soil indicators, enabling farmers to make informed decisions with the aid of artificial intelligence-driven advisories.

Looking ahead, Dr. Pathak underscored the critical importance of meeting the projected surge in food grain demand by 2033 amidst mounting climate challenges. High-yielding varieties and Hybrids of field crops are the major drivers for augmenting productivity and production. During 2022-23, a total of 467 high-yielding varieties/hybrids comprising 218 cereals, 57 oilseeds, 65 pulses, 98 commercial crops, 29 forage, and other crops were released for commercial cultivation by research institutes under ICAR. These included 35 special traits varieties (23 MAS and 18 biofortified).

Dr. Pathak also mentioned that ICAR has also been at the forefront of fostering international cooperation in emerging areas of science and technology. ICAR has been a partner in several international conclaves and workshops, ministerial meetings, and other research and technology sharing platforms.

Overall, the address highlighted the collective endeavours and forward-thinking strategies to ensure the resilience, innovation, and sustainability of India's agricultural sector in the face of evolving challenges.

Dr. A.B. Joshi Memorial Lecture - Prof. Panjab Singh, Past President, NAAS
Innovative Agri-food Systems Technologies for Sustainable and Resilient Agriculture
Convenor: Dr. W.S. Lakra, Secretary, NAAS; Former Director, ICAR-CIFE



Prof. Panjab Singh, former Secretary of DARE and Director General of ICAR delivered the Dr. A B Joshi Memorial Lecture, highlighting the multifaceted challenges surrounding food and nutritional security in India. He emphasized the need for a comprehensive approach that focuses on underprivileged communities, localized food systems, sustainability, resource conservation, and technological advancement.

He pointed out that India has the largest population of malnourished children on a global scale, leading to a 4% reduction in GDP. He underscored the importance of sustainable food production systems that uses resources within the Earth's capacity for regeneration. Additionally, he drew attention to the imperative to curtail food wastage, which amounts to roughly 30-40% of global food losses.

Prof. Singh recognized that modern agriculture heavily relies on energy-intensive technology, which contributes to greenhouse gas emissions. He called for a harmonious equilibrium between increased food production and resource conservation. In order to address these challenges, Dr. Singh proposed a comprehensive approach that includes: adopting crop patterning for a balanced food and income generation; promoting diversification in dietary habits; implementing efficient technological interventions; strengthening the agricultural value chain, with a focus on allied activities like dairying and livestock development; sustainable development and management of water resources; encouraging crop diversification, especially towards high-value and horticulture crops.

Prof. Panjab Singh emphasized the need to prioritize the well-being of economically disadvantaged communities and local food systems in efforts to address food security and nutrition challenges. He concluded by stating that a holistic and integrated approach is paramount for ensuring a resilient and inclusive agricultural sector capable of sustainably meeting the needs of the growing population.



Theme 1: Ensuring Food & Nutritional Security: Production, Consumption and Value Addition

Theme Convenor: Dr. M.S. Bamji

Technical Session 1 (Theme 1-TS-1): Problem of Malnutrition in India

The session was Co-Chaired by Dr. Kamala Krishnaswamy and Dr. P. Geervani. Session Coordinator was Dr. R. Narayana Kumar. The session had one keynote lecture by Dr. R. Hemalatha and three invited lectures. Rapporteurs of the session were Dr. Shoji Joseph and Dr. Salma Rehman.



In her keynote lecture on 'Dietary Guidelines for Indians, and What Indians Eat', Dr. R. Hemalatha, Director, ICMR-National Institute of Nutrition, explained the dietary patterns in India, considering various factors such as age, activity levels, income, and rural-urban settings. Significant disparities in food consumption across different population groups, including consumption of cereals in excess by most groups, and a substantial lack of intake of protective foods like pulses, legumes, milk, nuts, vegetables, and fruits were highlighted. In the invited lecture on 'Food processing to combat malnutrition in India', Dr. Sridevi Annapurna Singh, Director, CSIR-Central Food Technological Research Institute, discussed the use of nutrient dense products in intervention studies and their impact. The second invited lecture was on 'Nutraceuticals in food and health', wherein G. Bhanuprakash Reddy, ICMR-National Institute of Nutrition explained the role of functional foods in health outcomes related malnutrition and in particular non-communicable diseases such as obesity, diabetes, cancer, cardiovascular and neurological disorders. The third lecture was on 'Nutrition communication in India: From rhetoric to reality' by Dr. Subba Rao M. Gavaravarapu, wherein he explained the multifaceted evolution of nutrition communication in India, informed by a synthesis of reviews and empirical studies.

Recommendations:

1. Indian diet which are predominantly cereal based, should diversify to include more pulses, fruits, vegetables particularly green leafy vegetables, food of animal origin like milk, egg, fish etc. Lot of fat is derived from food we eat & consumption of visible fat should decrease.
2. Conventional food technology plays an important role in achieving nutrition security by reducing anti-nutrients. Apart from 19 known nutrients, plant food are rich in health living phytochemicals which protect against degenerative diseases, non-communicable disease.
3. Behavioural change is needed to promote dietary diversity - Awareness, Availability, Access & Affordability.

4. Need for nutrition literacy at all levels. Dangers of achievements which are misleading. Aggressive marketing should be avoided.

Theme 1: Ensuring Food & Nutritional Security: Production, Consumption and Value Addition

Theme Convenor: Dr. M.S. Bamji

Technical Session 2 (Theme 1-TS-2) Farm and Food-based Strategies for Combating Hidden Hunger

The session was Co-Chaired by Dr. V. Prakash and Dr. Ramesh Bhat. The session had one keynote lecture by Dr. R. Hemalatha and three invited lectures, including one recorded lecture. Session Coordinator was Dr. M.K. Verma and the Rapporteurs of the session were Dr. Anulekshmi Chellapan and Dr Jeena N.S.



The keynote lecture on Pharmaceutical Approach and Food Fortification for Combating Micronutrient Deficiencies, Dr. K. Madhavan Nair highlighted the challenges, knowledge gaps and research priorities in supplementation and food fortification. In the invited lecture on ‘Biofortification to combat hidden hunger’ by Dr. Siddharth Tiwari, genome editing and over-expression of candidate gene of the carotenoid pathway as an effective mode for provitamin A biofortification in banana was highlighted. In the second invited lecture on ‘Food based approaches and the role of women in alleviating malnutrition’, Dr. G.N. Hariharan, explained that there is a need for strong food-based approach and gender inclusive models to eradicate malnutrition at all levels. In the recorded lecture on ‘Addressing Dual Burden of Malnutrition: Role of Food Systems’, Dr. Bharati Kulkarni, highlighted the urgent need to strengthen agriculture-nutrition linkages to make nutritious foods available, accessible and affordable for the low-income consumers from urban and rural areas, which also include a large section of subsistence farmers and agricultural laborers.

Recommendations:

1. Agri research should not be seen in isolation. This should also address the prevention of food losses & waste. Food based approach using the Agric. Biodiversity for reaching nutrition to the needy.
2. Enable, Energize and Encourage youth to take agriculture as career and link it to National Nutrition Mission. Continuous interaction of Agriculture / Food Technology / Nutrition coupled with appropriate social science techniques and communication approaches are needed to solve the problem of hidden hunger.
3. “Agri-Horticulture remedies for nutritional maladies” - MSS (inclusive of empowerment of women)



4. Apart from dietary diversification, food fortification also has a place for combating micro nutritional deficiencies. Micronutrient supplementation involves higher doses of micronutrients. These programs are needed when the problem is acute.

Theme 1: Ensuring Food & Nutritional Security: Production, Consumption and Value Addition

Theme Convenor: Dr. M.S. Bamji

Technical Session 3 (Theme 1-TS-3): Resource Efficient and Environment Friendly Production of Pulses

The session was Co-Chaired by Dr. Anupam Varma. Session Coordinator was Dr. Krupesh Sharma. The session had one keynote lecture by Dr. P.K. Joshi and three invited lectures. Rapporteurs of the session were Dr. Jayasree Loka and Dr. Krishna Sukumaran



In the keynote lecture on ‘Demand for and Supply of Agri-food Commodities in India’, Dr. P.K. Joshi highlighted the need to improve dietary diversity, reduce post-harvest losses, promote millets and bio-fortified food commodities, improve food safety, and popularize nutrition education, so that India will accomplish Sustainable Development Goals, and make Indian agri-food system more efficient, competitive, nutritive, and sustainable without adversely affecting the environment. In the first invited lecture on ‘Resource efficient and environment friendly production of pulses’, Dr. Sanjeev Gupta highlighted the nutrient requirement of pulses as compared to cereals and why these are environment friendly, and their cultivation is ecologically sustainable. Prof. (Dr.) Ng. Iboyma Singh explained the need for adopting sustainable agriculture methods, improving water management, and creating resilient food systems that are adaptable to shifting environmental conditions, to address issues climate change, in his invited lecture on ‘Impact of Climatic Changes on Food Safety and Nutrition’. The third invited lecture was on ‘Nutraceutical functions of milk and milk products: Prospects and challenges’ by Dr. Ashish Kumar Singh, wherein he explained the health advantages of various milk products and milk.

Recommendations:

1. Challenges on the production of nutri crops, like pulses, and millets are enormous. There is a need to optimize their production systems for improving nutrition security.
2. Emphasis on the production and quality of non-bovine milk needs to be given for the effective utilization of this important resource.
3. There is a need to consider Cash Transfer in place of kind transfer.
4. Climate change has resulted in increase in toxin producing microbes. There is an urgent need to monitor and reduce food contamination by microbial toxins.
5. The technology for direct seeded rice and other crops needs to be promoted.

Theme 2: Climate Action for Sustainable Agri-food Systems

Theme Convenor: Dr. Anil. K. Singh

Technical Session 1 (Theme 2-TS-1) Climate Action for Sustainable Agri-food Systems

The session was Co-Chaired by Dr. B. Venkateswarlu. Dr. Shelton Padua, ICAR-CMFRI Dr. and Vinaykumar Vase, ICAR-CMFRI were the Rapporteurs. Dr. Philip Thornton, ILRI, delivered the keynote lecture, while the invited lectures were given by Dr. Anupam Mishra, CAU, Dr. Paresh Shirsat, BIS and Dr. Sudhanshu Singh, IRRI. The session presentation was carried out by Dr. Paras Nath Jha.



Dr. Philip Thornton, ILRI (recorded) spoke about blue sky technologies for adapting to climate change in agriculture. He elaborated on historical examples of innovations in food systems which can inform future innovations. Some of the innovations were sand batteries in Finland that can store green energy, electricity from plants, food out of thin air by extracting CO₂ from the air and combining with bacteria, water, nutrients and vitamins using renewable energy, growing fruits without plants. He also spoke about innovations in sustainable livestock domains. Dr. Anupam Mishra highlighted the extension strategies for mitigation adaptation of climate change in eastern Himalayan Region of India. He tried to draw insights based on an analysis and discussion of the multi-scalar and multi-indicator assessment through profiling of resilience in the Eastern Himalayan Regions of India, based on the development of a climate-resilient agriculture index. He reiterated the role of extension strategies in influencing adaptation of climate smart agriculture practices relevant to Eastern Himalayan region of India and emphasizes on the role of policy makers, agriculture institutions and farmers in efficient execution of these strategies in the target areas.

Dr. Paresh Shirsat spoke about targeting agriculture technologies to climate risks and pathways for strengthening adaptation. Several options exist for risk reduction in agriculture. The risk layering approach or risk matrix approach together with decision tree can greatly facilitate targeting adaptation to specific risk/regions. Use of satellite signature and advanced modelling techniques can effectively downscale risk characterization to pixel/village scale. Crop simulation models help identify adaptation interventions which could become maladaptive in future. Regional adaptation models linking biophysical and socio-economic attributes of interventions support more informed decision-making. Dr. Sudhanshu Singh highlighted the opportunities in big data analytics and ICTs to accelerate climate change. The application of BDA and ICTs in climate-smart agriculture can play a potential role in helping smallholder farmers to maximize their productivity and profitability



through effective monitoring of climate change, thereby mitigating and adapting to its impacts. However, taking these technologies and ICT tools to the farmers' fields becomes a challenge, especially where socio-technical and institutional constraints are prevalent.

Dr. Paras Nath Jha spoke about comparative analysis of energy use, carbon footprint and related environmental burdens of different fishing systems through life cycle assessment approach. Fish harvesting is one of the energy intensive food production systems, responsible for greenhouse gas emissions. Fossil fuel continues to be the main source of energy for the major fishing methods viz. trawling, gillnetting, purse seining and long lining, releasing high amount of CO₂ and other greenhouse gases (GHGs). It was found that per kg of live fish landed, trawlers contributed maximum towards carbon footprint among other fishing systems, followed by longliner-cum-gillnetters and purse seiners. Hotspot analysis revealed that diesel contributes maximum to global warming potential and associated environmental burdens, among other operational inputs.

Recommendations

1. Many disruptive technologies are emerging in food systems and energy which would reduce the burden on our planet. These include single cell protein, microbial fuel cells and green ammonia production. There is a need to invest and incentivise in such emerging areas of research and technology development.
2. Indigenous practices followed by farmers in NE Himalayan region have potential for adaptation and mitigation. Such technologies need to be catalogued, assessed and improved through R&D.
3. Vulnerability and risk assessment need to be done commodity wise and with a more granular approach using frontier tools like remote sensing.
4. Big data and machine learning applications have great potential to bridge yield gaps in rice, monitor GHG emissions and enhance resource use efficiency. India having extensive data sets and experience on rice cultivation should make use of big data and remote sensing approach for enhancing resource use efficiency and climate change adaptation and mitigation.
5. By using big data, we should identify areas where fertilizer use in paddy can be reduced without affecting crop yields to reduce economic and environmental burdens of high fertilizer use.



Theme 3: Frontier Science and Emerging Genetic Technologies: Genomics and Gene Editing

Theme Convenor: Dr. C. Viswanathan

Technical Session 1 (Theme 3-TS-1): Advances in Genomics and CRISPR-Cas Systems for Crop Improvement



Co-Chair of the session was Dr. Trilochan Mohapatra. Dr. Kutubuddin Molla served as the Session Coordinator. The rapporteurs of the session were Dr. Anil K. Singh, NIPB, New Delhi and Dr. Ginny Antony, Central University, Kerala. The keynote lecture was presented by Dr. Frank White from the University of Florida, USA, while Dr. Debasis Chattopadhyaya from NIPGR, New Delhi, delivered the invited lecture. Dr. Ginny Antony and Dr. Rahul Mahadev Shelake delivered the two short lectures.

Dr. Frank White addressed the importance of genome editing and variants in the TALE composition of Xoo strains that arise in bacterial populations that can potentially evade newly edited resistant S alleles and other R genes. He also elaborated on surveys of extant strains and major TALE content in relation to virulence testing and sequence analysis. Different major TAL effectors for full virulence like PthXo1, AvrXa7, PthXo3, PthXo2 and their role in evolution of the bacterial/host interaction were also discussed. Limited susceptibility gene may represent Achilles Heel for blight. Dr. Debasis Chattopadhyaya stressed the importance of large-scale genome editing for resource generation and presented the protocol to edit 100 chickpea genes at a go to know their functions and utility.

Dr. Ginny Antony highlighted the host gene targeting by TAL effectors of pomegranate bacterial blight. Transcript profile of pomegranate during compatible interaction with *Xcp119* was detailed. Top 10 up-regulated pomegranate genes and their predicted TAL effector binding elements in response to *Xcp119* was assessed. She also described the generation of TAL effector mutants of *Xcp119*. Dr. Rahul Mahadev Shelake elaborated the designing of CRISPR-based genome editing tools for microbial and plant biology. He touched upon the viral and fungal disease-resistant tomatoes generated through CRISPR-Cas gene editing technology. GE products reaching to consumers like high oleic soyabean oil and Sicilian Rogue high GABA tomatoes were also described.

Recommendations

1. The interaction of pathogen of BB on one gene like XaZl or others may be studied
2. Need emphasis of improvement of Chickpea transformation
3. Basic research to optimize the GE system is required for the best potential use
4. Time base target traits to be developed

Theme 3: Frontier Science and Emerging Genetic Technologies: Genomics and Gene Editing

Theme Convenor: Dr. C. Viswanathan

Technical Session 2: (Theme 3-TS-2): Application of CRISPR-Cas Systems for Crop Improvement and Sustainable Development

Co-Chairs for the session were Dr. Frank White and Dr. C. Viswanathan, with Dr. Satendra Mangrauthia serving as the Session Coordinator. The rapporteur of the session was Dr. Ginny Antony, Central University, Kerala. Dr. Robert M. Stupar from the University of Minnesota, St. Paul, MN, USA, delivered the keynote lecture. The invited lectures were presented by Dr. C. Viswanathan from ICAR-IARI, New Delhi, Dr. R.M. Sundaram from ICAR-IIRR, Hyderabad, and Dr. Naveen Bisht from NIPGR, New Delhi.



Dr. Robert M. Stupar discussed the potential of gene editing in Soyabean. Dr. C. Viswanathan emphasized the importance of genome editing for improving stress tolerance in rice focused at improving stress tolerance of rice using genetic engineering and CRISPR-Cas genome editing in a mega rice cv. MTU1010. The candidate genes targeted for genome editing included the DROUGHT AND SALT TOLERANCE (DST), Protein Phosphatase 2C (PP2Cs) Clade A group, MIR169, Farnesyl Transferase (FTA) and Phytomelatonin Receptor (PMTR). Their success in developing four different mutant alleles of *dst* gene and identification of two lines free of introduced exogenous DNA were emphasised. Mutants with high yield and stress tolerance developed will be useful to be released as variety and as a genetic stock for introgression of *dst* mutations in other indica varieties for genetic improvement in yield and climate resilience. Dr. R.M. Sundaram highlighted the importance of reshaping the rice genome to meet the emerging challenges. He pointed out that one of the principal reasons for low productivity of rice in the country was the occurrence of rice growing area under adverse ecologies such as hills, saline soils, rainfed areas, acid soils etc. Therefore, he stressed that genome engineering of rice should focus on enhancing the crop productivity in these adverse ecologies. He mentioned that the high yielding genome edited lines of Samba Mahsuri developed at ICAR-IIRR and drought and salt tolerant MTU1010 developed by ICAR-Indian Institute of Agricultural Research (ICAR-IARI) had already entered multi-location evaluation trials of All India Coordinated Research Project on Rice (AICRPR) for possible release and notification. The reshaping of rice genome through genome editing can bring another revolution to meet the emerging global challenges, particularly those posed by a rapidly changing climate. Additionally, he stressed that, apart from structural genomics, equal or more emphasis on functional genomics will determine the extent of success of these new breeding tools. Dr. Naveen. C. Bisht discussed about genome editing for an ideal low-seed, high-leaf glucosinolate oilseed mustard. He explained that the globally cultivated oilseed Brassica crops – Brassica napus



(rapeseed) and *Brassica juncea* (mustard) are rich in seed glucosinolate content which have anti-nutritional properties. He reported the application of CRISPR/Cas9-based editing of glucosinolate transporter (GTR) family genes in mustard (*Brassica juncea*) to develop ideal lines with the desired low seed glucosinolate content while maintaining high glucosinolate levels in the other plant parts for uncompromised plant defense. Use of three gRNAs provided highly efficient and precise editing of four BjuGTR1 and six BjuGTR2 homologs leading to a reduction of seed glucosinolate content from 146.09 $\mu\text{moles/g}$ dry weight (DW) to as low as 6.21 $\mu\text{moles/g}$ DW. Detailed analysis of the GTR-edited lines showed higher accumulation of glucosinolates in the foliar parts. Their findings presented a breakthrough in the breeding of oilseed Brassicas for oil and meal quality without compromising the protection provided by glucosinolates to all the vegetative parts of the plant.

Recommendations

1. Before using the gene, the gene editing for commercial purpose, biology of the gene and its impact on plant physiology must be worked out.
2. More funding for infrastructure and HRD is required for wider adoption of market/genomics assisted breeding
3. Genetic engineering must improve for some of the traits that cannot be improved through breeding and genome editing
4. There is a need for road map to utilize advanced biotechnology tools in agriculture
5. Equal or more emphasis on exploratory biotechnology research including the discovery of new genes associated with agronomically important traits.

Theme 3: Frontier Science and Emerging Genetic Technologies: Genomics and Gene Editing

Theme Convenor: Dr. C. Viswanathan

Technical Session 3: (Theme 3-TS-3): Genome Editing: IPR Policy, Biosafety for Product Development and Socio-economic Considerations

The Theme Convenor for the event was Dr. C. Viswanathan, the Co-Chairs were Dr. D.K. Yadava and Dr. Stuart S. The Session Coordinator was Dr. Kutubuddin Molla. Dr. Satendra Mangrauthia, ICAR-IIRR, Hyderabad was the rapporteur. The keynote lecture was delivered by Dr. Michael Jones from Murdoch University, Perth, Australia. Invited lectures were given by Dr. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai and Prof. Venkatesan Sundaresan, distinguished professor in Plant Biology and Plant Sciences at the University of California, Davis, USA. The Session presentation was carried out by Dr. K. Lakshmi, ICAR-SBI, Coimbatore.



Dr. Michael G.K. Jones elaborated on the international perspective on trade in gene edited crops. The new suite of technologies described as Genome- or Gene-Editing (abbreviated here as 'GEd') was creating exciting new opportunities for genetic crop improvement. He highlighted that GEd technology is already contributing both to a new understanding of gene function and directly to better crops. He pointed out the significant potential to break the nexus between Genetically Modified (GM) plants and GEd plants, and to avoid the issues that have prevented wider use of GM crops. He also discussed the factors to be considered for commercial application especially by confirming that no 'external' nucleic acid sequences are present, the possibility of off target edits and licensing of genome editing technology. Furthermore, he emphasized that international harmonisation, or at least alignment, is a pre-requisite for achieving the full benefits and enabling international trade in GEd produce. Dr. R. Ramakumar highlighted the socio-economic considerations of the new seed technologies. He directed his attention to GM seed technology, and specifically addressed the concerns around the introduction of Bt-Cotton seeds in India. It was pointed out that the issues raised vis-à-vis GM crops would equally be applicable to the prospective editions of gene-edited crops. A better appreciation of the socioeconomic contexts in the study of new agricultural technologies was called for. He tried to distinguish between policy failures and technological failures in the case of Bt-Cotton in India and argued for a nuanced analysis that does not conflate the two. Dr. Venkatesan Sundaresan discussed about generating self-cloning hybrid crops through synthetic apomixis. He spoke about synthetic apomixis that can be used to make fertile and vigorous hybrids in rice. Furthermore, he proposed the possibility of using apomixis methods to propagate other plants with genome combinations that are usually infertile to meiosis.

Dr. Lakshmi K elaborated on CRISPR/Cas9-mediated lignin modification in sugarcane towards improved lignocellulosic biofuel production. Lignocellulosic biomass consists of



cellulose and hemicellulose, the main source of sugar for biofuels production. However, utilization of sugar is restricted due to the protective coverage of lignin. She explained that the saccharification process is affected by a high syringyl to guaiacyl (S/G) ratio in the bagasse. They have identified Ferulate 5 Hydroxylase (F5H) and cinnamyl alcohol dehydrogenase (CAD) as the potential targets in synthesis of syringyl monomeric units.

Recommendations

1. New genetic, physical, and food technologies can help obtain 2050 goals of agriculture.
2. India needs more investments in CRISPR-Cas genome editing research to harness the benefit of the technologies.
3. Use of De regulation or easy regulation of SDN-1 and SDN-2 genome editing in India for developing improved breeds of crops for addressing challenges in agriculture
4. Need for more conversations between agriculture and society to address the socio-cultural factors and sustainability concerns of new technologies.
5. Private sector in India needs to invest more in research, especially discovery component.
6. IPR issues of CRISPR-Cas technology need to be addressed with immediate effect for timely exploitation of these technologies in agriculture and other fields.

Theme 4: Livestock Sector Transformation for Food Security

Theme Convenor: Dr. K.M. Bujarbaruah

Technical Session 1 (Theme 4-TS-1): Towards Livestock Production Sector Transformation



The Convenor for the Technical Session was Dr. K.M. Bujarbaruah, Former DDG (Animal Science), ICAR & Former VC, Assam Agricultural University. The Session Co-ordinator was Dr. V. K. Taneja, Former Vice-Chancellor, GADVASU. The Co-Chairs were Dr. Dheer Singh, Director, ICAR-NDRI and Dr. (Ms.) Taru Sharma, Director, NIAB. The Rapporteurs were Dr. Divya, P.R., ICAR-NBFGR and Dr. M.A. Pradeep, ICAR-CMFRI.

The Keynote lecture was delivered by Dr. Abhijit Mitra, AHC, GoI on 'Livestock sector transformation for food security'. In his lecture Dr. Abhijit Mitra emphasised the importance of the livestock sector in addressing the challenges of food security and to meet the protein requirements of the growing population. He highlighted the significant growth achieved by our country in the dairy sector, to emerge as a leading milk producing nation. Dr. Mitra also emphasised the importance of backyard livestock rearing systems, particularly as a livelihood option for poor and marginal farmers. He also underlined the importance of adopting modern techniques for enhancing the livestock food production in India.

The first invited lecture under Technical Session I was delivered by Dr. T. J. Rasool, Director, Camel Biotechnology Centre, Abu Dhabi, UAE. Dr. Rasool in his lecture informed that the livestock production has increased multiple times during the last century by the adoption of various technologies starting from selective breeding to whole animal cloning. However, the increasing demand for animal products necessitate rapid targeted methods to increase the trait of interest, within specified period. He said that among the available modern techniques for improving animal food production, genome editing is a powerful technique for improving animal food production. This technique can alter the genetic make-up of animals at specified regions of the genome, and permits the modification of endogenous genes, integration of exogenous genes and deletion of undesired traits in a targeted manner. Dr. Rasool informed that the major traits of interest that can be manipulated are disease resistance, sex ratio alteration, introducing sterility for population control, improving food conversion efficiency, growth etc.

Dr. Raghavendra Bhatta, Director, NIANP, Bengaluru in his invited lecture on 'Animal feed sector transformation for food and environmental security' informed that the animal feed sector plays a pivotal role in meeting the global demand for meat, dairy and poultry products for the growing population. He said that the conventional practices of feed production have raised concerns about their environmental impacts like greenhouse gas emissions,



resource utilisation and food waste. Dr. Raghavendra Bhatta emphasised the need for transforming the animal feed sector by adopting sustainable practices that reduce its carbon footprint. He said that by reducing the carbon footprint of feed production, recycling food waste and by-products, implementing precision feeding, promoting organic farming and mitigating greenhouse gas emissions, it is possible to enhance environmental security while meeting the growing demand for animal-based products.

Recommendations

1. National Phenomics facility for livestock and poultry to support precision animal breeding.
2. National Mission on animal feed and fodder security.
3. Pilot-scale implementation of the developed technologies for GHG mitigation from livestock.
4. Scientifically harness the speciality animal products from the vast indigenous animal biodiversity.

Theme 4: Livestock Sector Transformation for Food Security

Theme Convenor: Dr. Triveni Dutt

Technical Session 2 (Theme 4-TS-2): Livestock Products, Health and Support Sciences



The Convenor for Technical Session II was Dr. Triveni Dutt, Director, ICAR-IVRI, Izatnagar. The Co-Chairs were Dr. K.M. Bujarbaruah, Former DDG (Animal Science), ICAR & Former VC, Assam Agricultural University and Dr. Kusumkar Sharma, Former ADG (HRD), ICAR. The Rapporteurs were Dr. Krupesha Sharma, ICAR-CMFRI and Dr. Sumitra T.G., ICAR-CMFRI.

Dr. S.B. Barbuddhe, Director, ICAR-National Meat Research Institute, Hyderabad in his invited lecture spoke on 'Meat sector visioning and action agenda for continued food security'. In his lecture, he said that the livestock production is crucial in providing food security and financial stability for more than two-thirds of the population in India. Dr. Barbuddhe said that there is a wide gap between the demand and availability of meat and hence collaborative and concerted efforts in breeding, feeding management and meat value chain would help competitive meat production. He also informed that implementation of traceability in the meat value chain has the potential for boosting export.

Dr. Dheer Singh, Director, ICAR-NDRI, Karnal delivered a lecture on 'Dairy value chain for food and income security'. He said that the dairy industry plays an important role in ensuring food and income security, contributing significantly to the global economy and the well-being of millions of individuals. Dr. Dheer Singh said that the dairy sector faces many challenges like milk price fluctuation, inadequate infrastructure for milk collection and transportation, issues related to animal health and welfare, greenhouse gas emissions and water usage require solutions for sustainable positive impact. Dr. Singh said that efficient and climate-resilient farming techniques, improved animal husbandry, and modern processing infrastructure such as cooling milk cans to prevent spoilage during transportation by vendors are imperative.

Dr. A. Kumaresan, ICAR National Fellow & Principal Scientist, Southern Regional Station of ICAR-NDRI, Bengaluru delivered a lecture on 'Sexed sorted semen for higher production and income security'. He said that skewing sex ratio and obtaining offspring of desired sex has been made possible with the development of fluorescent activated sperm sorting using the differences in DNA content between X- and Y-bearing spermatozoa. Dr. Kumaresan informed that although the flow cytometry-based sperm sorting is commercially used in case of cattle, this technique has its own demerits due to several reasons. Hence, development of an alternate method of sexing of semen that is easy to perform and effective to separate X-bearing spermatozoa with high accuracy is essential. He mentioned that the



enhanced approach does not impact the sperm fertilizing ability and would also reduce the cost of production.

Recommendations

1. Programme on non-bovine milk for nutraceuticals and therapeutic purposes.
2. Operational research on the developed portable slaughterhouses for small animals.
3. Specific programme on rural poultry for doubling the farmers' income.
4. Pilot-scale study on sex-sorted semen - embryo transfer combine for harvesting the benefit of both the technologies.

Theme 5: Horticulture based Transformations of Food Systems

Theme Convenor: Dr. Sanjay Kumar Singh

Technical Session 1 (Theme 5-TS-1): Fruit and Plantation Crops

Theme 5 focused on “Horticulture-based Transformations of Food Systems” was convened by Prof. Sanjay Kumar Singh, Director ICAR-IIHR, Bengaluru. Fruit and Plantation Crops, Vegetable and Tuber Crops, Spices, Ornamental & Medicinal Plants and Nutraceuticals and Value Addition were the four technical sessions.



Co-Chairs of the technical session were Dr. S.D. Shikhamany Prof. N. Kumar. Session Coordinator was Prof. Sanjay Kumar Singh. Dr. Deepu Mathew, KAU and Dr. Shoji Joy Edison, KVK, Ernakulam were the rapporteurs. The keynote lecture was delivered by Dr. Anand K. Singh, Vice Chancellor, CSAU & AUT Kanpur, on “Hi-volume Multiplication of Quality Planting Material for Atmanirbhar Bharat in Fruit Crops”. Dr. S. Uma Principal Scientist, ICAR-NRC on Banana, Thiruchirapally, gave the invited lecture on “Organic Production of Fruits and Plantation Crops”. The next invited lecture was by Dr. Sanjay Kumar Singh, Director ICAR-IIHR, Bengaluru on the topic "Fast Track Breeding Approaches in Fruit Crops for Targeted Genotype Development". He emphasized on fast-track breeding approaches that assisted in overcoming long juvenility in fruit trees via the transgenic expression of the desired genes. He also discussed that fast-track breeding system is still under nascent stage in several fruit crops, and it needs to be explored for hastening the total breeding process especially in perennial fruits for achieving precision in breeding.

The third invited lecture was on “Integrated Approaches for Safe Horticulture Production: Pesticide Residue Management” by Dr. Partha P. Choudhury, Principal Scientist, ICAR-IIHR, Bengaluru. He detailed the aspects of management of pesticide residues at the level of agricultural practices through Good agricultural and agronomic practices, the use of recommended and safer pesticides and formulations, biopesticides and botanicals, integration with non-chemical non-biological devices and the use of Artificial Intelligence for Integrated Pest Management. He also emphasized that weed control in the future will likely involve the use of robots as well as improvements in sensor and plant recognition technology.

The session presentation on “Transmission and Real time detection of viruses (ApMV and ApNMV) associated with mosaic disease of apple (*Malus domestica*)” was delivered by Dr. Sajad un Nabi, Scientist, ICAR-CITH, Srinagar, Jammu and Kashmir. He spoke on apple mosaic disease; a commercially significant viral disease associated with apple cultivation and demonstrated that grafting/budding inoculation methods efficiently transmit both viruses (ApMV and ApNMV).



Recommendations

1. Clean Plant Program of GoI should encompass monitoring of the certified/registered nurseries for genetic fidelity of the scion/ rootstock and freedom from disease.
2. Fast and large-scale multiplication of QPM may be undertaken through public-private partnership taking all stakeholders.
3. Organic production may be confined to fruit crops that are in surplus production and in which the disease and pest pressure is less. Organic production may be for export only since there is a huge demand globally.
4. Multiple disease and pest resistance breeding and gene editing approaches should be given priority since it is profitable to farmers, safe to consumers and environment.
5. Pesticides load on fruits can be reduced by need-based application guided by pest/disease prediction and mass adoption of IPM/IDM modules.
6. Research on bio-fortification and bioremediation needs to be intensified to improve the nutritive value and increasing food safety.
7. Mechanization and small implements need to be developed for reducing drudgery and safe handling of produce in value chain.



Theme 5: Horticulture based Transformations of Food Systems

Theme Convenor: Dr. Sanjay Kumar Singh

Technical Session 2 (Theme 5-TS-2): Vegetable and Tuber Crops



The Co-Chairs of the session were Dr. S.K. Chakrabarti and Dr. S.D. Shikhamany. Session Coordinator was Dr. T.K. Behera. Dr. Anikuttan K., ICAR-CMFRI and Dr. Kalidas C., ICAR-CMFRI were the rapporteurs. The invited lecture was delivered by Dr. Madhavi Reddy K. Principal Scientist, ICAR-IIHR, Bengaluru, focused on "Targeted Breeding of Vegetables for Safe Production" In her presentation, she emphasized the significance of targeted and rapid assembly of beneficial alleles using optimized breeding strategies and precise genome editing techniques for developing ideal vegetable crop varieties for the future. Dr. Madhavi also highlighted the importance of adopting superior varieties and integrating pest and disease management practices to ensure safe and cost-effective vegetable production. Invited lecture, delivered by Dr. Sudhakar Pandey ADG (Hort-II), ICAR, New Delhi, focused on "Gene Editing in Vegetables for Biotic and Abiotic Stress Management." The Session Presentation, by Dr. A.N. Tripathi, Scientist, ICAR-IIVR, Varanasi, focused on "Detection, identification and chemo- sensitivity of seed borne pathogens in vegetable crop seeds." He emphasised the paramount importance of the indicative aspects on the tropical areas for vegetable seed pathologist towards profiling seed borne pathogens and implementing safer seed treatment for the management of seed borne diseases for safe trans-boundary movement of seeds (seeds without border).

Recommendations:

1. Horticultural crops including vegetables, fruits, tuber crops etc. will play an important role in the transformation of food systems in India during Amrit Kaal. Commodity-specific documents on primary horticultural crops covering all aspects of food systems (food supply chain, food environment, individual factors, and food behaviour) indicating road maps for the transformation of Indian Food Systems from rural and traditional to industrialized and stabilized systems may be prepared.
2. To cope with such extreme weather aberrations, the technologies of speed breeding and targeted trait development in both annual and perennial horticultural crops are to be quickly standardized in prioritized crops and targetable traits.
3. Genomic tools are to be harnessed and utilized on priority crops for exploring genetic diversity available in horticultural crops.
4. Seed or planting material-borne pathogens are a big challenge, particularly for horticultural crops, Capacity building for detection and diagnosis of seed-borne pathogens should be emphasized for ensuring the health of horticultural crops within the paradigm of "One Health".
5. Rapid popularization of biofortified root and tuber crops to their fullest potential.

Theme 5: Horticulture based Transformations of Food Systems

Theme Convenor: Dr. Sanjay Kumar Singh

Technical Session 3 (Theme 5-TS-3): Spices, Ornamental & Medicinal Plants



Co-Chairs of the sessions were Dr. K. Nirmal Babu and Dr. K.V Prasad and the Session Coordinator was Dr. R. Dinesh. Dr. Jayasree E., ICAR-IISR, Kozhikode and Dr. Thankam T. Paul, ICAR-CIFRI were the rapporteurs. The keynote lecture was given by Dr. Vinay Bhardwaj, Director, ICAR-NRC on Seed Spices Ajmer, on Total Quality Management in High-Value Spice Production. He emphasised the importance of maintaining hygiene standards to ensure that seed spices remain free from extraneous substances, including pathogenic microbes and defective materials. He concluded that following GAP protocols for the cultivation of spices is essential for yielding superior quality in the harvested produce by growers. The invited lectures were presented by Dr. K.V. Prasad, Director, ICAR-DFR, Pune on Pigments as Components of Functional Foods: Lab to Commercial Production and Dr. D. Prasath, Principal Scientist, ICAR-IISR, Kozhikode, about Nutraceuticals from Indian Spices. Ms. A.M. Simmy, Asst. Professor, AICRP on Floriculture College of Agriculture, Vellanikkara, gave the session presentation on Ornamental Flowers: Potential for future food and health, an investigation. She explored the utilization and the necessity of exploring various nutrients and phytochemicals from edible flowers while also delving into the value-added aspects of these floral products.

Recommendations

1. Target high value compounds for spices, ornamental and medicinal plant and isolation, product development and release into the nutraceutical and cosmetic industry in a stipulated manner.
2. Mainstreaming of different crop nutraceuticals as health supplements with industry.
3. Creating general awareness of food safety and quality by PHT, novel value-added products and small packaging.
4. Strategies to reduce pesticide residues in high-value and native crops and spices and adoption of traceability of safe certified produce.

Theme 5: Horticulture based Transformations of Food Systems

Theme Convenor: Dr. Sanjay Kumar Singh

Technical Session 4 (Theme 5-TS-4): Nutraceuticals and Value Addition



Co-Chairs of the session were Prof. N. Kumar and Prof. Ram Krishna Pal. Dr. V.S. Basheer, ICAR-NBFGRI was the rapporteur. The keynote was delivered by Dr. Ram Krishna Pal, Former Director, ICAR-NRC on Pomegranate, Sholapur, Maharashtra, on the Application of Sensors, New Molecules, and Smart Packaging in PHM of Horticultural Crops. He spoke about the significance of sensors, new molecules, and intelligent packing in the post-harvest management of perishable horticultural products emphasising their vital role in the artificial intelligence arena. He highlighted some critical issues in using technologies in post-harvest management.

Dr. T. John Zachariah, Former Director and Principal Scientist ICAR-IISR, Kozhikode, in his invited lecture on the Potential for the Development of Functional Food and nutraceuticals from Horticultural Crops highlighted the concept of food that goes beyond basic nutrition which help in minimizing the risk of certain diseases while enhancing overall health and well-being. He spoke about various fruits and vegetables which serves as good sources for the development of functional foods and nutraceuticals.

Dr. R.T. Patil, Chairman of the Benevole Welfare Society for Post-Harvest Technology, Bhopal delivered a presentation on the exploration of Novel biomolecules from horticultural crops and their significance in the field of therapeutics and health benefits. He placed particular emphasis on the effective use of biomolecules from the horticulture products in the context of cancer treatment, cardiovascular treatments, and diabetic and neurological treatment. He also addressed the associated challenges including the issues related to bioavailability, safety, and the standardization of these biomolecules.

Dr. Anindita Paul, Scientist, ICAR-CTRI, Rajahmundry in the session presentation on Response surface methodology and Genetic Algorithm guided ultrasonication resin-assisted purification of anthocyanin elaborated on the application of ultrasonic-assisted absorption (UAA) for the effective absorption of anthocyanin resin in plant-based nutraceuticals. She mentioned the establishment of resin-based absorption technology on an industrial scale, which has seen limited systematic optimization, holds promise.

Recommendations

Researchable issues:

1. Scavenging post-harvest losses of horticultural crops by creating awareness on “Know your produce” on what, how, and when to harvest using various sensors.
2. A program to study the maintenance and delivery of functional foods by encapsulation or other means without loss of quality.
3. Clinical trials on bioavailability of nutraceuticals through collaboration.



4. Non-destructive sensors for detection of latent infection in fruits
5. Sensors for detection of spongy tissue/jelly seed in mango
6. Resin-assisted extraction of anthocyanin

Policy issues:

1. Competent authority should consider the approval of the use of 1-MCP as a potential ethylene inhibitor by declassifying this molecule from the group of insecticides since it is widely accepted in most of developed countries for extending the green life of horticultural produce.
2. Data on functional food components should be made available during the release of any new variety.

Theme 6: Aquaculture & Fisheries-based Transformation of Food Systems

Theme Convenor: Dr. J.K. Jena

Technical Session 1 (Theme 6-TS-1): Aquaculture Systems & Fisheries

The session was Co-Chaired by Dr. K. Gopakumar, former DDG (FS), ICAR and Dr. B.K. Das, Director, ICAR-CIFRI, Barrackpore. Dr. Shoba J. Kizhakudan, Pr. Scientist & HoD, ICAR-CMFRI was the session co-ordinator. The rapporteurs of the session were Dr. Muktha Menon, ICAR-CIFRI and Dr. Deepa Sudheesan, ICAR-CIFRI.



Dr. Rishi Sharma, FAO, Fishery and Aquaculture Policy and Resources Division, Rome, Italy presented the keynote address on “BLUE TRANSFORMATION: Building a world without hunger and poverty with aquatic foods”. He emphasized the need for innovation in feed ingredients as well as feeding technologies and use of digital technologies comprising intelligent systems for aquaculture improvements in India. Further he stressed upon the need to support the integration of fisheries related policies in global, regional and national development agendas (cross-sectoral, multi-risk, food systems). Facilitate the development of organizational, technical and business skills of small-scale food producers, including women and youth groups, their organizations and institutions for equitable and effective participation in decision-making processes, resource management and value chain development will help in sustainable development of the fisheries sector. Dr. J.K. Jena, Deputy Director General, Fisheries Science, ICAR presented an invited lecture on “Sustainable Aquaculture & Fishing Practices: A Key Driver of Food Security in the 21st Century”. He outlined the Indian fisheries scenario and attainable SDG 2030 targets for fisheries and Aquaculture in India. He emphasized the need to increase the development and adoption of sustainable aquaculture practices, integration of aquaculture into national, regional and global development strategies and food policies. He also stressed the expansion and intensification of aquaculture production by adopting smart technologies and improving capacities at all levels to develop and adopt innovative technology. Dr. Salin Krishna, Chair, the Aquaculture Program at the Asian Institute of Technology, Bangkok, Thailand presented an invited lecture on “Aquaculture to Improve Nutrition and Food Security in Developing Countries”. He presented a brief overview of the world population at present and the projected demand for protein requirement. He emphasized the need to apply innovations including digital applications to increase crop yield in Agriculture and allied sectors. He underlined the importance of protein as well as the nutritional value of seafood among all meat produced over the world. He presented an overview of aquaculture production from Asia, Africa and South America. He stressed upon the important role played by small-scale farmers in developing countries in alleviating poverty. There is a need



for a sustained increase in seafood production to cater to the ever-increasing demand for aquatic food.

Dr. E Vivekanandan, Former Head, ICAR-CMFRI presented an invited lecture on “The Intersection of Climate Change and Fishery Management: Opportunities for Sustainable and Resilient Fisheries”. He outlined climate change and its impact on fisheries, which is presently at the intersection of sustainability and climate change. He stressed upon integration of adaptation measure required at local and national levels by mainstreaming climate change into fisheries policy and management using climate smart technologies, green fishing, ecosystem approach, and improved fish value chains, access to affordable insurance, gender equity, and safety at sea. He emphasised that sustainability of fisheries vis-à-vis climate change impacts could be achieved by implementing effective fisheries management and policies to address ecological, social and economic benefits; ensuring equitable access to resource and services to enhance livelihood of fishers; ensuring efficient value chains to reduce food loss, and increase profitability; increasing consumption and access to healthy, safe and high quality aquatic food particularly in areas with low food and nutrition security; improving accessibility of aquatic food products to international markets; and ensuring effective regional and global cooperation.



Theme 6: Aquaculture & Fisheries-based Transformation of Food Systems

Theme Convenor: Dr. J.K. Jena

Technical Session 2 (Theme 6-TS-2): Genetics, Health & Nutrition



The session was Co-Chaired by Dr. Iddya Karunasagar, Former FAO Expert & Sr. Director (International Relation), NITTE University, Mangaluru and Dr. P.K. Sahoo, Director, ICAR-CIFA. Dr. Imelda Joseph, Principal Scientist, ICAR-CMFRI, Kochi was the session co-ordinator. The rapporteurs of the session were Dr. Krupesha Sharma, ICAR-CMFRI and Dr. Sandhya Sukumaran, ICAR-CMFRI.

Dr. Eric-Jan Lock, Research Director, Nutrition and Feed Technology NOFIMA, Norway, presented a keynote address on “Fish Feed: Innovations for Driving Sustainable Aquaculture Growth”. He outlined the importance of feed and the ingredients used in the formulation of aquaculture feed. He explained in detail the various drivers for feed development during the evolution of aquaculture development. Traditionally, the drivers of feed development revolved around considerations such as nutritional quality, price and safety, however now these drivers include footprints, competition with food and biofuel and changing consumer awareness and potential inclusion of new factors in the future like high quality, low-trophic animal proteins, lower quality fermentation products used in bulk. However, he stressed the critical need for innovative approaches to the development and increased production of new ingredients to meet the growing demand for aquaculture feed.

Dr. Morten Rye, Director of Genetics, Benchmark Genetics, Norway presented an invited lecture on “Leveraging Technology for Genetic Improvement in Aquaculture Production”. He outlined the importance of a selective breeding program in aquaculture as a crucial strategy for sustainable achievement of global seafood production targets. Selective breeding programs serve as a powerful mechanism for specific traits. He emphasized the use of integrated technology of both conventional selective breeding methods as well as genomic tools for trait improvements in aquaculture.

Dr. Kuldeep K. Lal, Director, ICAR-CIBA, Chennai presented an invited lecture on “Fish Biotechnology Options for Transforming Aquaculture”. He opined that new biotechnology exploits the potential of aquatic life diversity to access new genes, new molecules, microorganisms and understanding of mechanisms. He stressed the need for interdisciplinary collaboration to meet the expectations and challenges. So future research focused on translating genomes into functional and phenotypic information will form solutions to challenges in aquaculture. He stressed that the field of aquatic biotechnology is nascent but has established itself as an important scientific and innovation field providing for nutritional and economic security.

Dr. Neeraj Sood, Principal Scientist & HoD, ICAR-NBFGR, Lucknow presented an invited lecture on “Technological Advancements and the Promise of Innovations towards Emerging



Threats to the Fish Health in Aquaculture Systems”. He presented an overview of disease prevalent in aquaculture system and the different protocols used for their detection. He also opined that sustainable aquaculture is essential for global food security. However, global aquaculture faces disease threats, including emerging ones. Recent pandemics highlighted global inter-connectedness and shared threats. He stressed that these issues should be addressed with national/regional/global cooperation. Further he emphasized that improved aquatic health management will be the key for food security.

Theme 6: Aquaculture & Fisheries-based Transformation of Food Systems

Theme Convenor: Dr. J.K. Jena

Technical Session 3 (Theme 6-TS-3): Processing, Value Addition, Quality Control & Social Sciences



The session was Co-Chaired by Dr. B. Meenakumari, Former DDG (FS), ICAR & former chairperson, NBA, and Dr. Bimal Mohanty, ADG (I. Fy), ICAR. Dr. Toms Joseph, Principal Scientist, ICAR-CMFRI, Kochi was the Session co-ordinator. Dr. Aswathy N., ICAR-CMFRI and Dr. Tanuja Abdulla, ICAR-CIFRI were the rapporteurs.

Prof. (Dr.) Soottawat Benjakul, Professor, Prince of Songkla University, Thailand, presented the keynote address on “Advancements in Seafood Preservation: Ensuring Safe and Nutritious Fish Products”. He detailed the quality losses happening to seafoods and products while handling, processing and storage. He opined that non-thermal processes can be used instead of thermal process to maintain the sensory and nutritive property of seafoods, while assuring safety and quality. Further, he suggested the use of safe additive in combination with non-thermal processing technology to tackle the undesirable problems and can provide the synergistic effect on quality improvement and shelf-life extension.

Dr. Ravishankar C.N., Director, ICAR-CIFE, Mumbai, presented an invited lecture on “Innovations in Fish Processing Technology for Increasing Efficiency and Reducing Wastage”. He emphasised the transformation in aquatic food systems to support the need of ever-growing population for a healthy and sustainable diet. This necessitates industries to shift their focus beyond traditional frozen products. Further, he stressed the need for product diversification, exploration of new markets, value addition, increasing exports, complete utilization of harvested catch, effective waste utilization and reduction in post-harvest losses. He recommended the need for innovations in processing and packaging machineries/tools/instruments and also in supply chain management & logistics. He urged the adoption of advanced technologies like blockchain, machine learning, big data analysis, IoT, imaging technology, as means to enhance the fish processing efficiency.

Dr. Holly Hapke, Director of Research Development School of Social Sciences, University of California, Irvine, presented an invited lecture on “Gender in Fisheries & Aquaculture: Driving Transformational Change for Food Systems”. During her presentation, she expounded upon the existing knowledge in this field and presented an agenda for advancing gender and fisheries science research to drive transformational change in food systems. She pointed out that women’s involvement in the fisheries and aquaculture sector remains invisible, and they are notably excluded from national development policies and programs. The neglect of post-harvesting activities and the exclusion of women from research and



policy have created gender inequities and differential impacts on men and women – often to women’s detriment. She emphasised that the failure to account for sex, gender and other social factors in fisheries and aquaculture research results in weak science and, often, policy failure. Such failures also hinder transformations of food systems required to attain sustainable development goals. She stressed that the incorporation of gender analysis in fisheries and aquaculture research is not only essential for achieving social equity in the sector but is also critical for the development of robust fisheries and aquaculture science.

Recommendations

1. Expansion and intensification of mariculture using new-generation smart technologies for effective resource utilizations and sustainable production.
2. Effective and scientific management of open water fisheries including climate-resilient adaptations.
3. Integrated trait improvements through conventional selective breeding and genomic tools.
4. Reducing carbon footprint in aquaculture practices and systems.
5. Strategic action for reduction of post-harvest losses in fisheries.
6. Novel food preservation methods using promising non-thermal technologies.
7. Broadening and deepening the scope of gender analysis in fisheries and aquaculture research.

Theme 7: Nature-based Solutions for Sustainable Agri-food Systems

Theme Convenor: Dr. Anil K. Singh

Technical Session 1 (Theme 7-TS-1): Water Harvesting and Enhancing Water Productivity



The session was co-chaired by Dr. M. Madhu, Director, ICAR-IISWC, Dehradun and Dr. K. G. Mandal, Director, ICAR-MGIFRI, Motihari. Dr. P.S. Brahmanand, Project Director, WTC ICAR-IARI was the session co-ordinator. Dr. Rema Madhu, ICAR-CMFRI and Dr. S. Ramkumar, ICAR-CMFRI were the rapporteurs.

Dr. A.K. Sikka, Representative, IWMI, New Delhi & Former DDG (NRM) presented the keynote address on “Enhancing Water Productivity – A Pathway for Transforming Agri - Food Systems”. He emphasized the significance of water conservation. He also highlighted the potential for rainfed districts in India, with low access to irrigation, to harvest water and enhance water productivity to increase yield and physical water productivity (PWP). He emphasized the need for policy support to increase micro irrigated areas. He also stressed the need for estimation of worth of natural resources especially with respect to the water resources. Both rainfed and irrigated areas with water stress should consider diversification to high value drought tolerant crops to increase the economic water productivity and to increase income under normal climatic conditions and enhance resilience under drought conditions. Prof. Vinay Nangia, Research Leader, ICARDA presented an invited lecture on “Nature Based Solution for Climate Smart Water Management”. He emphasised that drylands are reported to be among the most vulnerable to land degradation caused by climate change and anthropogenic activities. Approximately 41% of the Earth’s land area is classified as dryland, characterised by low annual rainfall with a significant portion occurring in the winter and spring. He underscored the importance of Nature-based solutions (NbS) that conserve water, withstand climatic challenges, produce highly nutritious food, and benefit the environment. He narrated ICARDA’s successful initiatives in this regard, relating to valuation of ecosystem services in Aral Sea Basin to improve agricultural water productivity in Central Asia, micro-catchment rainwater harvesting in West Asia, improving khadin-based systems in Rajasthan, conservation agriculture in North Africa, etc. Dr. S.P. Wani, Former Director, ICRISAT development centre ASIA delivered an invited lecture on “Innovations in Rainwater Harvesting Technologies and their Utilization”. In his introductory remarks, he mentioned that globally about four billion people live under conditions of severe physical water scarcity and about 80% of the world agriculture relies on rain-fed systems, with India's figure standing at 55%. Hence, the management of rainwater must be innovative, efficient and science based. He stressed the importance of integrated watershed management, optimizing the utilization of green water (soil moisture),



rainwater harvesting, and its efficient application through drip and sprinkler irrigation, using IT-based solutions/Apps. He urged that Researchers and extension staff must adopt a demand-driven approach rather than a supply-driven approach for providing integrated solutions to farmers' complex issues. Dr. P.S Minhas, Former Director, ICAR-NIASM, Baramati presented an invited lecture on “Managing Poor Quality Water for Sustainable Agri-foods Systems”. He provided valuable insight into the utilization of non-conventional waters like the brackish groundwater, saline drainage water, and wastewaters to address excessive groundwater withdrawals. He also emphasized the risks associated with the indiscriminate use of these waters and the absence of proper soil–water–crop management strategies which can significantly risk soil health and environment.

Recommendations

1. Periodical assessment of water bodies/water harvesting structures is needed to understand the real status for further maintenance or revival.
2. The status of physical water productivity of different crops grown under green, blue and grey water may be the priority areas for making strategies for enhancing water productivity.
3. Water should be treated as “One Water” like One Health to create changed positive attitude towards water which enables water conservation and increasing its productivity.
4. State/regional level policies and regulations are to be followed with latter and sprit with respect to water including legal stringent measures.
5. Holistic approach and strategies are required starting from R&D activities to the stakeholders' adoptions of technologies for efficient management of water to have higher water productivity by following circular economy models.

Theme 7: Nature-based Solutions for Sustainable Agri-food Systems

Theme Convenor: Dr. Anil K. Singh

Technical Session 2 (Theme 7-TS-2): Soil Health and its Restoration



The session was Co-Chaired by Dr. Sammi Reddy, ICAR-NIASM, Baramati and Dr. R.K. Yadav, Director, ICAR-CSSRI, Karnal. Dr. S.P. Datta, Director, ICAR-IISS, Bhopal was the session co-ordinator. Dr. Sumithra T.G., ICAR-CMFRI and Dr. R. Vinothkumar, ICAR-CMFRI were the rapporteurs.

Dr. B.S. Dwivedi, Member (NRM), ASRB presented keynote address on “Soil health enhancement for sustainable agriculture production”. During his presentation he emphasized the need for properly addressing multinutrient deficiency of soil. He also highlighted the importance of identifying soil pollutants beyond heavy metals, such as microplastics. He opined that a better understanding of soil biodiversity and biological processes may help harnessing the same to develop low-cost and eco-friendly soil management options. Enabling policy support and investment would be inevitable to ensure faster development, dissemination and adoption of the technology recommendations. Furthermore, he stressed the importance of implementing Artificial intelligence-based technologies for soil health only after developing proper database (spectral imaging, drones, sensors).

Dr. Mohan Kumar, Former Vice Chancellor, Arunachal University of Studies has presented keynote address on “Agroforestry: A nature-based solution for mitigation and adaptation to climate change”. He emphasized the need for a policy for Conversion of degraded land to agroforestry. Implementing a green credit program is essential. Agroforestry also plays a significant role in lowering the vulnerability of agricultural production systems by imparting enhanced resilience. The promotion of agroforestry through integrated farming practices holds great promise. Additionally, there should be encouragement for the production of Biofuel production from agroforestry. Agroforestry also can serve as stepping stones and refuges for biodiversity conservation, he opined.

Dr. Ch. Srinivasa Rao, Director ICAR-NAARM has presented an invited lecture on “Carbon farming opportunities and action plan towards achieving SDGs in India”. During his lecture, he emphasized the need for location-specific cover crop requirements to improve soil health and carbon sequestration. He advocated the promotion of farmer-producer organizations for carbon farming to decrease crop residues. He also opined to adopt conservation agriculture and resource conservation technologies. To encourage farmers to use CF technologies, knowledgeable advising services, reliable soil tests, identification of the challenges and solutions on a local basis, incentives and subsidies for carbon farming



farmers are pivotal to ultimately attain the goals of sustainable agricultural productivity and soil management. Furthermore, he underscored the need for policy and programmes with long-run investments to identify and implement appropriate CF techniques through collective decisions with participation of government and NGOs, researchers, with community participation as a central focus.

Prof. A.R. Podile, Senior Professor, University of Hyderabad delivered an invited lecture on “Microbiome-based approaches for sustainable agriculture”. He provided an overview of Microbiome-based approaches, rooted in the study of microbial communities inhabiting agricultural ecosystems, which have emerged as a key component of Nature-based solutions NbS. Agricultural microbiome research must be tailored to increase crop health and production. It was emphasized that microbiome research aids in enhancing crop resilience against diseases and climatic stressors, thereby bolstering the adaptive capacity of agri-food systems in a changing climate. As microbiome research advances there is a need for microbiome engineering research in agriculture for harnessing their benefits.

The talk by Mr. Shailendra Singh, COO, M/S Zydex agro solutions on “Technological improvement in soil health” explained the importance of using Zytonic technology to improve soil health.

Recommendations

1. Need to develop protocols for quantifying soil organic carbon and carbon sequestration in different agri-food systems for encashing carbon credits.
2. Establishing Real time Soil Information System and Centre for soil carbon research at national level.
3. Systematic research is needed on soil pollution and its impact and management for sustainable agri-food systems.
4. Devising policy for promoting agro-forestry in waste lands with a concept of sustainable wood for sustainable agro-ecosystems.
5. Promoting integration of carbon farming and resource conservation technologies (RCTs) in rainfed areas for circular carbon economy to achieve SDGs.
6. Exploitation of plant microbiome-based products for mitigating abiotic stresses in crop plants.
7. Cutting edge research is needed on rhizosphere microbiome management to understand its role in mitigating climate change/variability.
8. Need to evaluate and validate the zytonic technology developed by M/s Zydex Agro Solutions for soil and plant health improvement in multi-location trials under diverse soil and production systems.

Theme 7: Nature-based Solutions for Sustainable Agri-food Systems

Theme Convenor: Dr. Anil K. Singh

Technical Session 3 (Theme 7-TS-3): Ensuring Nutritional Security through Natural Resource Management



The session was Co-Chaired by Dr. O.P. Yadav, Director, ICAR-CAZRI and Dr. V.K. Mishra, Director, ICAR-RC, NEH. Dr. N. Krishna Radhika, ICAR-CTCRI and Dr. B. Johnson, ICAR-CMFRI were the rapporteurs.

Dr. Suresh Kumar Chaudhari DDG (NRM), ICAR, presented a keynote address on ‘Addressing Nutritional Security through Natural Resource Management’. He described the need for a strategic plan and policy implementation specific to diverse agro-ecological zones to attain sustainable nutritional security. He emphasized empowering women, increasing agricultural productivity and enhancing income to attain sustainable food and nutritional security and creating nutrition awareness among stakeholders. Several NRM interventions like soil and land management, and agro forestry have a key role in nutrient contents in the soil that ultimately affects the nutritional quality of the crop. Healthy soil is the starting point to produce nutritionally superior crops.

Prof. Indira Sarangthem Dean, CoA, CAU, Imphal, presented an invited lecture on “Prospects of Nature-based – Solutions for Climate Resilient Agriculture”. In her talk, she proposed nature-based solutions that can be attained through an integrative approach comprising of five “A”s - Aquaculture, Agriculture, Apiculture, Animal-based model and Agroforestry, citing examples from the NE Region. She suggested that the farm production diversity using these approaches can enhance dietary diversity and improve soil organic matter that ultimately contributes to nutritional security.

Dr. G. Ravindra Chary, ICAR-CRIDA, Hyderabad presented an invited lecture on “Food and Nutrition Security in Rainfed Ecosystems”. He highlighted the advantages of rainfed agroecosystems having a rich biodiversity. Improved soil moisture and integrated farming systems were also stressed to increase productivity, economic upliftment, and employment generation. He suggested breeding improved varieties with abiotic stress resistance, and biofortified crops for rainfed ecosystems to attain sustainable nutritional security.

Dr. Anil K. Singh, Vice-President, NAAS has presented an invited lecture on “Criticality of Soil and Water in ‘One Health’”. In his lecture, he emphasized the importance of one health, comprising soil health, and water health, that impacts animal and human health and environmental health in general. He particularly recommended that site-specific nutrient management include micronutrient management, ensuring the soil's health, which is a



basic requirement of one health concept that can lead to the nutritional security of the society. He has also recommended the integrated efforts of agronomic and genetic-based approaches to attain nutritional security.

Mr. Gulshan Rana of M/s Bayer presented the topic ‘Advancing Sustainable Climate Smart Resilient Agriculture Eco-system in India (Industry)’. He commented on the impact of using newer technologies like drone applications and direct-seeded rice as potential alternative and sustainable methods. It was mentioned that companies in private sector are taking interest in sensitizing the farming community and other stakeholders for carbon trading and sustainable management of natural resources to attain the nutritional security.

Recommendations

1. Several NRM interventions influence the availability and efficiency of both macro- and micro-nutrients in the soil profile. Thus, they have critical role to play in augmenting nutritional security. To fully harness their potential, clearcut strategic plan and enabling policy framework are required for diverse agroecological situations.
2. The agronomic practices and breeding approaches should work in an integrated way to increase the food production and to enhance nutritional security.
3. ‘One Health’ concept is the need of the time. Deficiency, toxicity and efficiency of nutrients are to be addressed in a comprehensive way in the promotion of ‘One Health’ concept.
4. The efficient and need-based use of available natural resources is essential for attaining sustainable nutritional security.



Theme 8: Next Generation Technologies: Digital Agriculture, Precision Farming and AI-based Systems

Theme Convenor: Dr. Rajender Parsad

Technical Session 1 (Theme 8-TS-1): Digital Agriculture

The session was Co-Chaired by Dr. R.C. Agrawal. Session Coordinator was Dr. Alka Arora. The session had one keynote lecture by Dr. J. Adinarayana and four invited lectures. Dr. Eldho Varghese, ICAR-CIFRI and Dr. K.G. Mini, ICAR-CIFRI were the rapporteurs.



In the keynote lecture on 'AIIA (Assimilate, Interpret, Innovate and Adapt) Model in Smart Agriculture', Dr. J. Adinarayana highlighted the need for adapting cutting edge technologies in Precision Agriculture for amending of the existing tried-and-tested technologies employed in agriculture with a substantial quotient of innovativeness to address the issues on Food security Vs climate change. Dr. E. V. S. Prakasa Rao, in his invited lecture on 'Digital agriculture for agri-food systems disruption in India-Prospects and problems' explained how digital agri-food systems could help meet the Sustainable Development Goals. Dr. Ajit Govind in his lecture on 'Digital Transformation of Agricultural Sector in the Global Drylands: Digital Tools, Stakeholder Engagement, and Scaling' highlighted the digital technology in transformation of global agriculture. The invited lecture on 'Getting ready for Next Leap in Precision- AG Innovations: Challenges and Opportunities' by Dr. Rabi N. Sahoo, highlighted the challenges and opportunities in future agri innovations based on precision agriculture systems. The invited lecture on Compact field-savvy instrument for rapid detection of aflatoxins-B1 in maize using a hyperspectral imaging system with machine learning by Chakraborty, S. K., the hyperspectral imaging, which is a popular non-invasive technique for detection of fungal contamination in food grains, was explained.

Recommendations:

1. Emphasis should be laid on Data platforms / Spaces databases with standardized formats and SOP's for quality data following FAIR principle along with advanced analytics to assimilate, interpret, innovate and adapt for smart farming.
2. Need for inter-disciplinary and inter-stakeholder collaborations (inclusiveness or PPPP model) to scale up infrastructure and improve informatics & sharing culture in Agriculture Systems, which will help in more innovations and open solutions.
3. Need for methods, models, and hardware/software solutions for creating and actualization of digital clones of crops that ensure the possibility to perform virtual biological experiments with evaluation and forecasting of parameters that have an effect for the further field setting and adaptation of plants in conditions of natural environment and climatic factors.



4. Scaling digital actions with the right enabling environment policies taking the benefits to the last mile.

Theme 8: Next Generation Technologies: Digital Agriculture, Precision Farming and AI-based Systems

Theme Convenor: Dr. Rajender Parsad

Technical Session 2 (Theme 8-TS-2): Artificial Intelligence based Systems.

The session was Co-Chaired by Prof. Gajendra Singh and Dr. Anil K. Singh. The session had one keynote lecture by Dr. Sanjay Chaudhary and three invited lectures. Dr. Sreenath K.R., ICAR-CIFRI and Dr. Abdul Azeez, ICAR-CIFRI were the rapporteurs of the session.



In the keynote lecture on Artificial Intelligence systems for agriculture, Dr. Sanjay Chaudhary explained how concepts of Artificial Intelligence can be used to develop intelligent systems to solve agricultural problems. During the invited lecture on Artificial Intelligence: Case studies in Indian agriculture, Dr. Alka Arora described various case studies and opined that the incorporation of AI into agriculture stands as a promising avenue to revolutionize the industry and usher in a more sustainable and resilient future. Dr. Satyajit Dwivedi, in his invited lecture on ‘Opportunities and challenges in application of AI in building innovative climate smart digital agriculture solutions’, discussed a comprehensive data quality process to enhance the accuracy of the models and a social network based agromet advisory framework for effective roll out of climate smart digital agriculture solutions. Dr. J. Jayasankar explained the application of AI tools in harnessing marine fisheries in his invited talk on ‘Charting the Future of Marine Fishery Resource Management: Harnessing Artificial Intelligence Systems for Exploration and Sustainable Utilization’.

Recommendations:

1. The computational infrastructure, particularly GPU/NVIDIA should be strengthened multifold so that researchers in AI and stakeholders can benefit.
2. Data acquisition and Data quality should be key words and SOPs mechanism for data quality should be in place.
3. AI applications in Plant Phenomics, disease and pest identification should further be strengthened for the benefit of stakeholders.
4. Strengthened efforts should be made to develop Centre of Excellence in AI with Hub and spoke model. The capacity building in AI should be a priority

Theme 9: Role of Policies and Institutions in Transforming Agri-food System

Theme Convenor: Dr. P.K. Joshi

Technical Session 1 (Theme 9-TS-1): Food System Transformation: Role of Policies and Institutions

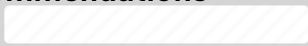


Co-Chair of the session was Dr. P.S Birthal. Session Coordinator was Dr. R. Sendhil. Dr. Solomon Rajkumar, ICAR-CCARI and Dr. S. S. Raju, ICAR-CMFRI were the rapporteurs. The keynote lecture was given by Dr. P. Pingali Professor and Founder Director TCI Cornell, on Food system transformation in India: Role of Policies and Institutions. He highlighted challenges in India's food system transformation, including meeting dietary diversity demand, promoting diverse food systems for better nutrition, affordability of nutritious food for the poor, and enhancing nutrition-sensitivity in safety net programs. He emphasized on the top five policy priorities, including reorienting agricultural policy for food system diversity, connecting small farms to urban food value chains, investing in value chain infrastructure, reimagining food-based safety net programs, and enhancing consumer demand for healthy diets.

The first invited lecture on Bio-fortified Food Commodities in the Food System for Achieving SDGs: Role of Policies and Institutions was by Anjani Kumar, South Asia Regional (SAR) Office International Food Policy Research Institute. He outlined that bio fortification is a pivotal and cost-effective means to reduce micronutrient malnutrition and under-nutrition in developing countries, establishing its feasibility as a key intervention. He emphasized that the critical factors for promoting the success of bio-fortification include achieving a balance between high and stable micronutrient density, crop yield, and productivity at comparable costs, demonstrating efficacy for human health, and ensuring adoption by both farmers and those affected by micronutrient malnutrition. He underscored that the proposed interventions are all supply-side oriented and can significantly address hidden hunger in India.

The second invited lecture featured "Sowing Sustainability: G20's Vision for Agri-food Transformation on One Earth, One Family, One Future" by Dr. Smita Sirohi, former Joint Secretary (G-20) at DAFW and currently serving as a Principal Scientist at ICAR. During her presentation, she outlined the priority areas of the G20 Agriculture working group, discussed principles related to food security and nutrition, and highlighted international research initiatives focused on millets and other ancient grains, all aimed at enhancing both nutritional value and food security.

Recommendations





1. Inter-Ministerial convergence is required to mitigate hunger and to achieve nutritional goals, policy and operational strategies.
2. Adequate infrastructure investment in drinking water, sanitation, hygiene practices are essential for overall health and nutritional status.
3. Formulating inclusive policies for women empowerment.

Theme 9: Role of Policies and Institutions in Transforming Agri-food System

Theme Convenor: Dr. P.K. Joshi

Technical Session 2 (Theme 9-TS-2): Diet Diversification and Food System Transformation



Co-Chairs of the session were Dr. Puranjan Das & Dr. C. Ramasamy. Session Coordinator was Dr. R.K. Singh. Rapporteurs of the session were Dr. Sanal Ebenezer, ICAR-CMFRI and Dr. Chandrasekhar S., ICAR-CMFRI. The keynote lecture delivered by Dr. P. Das, Former Deputy Director-General of Agricultural Extension at ICAR, New Delhi, focused on "Balancing Food Demand and Ecological Sustainability." In his presentation, he provided an overview of the science of sustainability, the different categories of farming systems, the properties of sustainable agroecosystems, and the impact of agricultural sustainability. He also discussed technologies and practices, the advantages of sustainable agroecosystems, and various approaches to sustainable natural resource management. Additionally, Dr. Das summarized the key issues to be addressed for achieving sustainable agriculture in the future. He emphasized the importance of adapting approach choices to suit local contexts and priorities for effective implementation. Furthermore, he stressed the need for standardized metrics to assess and monitor the environmental performance of these approaches, covering aspects such as labor, productivity, profitability, yield gaps, scalability, uptake, and the balance between public and private investments in sustainable land use, and highlighted the need for improvement in this regard.

In the invited lecture, delivered by Dr. Surabhi Mittal, an Economist at Asia Nutritional International, the focus was on "Diversification of Food Diets through Social Safety Net Programs." She underscored the essential need for dietary diversification and the improved intake of micronutrients to achieve holistic growth and nutrition. Dr. Mittal also presented a comprehensive gap assessment analysis of public health and nutrition, based on a study conducted in Telangana. She emphasized that for successful dietary diversification, a critical factor is aligning it with local preferences and availability, coupled with raising awareness and enhancing nutrition literacy among beneficiaries.

The invited lecture, by Dr. Shalander Kumar, Deputy Global Research Program Director at ICRISAT, focused on "Food System Transformation in Marginal Environments." Dr. Kumar highlighted the intricate food system already in place and the urgent need for its transformation, mainly due to the threats posed by climate change and environmental degradation. He underscored that achieving a sustainable and healthy diet in a transformed food system necessitates addressing four key factors: availability, accessibility, affordability, and desirability. Additionally, he outlined the challenges associated with food transformation in marginal environments, which are especially vulnerable to the impacts of



climate change. Dr. Kumar's presentation emphasized that the heterogeneity in agri-food systems within marginal environments must be considered when designing food system transformation strategies. He also stressed the importance of understanding the rural food environment to craft food systems that promote healthy and sustainable diets. He concluded by emphasizing that low-chemical-input farming and natural, regenerative agriculture hold promise for marginalized environments.

Recommendations

1. Heterogeneity in the agri-food systems within marginal environments needs to be factored while designing the food system transformation strategies.
2. Dietary diversification in the social safety net programs is crucial for enhancing nutritional status of pregnant and lactating mothers and children under the age of 5 and they need substantial support to achieve the goal.

Theme 9: Role of Policies and Institutions in Transforming Agri-food System

Theme Convenor: Dr. P.K. Joshi

Technical Session 3 (Theme 9-TS-3): Agri-food System Transformation towards High-value Commodities



Technical Session 3 focused on "Agri-food System Transformation Towards High-Value Commodities" and included two presentations. Dr. R. Kirubasankhar, ICAR-CIARI, Port Blair was the rapporteur of the session. The keynote lecture, delivered by Dr. P.S Birthal, Director of NIAP, centered on "Policies and Institutions for Transforming High-Value Food Commodities." In his presentation, Dr. Birthal emphasized the imperative need for transformation, highlighting its role in enhancing farmers' incomes, addressing malnutrition, averting natural resource degradation, and mitigating climate change. He provided an insightful overview of the trends in Indian agriculture, including growth in agricultural value of output, changes in the product portfolio, per capita consumption, and net returns from crops. Dr. Birthal also offered details about Farmer Producer Organizations (FPOs) and their commodity coverage in India. Furthermore, he underscored the challenges faced in the livestock sector and the disparities in investment compared to the crop sector. In his presentation, Dr. Birthal shed light on the vulnerability of Indian agriculture to climate change and discussed adaptation and mitigation strategies to combat this global challenge. He emphasized that the transformation should shift the focus from food production to resilient food production, from food security to nutritional security, and should encompass improvements in value chains and changes in policies to promote resilience and nutrition.

The invited lecture by Dr. Seema Bathla, Professor at Jawaharlal Nehru University, addressed the topic of "Changing Patterns of Demand for Agri-processed Commodities." Her presentation highlighted shifts in food consumption patterns, the challenges of meeting processed food demands from both international and domestic markets, and policy implications. She emphasized that dietary transitions signify prosperity and that diversified diets contribute to the adoption of technology and higher agricultural growth, emphasizing the need for sustainable practices. Furthermore, she observed a changing structure and trends in the consumption of primary and processed foods, with growth seen in dairy/livestock products and processed items like juices. There is minimized reliance on global markets for imports, however, reduced support to primary foods affects farmers' gains, while high protection for processed foods hinders consumer benefits from lower global prices. Changes in trade relations or trade dependencies can leave farmers and consumers vulnerable to price fluctuations and subsidized imports may harm livelihoods and food availability. Addressing the challenges involves making processed food affordable



through public health campaigns and food safety awareness while promoting cost competitiveness in the food industry with fiscal incentives, technological upgrades, and stringent regulations. Additionally, enabling diversification and agri-value chains necessitates addressing pre/post-harvest requirements, reducing food losses, and fostering sustainable practices, along with innovative financing for stakeholders in the value chain.

Recommendations:

1. To increase investment in cold storage, refrigerated vans, food processing sector and Agricultural Research and Development
2. To strengthen Agri-industry-service linkages through production-linked incentives and improve credit supply to organized and unorganized enterprises.

Theme 10: International Partnership for Research, Education and Development

Theme Convenor: Prof. Kadambot Siddique

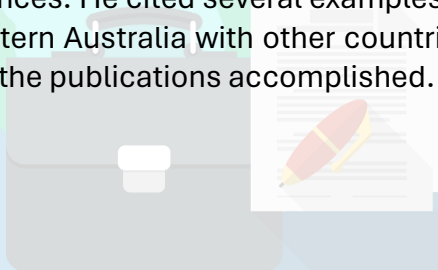
Technical Session 1 (Theme 10-TS-1): International Partnership for Research, Education and Development



Theme 10 focussed on the strategies to be evolved for effective international partnerships in the field of agricultural research, education and development. This theme had only one technical session (TS-1).

The Theme Convenor was Prof. (Dr.) Kadambot Siddique, Professor at the University of Western Australia, and the Co-Chairs were Dr. R.S. Paroda, TAAS, India and Prof. R. B. Singh, Former ADG, FAO. The Session Co-ordinator was Dr. Bikash Mandal, ADG (International Relations), ICAR. The rapporteur of the session was Dr. Reshma Gills, ICAR-CMFRI.

The Keynote lecture was delivered by Prof. R.B. Singh who spoke on international partnership for transformation of Agri-food systems for achieving sustainable development goals. He presented the present status and level of partnerships between India and other nations and highlighted the immediate need for achieving effective international partnerships in agricultural research and education. The second invited lecture was that of Dr. Chikelu Mba who could not attend the Congress, and hence the recorded presentation was projected. Dr. Chikelu Mba’s presentation was on ‘Plant genetic resources for food security and nutrition: A commons approach’. In his presentation, he highlighted the importance of maintaining and conserving the plant genetic resources, particularly the indigenous crop varieties for food and nutritional security. Prof. (Dr.) Kadambot Siddique was the third speaker who spoke on ‘International partnership for advancing agricultural research and education’. In his lecture Dr. Siddique highlighted the importance of international partnerships in the field of agricultural research and education and said that it is time that our students and young researchers get ample opportunities to carry out research in state-of-art laboratories across the world in advanced areas of agricultural sciences. He cited several examples of collaboration and partnerships by the University of Western Australia with other countries, including India, highlighting the projects executed and the publications accomplished.





Recommendations

1. International partnership for research, education and development should be made through proper planning, and needs to be strategically executed. Follow-up actions are needed for effective functioning of the partnerships.
2. The partnerships should help in translational research without duplication.
3. Adequate funding needs to be ensured for effective international collaborations.

Special Session on Role of PPV&FRA in Transformation of Agri-Food Systems for Achieving Sustainable Development Goals

Protection of Plant Varieties and Farmer’s Rights in India

Convenor: Dr. T. Mohapatra

Session was Coordinated by Dr. Ravi Prakash, PPVFRA. Keynote lecture was delivered by Dr. D.K. Agarwal, Registrar General, PPVFRA. Dr. Javid Iqbal Mir, ICAR-CITH and Dr. Smita Lenka Jain, ICAR-NBPGR were the rapporteurs. Invited lectures were by Dr. J.C.Rana, Country Representative-India, Biodiversity for food and agriculture and Dr. Raji Namboodiri, Asst. Professor and Coordinator, IPR cell, KAU, Kerala.



Dr. D.K. Agarwal presented an overview of PPVFR Act 2001. He elaborated on IP, IPRs, PBRs, CRs & FRs concept and relevant ‘customary and codified laws, Genesis of PPVFR Act, 2001, Provisions of PPVFR Act, 2001, Farmers’ Rights and PPVFR Authority and its functions. A farmer shall save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a protected variety in an unbranded manner. A Farmer who is engaged in conservation of Genetic Resources of land races and wild relatives of economic plants and their improvement through selection and improvement shall be entitled for award, reward and recognition, provided the material so selected and preserved has been used as donor of genes in varieties registerable under the law. Farmers have a right to claim Benefit Sharing if the genetic material conserved by them has been used in the development of regd. variety. Village or Local Communities are entitled compensation if they have contributed significantly to the evaluation of registered variety. When an EDV is derived from a Farmers Variety, then authorization is required from farmers or community of farmers who have made contribution in the preservation or development of such variety.

Dr. J.C. Rana spoke about the role of community seed banks of farmers’ varieties in seed security. Community seed banks are only solution to promote on-farm conservation, increase access to quality seeds, planting materials to farmers for food security, protect farmers’ rights and from exploitation of seed companies, and to cope up with climate change. Many local varieties can be registered/released through simple selection/improvement process, to legally produce, sold/ distribute the seed. This can easily be done through seed banks. Govt should include FVs in Seed Act, should support CSBs through regular financing, incentivize the Custodian farmers etc. Custodian farmers should lead these banks and diversify their portfolio including seed production, branding and sale of products through FPO’s.

Dr. Raji Namboodiri elaborated on protection of farmer varieties and conservation efforts by farmers of Kerala. She also spoke about protection of plant varieties and farmers rights act, 2001. She described in detail the criteria for registration of plant varieties as four stages, Stage I -All applications (form I) received by the Authority are compiled and published on its



website. Stage II - Only those varieties granted certification for “DUS” (distinctiveness, uniformity, stability) testing are subsequently published in the Plant Variety Journal of India. Stage III- Registration is granted based on the denomination, also called the “the label or title”. Stage IV -Exclusive right to market and produce the crop for a period of 15 years in the case of vines. annual crop varieties, and for 18 years in the case of trees. She also elaborated on plant genome saviour awards.

Mr. S.S. Parmesha has described Sidhu Jack variety of Jackfruit. Siddu Jack has now been registered as PPVFRA (Protection of Plant Varieties and Farmers’ Rights Act, 2001). Mr. Parmesha S. S. have the exclusive right to produce, sell, market, distribute, import or export the variety and of authorizing any other person to do so. Siddu jack can be cultivated in low rainfall, dry land and Red soiled Areas. Siddu Jack offers an income generating model by linking Siddu Jack biodiversity for livelihood and nutrition security.

Mr. John Joseph, a nutmeg farmer shared his experience in Nutmeg conservation.

Recommendations of the special session on role of PPV&FRA

- In Kerala the number of farmer varieties registered through PPV&FRA, New Delhi are very less and thus more efforts should be made on the protection and registration of farmer varieties in Kerala.
- There is an urgent need for the promotion of community seed banks at the more intensive level to ensure the supply of quality seeds to farmers for food and nutritional security in the country.
- Biodiversity conservation by the farmers should be encouraged and recognized to minimize the possibilities of losing the important traits available in the existing gene pool.
- To ensure the availability of literature about PPV&FR Act 2001 and its benefits in different languages for scientists and farmers for generating mass awareness.
- Already registered varieties should be promoted and taken forward by developing a suitable business model.

Workshop on Advancements in Research for Marine Mammal Conservation in India

Convenor: Dr. Ratheesh Kumar R.



The program was organised as part of the XVI Agricultural Science Congress & ASC Expo, hosted by the ICAR-Central Marine Fisheries Research Institute in Kochi, India. Dr. R. Ratheesh Kumar, Scientist, ICAR-CMFRI, was the convenor of the event. The Co-Chairs of the session were Dr. Grinson George, Principal Scientist & Head, ICAR-CMFRI and Dr. Sreenath K.R., Senior Scientist, ICAR-CMFRI. The rapporteurs of the session were Dr. Miriam Paul Sreeram, ICAR-CMFRI and Dr. L. Ranjith, ICAR-CMFRI.

Dr. A. Gopalakrishnan, Director of ICAR-CMFRI, inaugurated the program. Around 100 participants, including scientists, subject experts, and research scholars, attended the workshop. Dr. A. Gopalakrishnan, Director of ICAR-CMFRI, had the honour of inaugurating the program. The primary focus of the event was to facilitate discussions on ongoing research priorities and to promote multi-stakeholder collaboration in the realm of marine mammal stock assessment and conservation in India. The workshop featured a series of lectures delivered by marine mammal experts from ICAR-Central Institute of Fishery Technology, Marine Products Export Development Authority, ICAR-Central Marine Fisheries Research Institute, and the Fishery Survey of India.

The Keynote address on the topic “Compelling research properties for marine mammal conservation in India” was delivered by the emeritus Dr. E. Vivekanandan, Former Principal Scientist and Head, ICAR-CMFRI. The talk was deliberated on wide arenas in trends of marine mammals’ research, with respect to sightings and strandings of these gracious giants. He insisted on more of observations at Indian seas with high precision and accuracy in representation of the stock datasets; following the standardized survey protocols to proceed with the appropriation of stock estimates, acoustics survey, using satellite imageries at selected locations, etc.

This was followed by the subsequent lecture on the topic “Addressing Trade related issues for the conservation of marine mammal species in India” by Shri. Anil Kumar P, Joint Director, Marine Products Export Development Authority of India. The talk covered the facts on seafood export performance in India, objectives of Marine Mammal Protection Act (MMPA), the norms of National Oceanographic Atmospheric Administration (NOAA) on the present status of seafood export to the United States of America and need for marine mammal conservation in India, actions taken towards the norms since the pandemic 2019 and challenges. He also articulated on the approvals and way forward towards the Turtle Excluding Device (TED) implementation in India, the coastal-state legal framework towards marine mammal conservation in India. The talk also highlighted the importance on improvisations required solving the constraints in seafood export range.



Dr. Shijo Varghese, Zonal Director, Fishery Survey of India, addressed the topic on “Onboard survey sampling methods followed by the Fishery Survey of India-Pradhan Mantri Matsya Sampada Yojana”. Information on project background, survey methodology and results, expected outcomes was also conferred. The talk also articulated on methods adopted for survey and assessment of marine mammal stocks using their eleven research vessels deployed along the coastal states from six FSI regional base. The marine mammal stock assessment was done using the visual census method adopting the Line Intercept Transect (LIT) and the sighted individuals were counts as point of abundance in the distance based statistical method to estimate the stock of that species. The hand-held binoculars were used to spot the animals, datasets on observations were done using the data collection proformas, taxon identification was done using guides from FAO and CMFRI taxonomical identification guides. The outcomes of the survey during November 2022 to March, 2023 were also presented.

On further, a talk on “Assessment of Marine Mammals stock and Bycatch of Marine mammals and sea turtles” was delivered by Dr. J. Jayasankar, Head and Principal Scientist, FRAEED, ICAR-CMFRI. The talk deliberated the statistical and computational measures undertaken during the stock assessment of marine mammal. He also added on outcomes of the previous project on marine mammal stock assessment and bycatch of marine mammals and turtles.

The workshop ended up with the last talk on the topic titled “Marine Mammal bycatch and mitigation strategies in India”. The bycatch measures were studied using the socio-economics questionnaire survey method. He also added on marine mammal interaction with fishing systems, behaviours, and mortality. The talk described two methods of implementing the strategies such as indigenous and modern methods. Other related information on using pringers, net walls, and net alarm to reduce the mammal interactions to the gear was recommended as a precautionary measure to decrease the damage of gears. The programme ended up with the vote of thanks, by Dr. R. Ratheesh Kumar, Scientist and PI of the project.

The workshop on marine mammal conservation in India brought together experts, scientists, and stakeholders to discuss the crucial issues and challenges faced by marine mammals. The recommendations provided a comprehensive framework for future research and conservation efforts in India. The event marked a significant step towards safeguarding the marine mammal populations and their ecosystems in the country.

Recommendations

- ✓ Prioritize research and monitoring for conservation, focusing on stock level distribution, population trends, acoustic data, and population structures.
- ✓ Address threats such as fisheries bycatch, coastal pollution, coastal developmental activities, and climate change.
- ✓ Capacity building for officials, researchers, and conservationists, including the formation of a stranding analysis network.
- ✓ Develop evidence-based conservation planning with a focus on protected areas, national species action plans, and bycatch mitigation.



- ✓ Engage communities and increase awareness to involve them directly in conservation efforts.
- ✓ Develop a plan of action through networking, policy development, and allocation of budgetary provisions.
- ✓ Promote coordination and cooperation on an inter-departmental, inter-ministerial, and international level.

Plenary Lectures - 1

Rethinking Food Crisis Responses: Dr. Channing Arndt, Senior Director for Transformation Strategies of CGIAR and IFPRI

Convener: Dr. P.K. Joshi



Dr. R. S. Parod Chairman, TAAS, was the Chair. Dr. Channing Arndt highlighted the fact that the recent years have been marked by multiple, often overlapping, crises. The COVID-19 pandemic, various natural disasters, and the ongoing war in Ukraine, have all had strong implications for the global food system, with often highly heterogeneous implications for countries and regions. Already in 2023 and into 2024, a looming El Niño event has prompted important policy decisions and significant movements in global markets for key commodities. These crises have collectively set back the global development agenda by about 1.5 years. The El Niño event in the Pacific has the potential for further substantial disruption, particularly as it interacts with ongoing climate change. The presentation examined the cumulative implications of the Covid-19 pandemic, the ongoing war in Ukraine, and the projected El Niño event for the achievement of the SDGs. The focus was on the analyses using economywide simulation models to measure the near-term impacts of the crises on agri-food systems, poverty, and food insecurity. In retrospect, the presentation analysed the implications of the crises as derived from models and consider where the models have done well and where the models have done not so well to the extent permitted by available data. He provided the projections on the implications of El Niño for selected countries. The key message conveyed was the necessity for an improved response to crises. Looking in terms of ability to simulate implications of crises and develop appropriate, timely, and actionable policy responses, crisis response capability is improving, and it must continue to do so. Climate change introduces a far more unpredictable world, characterised by both climatic and weather instability, with a marked increase in the frequency and severity of extreme events, and substantial risks associated with a transition to a globe with net zero emissions. To confront this reality, simulation is necessary once again. He briefly presented a structural approach to biophysical and economic modelling that incorporates climate uncertainty and allows for rigorous comparison of climate, biophysical, and economic outcomes across global mitigation regimes and provided a few examples that were illustrated to develop robust policy conclusions.

Recommendations:

1. Develop database of regional agri-innovators, prepare, and develop their skill further to take on the already unfolded and “to-be-unfolded” technology challenges.
2. Institutionalize early warning responses to minimize impact of risk.
3. Incorporate risk / resilience in investment decisions.
4. Develop flexible social safety net programmes.

Plenary Lectures - 2

The Contributions of Gene Editing Towards Achieving the Sustainable Development Goals: Prof. Stuart Smyth, Agri-Food Innovation and Sustainability Enhancement Chair, The University of Saskatchewan, Canada

Convener: Dr. Malavika Dadlani



Dr. P.L. Gautam, Former Chairperson, PPVFRA was the Chair. Prof. Stuart Smyth, during his lecture, reported that The Sustainable Development Goals (SDGs) were launched in 2015, with the top three goals being poverty eradication, improved food security and increased human health. He further conveyed that all 17 SDGs have a target achievement date of 2030, describing these as ambitious and inspirational goals that necessitate significant innovation and technology adoption for successful achievement. Prof. Smyth pointed out that innovations in plant breeding have substantially contributed to transforming the efficiency of food production since the mid-20th century, with innovations emerging in the current millennium demonstrating enhanced potential to improve crop yields, the nutritional values of food crops and mitigate environmental impacts. He stressed that these outcomes underpin several SDGs, but in particular the first three. Additionally, Prof. Smyth noted that as climate change is expected to become increasingly variable, with greater impacts on agriculture, the ability to ensure increased food production is going to be increasingly important, as higher yields directly contribute in reducing poverty. Prof. Smyth's presentation revolved around discussing potential contributions from gene editing technologies in terms of increased yield, enhanced nutrition and enhanced sustainability, highlighting their significance in achieving the primary three SDGs.

Recommendations:

1. Based on the results of the field trials as well as the safety angle, SDN1 and SDN2 protocols are recommended for gene editing.
2. Crop losses due to various biotic and abiotic stress is an issue that is recommended to be monitored scientifically and addressed using gene editing technology for improved production and total factor productivity.

Plenary Lectures - 4

Biotechnology for Sustainable Use of Biodiversity to Transform Agrifood System

Dr. T. Mohapatra, Chairperson, PPVFRA

Convener: Dr. A. K. Singh



Dr. Himanshu Pathak, President, NAAS, Secretary DARE & DG, ICAR was the Chair.

Recommendations

1. Create a duplicate National Gene Bank as a safety measure to avoid total loss due to any catastrophic event.
2. Support and mainstream seeds being conserved by farmers through an appropriate institutional mechanism.
3. Strategies needed for utilizing the existing germplasm and local land races for relevant traits through gene prospecting, allele mining, and for pangenomics.
4. Landscape genomics for adaptation identification of adaptive signatures.
5. Benefit sharing mechanism to be defined along with access to germplasm resources.
6. An expert consultation needs to be organized for defining India's position about digital sequence information in relation to PGR.



Plenary Lectures - 5

Role of Aquatic Foods in Achieving Nutrition Security

Dr. Essam Yassin Mohammed, Director General, WorldFish (Recorded)

Convener: Dr. W.S. Lakra, Secretary, NAAS; Former Director, ICAR-CIFE

Prof Panjab Singh, Former President, NAAS was the Chair.

Recommendations

1. Considering significant contribution of small-scale fisheries to the national fish basket, the sector needs enhanced fund allocation and innovative technology support for sustained food, nutritional and income security.
2. International partnership –foster collaborative approach for information, technology, resource and market dynamic sharing to overcome challenges of aquatic food systems.
3. Enhance allocation of climate funds towards managing fish stocks and their habitats on economic infrastructure which in turn will lead to equitable sustainable management.

Panel Discussion 1

Quality Education for Transforming Agri-food Systems.

Convenor: Dr. R.C. Agrawal



Co-Chair	Dr. W. S. Lakra, Secretary, NAAS; Former Director, ICAR-CIFE
Co-Chair	Dr. A. R. Rao, ADG (PIM), ICAR
Rapporteurs	Dr. Srinivasa Raghavan, ICAR-CMFRI Dr. Anuja, A.R., ICAR-CMFRI
Speaker	Dr. R. C. Agrawal, DDG (Ag. Edu.), ICAR Keynote Lecture: Quality Education for Transforming Agri-Food System.
Panellists	Dr. Chindi Vasudevappa, Former Vice-Chancellor, NIFTEM and UAHS, Shivamogga Dr. M. S. Chauhan, Vice-Chancellor, GBPUA&T, Pantnagar Dr. M. K. Naik, Former Vice-Chancellor, University of Agricultural & Horticultural Sciences, Shivamogga

Recommendations

1. Congruence of all sectors in agriculture (including education) using multidisciplinary approach may help in improving academic legitimacy and inclusiveness in agri food systems.
2. Incorporating agriculture in STEM which may lead to STEAM can boost effectiveness and employability in agri food systems.
3. Professional Development Program for faculties and student exchange program at national and international levels in a collaborative mode will strengthen the agri food systems.
4. Promotion of non-agri food systems (synthetic food products) to supplement the existing agri food systems may address the food demand of the burgeoning population.
5. Inclusion of courses: Systems Agriculture, Agri food systems and transformation, Synthetic Biology, at UG and PG level course curriculum
6. Integration of modern infrastructure in the agri food systems may increase the effective delivery of services.

Panel Discussion 2

Innovation in Information Dissemination

Convenor: Dr. Ashok K. Singh



Co-Chair	Dr. P. Das, Former DDG (Extn), Dr. Rajarshi Roy Burman, ADG (AE), ICAR
Rapporteurs	Dr. Reshma Gills, ICAR-CMFRI
Speaker	Dr. Rajarshi Roy Burman, ADG (AE), ICAR
	Keynote Lecture: ICT led Innovations in Information Dissemination for Sustainable Agricultural Development and Livelihood Security
Panellists	Dr. Poonam Malakondaiah, Special Chief Secretary, Govt of Andhra Pradesh
	Dr. Anil Rai, ADG (ICT), ICAR
	Dr. S. N. Meera, Director, ICAR-ATARI, Hyderabad
	Dr. R. Saravanan, Director, MANAGE, Hyderabad

Recommendations

1. Need to create a knowledge model for big data management in extension for generating evidence and analysing for drawing generalized inferences.
2. There is a need to have coherence between research, teaching and extension-capacity building for bridging yield gap and technology gap.
3. Customised demand driven advisory is very important for increased access to reach the unreached.
4. There is a need to develop, and establish more multimedia based digital information management and delivery systems like kisan sarathi.
5. Kissan sarathi mobile app with chatbot interface will reduce the cost of telecommunication (present system of answering call to address queries of the farmers) and will take the information delivery more effective.
6. There is a need for integration of the farmers database of PM Kisan beneficiaries in Kisan Sarathi portal, IMD database and VISTAAR (virtually integrated system to access the agricultural resource) platform.
7. Addressing the macro-issues by digital agricultural like resource scarcity, financial inclusion, market linkage and finally looking at social impact in the priority.



8. The need of the hour is to move away from the island approach to platform-based approaches multiple effect of bundled services.
9. Collaboration and platform-based approach upgrading from what we have to what will be the key to scaling up and scaling out the digital coverage in the rural section.
10. Enable cost-effective IOT's/ IOF's linking profitability should be taken at the national level through a comprehensive digital platform.

Panel Discussion 3

Farming Systems for Enhancing Nutrition and Sustainability

Convenor: Dr. V.K. Singh



Co-Chair	Dr. N. P. Singh, Former Director, NIASM, Baramati
Co-Chair	Dr. S. Ghosh, ADG (Marine), ICAR
Rapporteurs	Dr. S. Kundu, ICAR-CRIDA Dr. Anshida Beevi, ICAR-CRIDA Dr. Loveson Edward L, ICAR-CMFRI
Speaker	Dr. Rajarshi Roy Burman, ADG (AE), ICAR Keynote Lecture: Farming System for Efficient Resource Use, Nutritional Security and Sustainable Livelihood
Panellists	Dr. N. P. Singh, Former Director, NIASM, Baramati Dr. M. L. Jat, Global Research Program Director Resilient Farm and Food Systems, ICRISAT, Hyderabad Dr. Vandana Dwivedi, Advisor (PKVY), DAC&FW, Ministry of Agriculture & Farmers' Welfare, New Delhi Dr. H. B. Babalad, Dean (Agri) & Professor of Agronomy, College of Agriculture, University of Agricultural Sciences, Dharwad Dr. K. Narsaiah, ADG (Process engineering), ICAR

Recommendations

1. There is need to evolve robust integrated farming system (IFS) models suited for diverse farming scenario viz., coastal system, drylands, hilly ecosystem etc and scientific assessment of role of IFS in soil-plant-animal and human nutrition continuum has to be studied.
2. Integrated organic farming system models (IOFS) and IFS models has to be compared with respect to total productivity, change in important soil health parameters, microbial diversity and net economic returns in long term basis.
3. Post- harvest management paved way for achieving sustainability in IFS by reducing the carbon footprint as a consequent of reduced food losses. Value added products from IFS can be differentiated and branded to fetch more remunerative price to farmers.



4. Kulagar Farming system prevailing in Coastal ecosystem is a viable option for the formers for addressing the issues of natural calamities, better economics, family nutrition and soil health. It can be emphasized and evaluated as potential carbon sink and better soil health.
5. Tradeoffs in crop residue utilization in IFS and conservation agriculture-based system needs to be analyzed especially for rain-fed region.
6. Integrated farming systems that incorporate fisheries and aquaculture as key components are essential for promoting sustainable agriculture and ensuring food security. It is crucial to adopt a multi-faceted approach, such as rice cum fish culture, horticulture, cattle rearing, poultry, duck farming, and piggery, along with other agricultural activities.
7. The innovative Integrated Multi-Trophic Aquaculture (IMTA) system, including fish, seaweed, and mollusks as components needs to be emphasizes for better livelihood and sustainable nutritional security.
8. System-based approach is needed to have a paradigm shift from crops and cropping to Integrated farming systems at landscape and eco-region scale. For this, well-defined theory of Change (TOC) at local, sub-national, national level is needed. Also, science evidence-based targeting and investments through appropriate Policy support are required.
9. There is a need to integrate social and behavioural science communication for faster understanding among different stakeholders, society and farmers about the significance of IFS in terms of economic gain, nutritional security and environmental safety.
10. Digital decision-supporting tools based on the multi-criteria analysis for appropriate decision-making in IFS approach have to be evolved.
11. Interdisciplinary research is needed in order to fully understand the likelihood of adoption and to support management recommendations that are deliberately tailored to a unique agroecosystem context.
12. The IFS models need to be validated in the farmer-participatory mode for further outscaling by the states and produce of different farm enterprises under IFS should essentially be certified so as to ensure premium price to the farmers. Government policy support is key for upscaling IFS in the wider domain.

Symposia 1

Coastal Agriculture: Livelihood and Sustainability

Convenor: Dr. Parveen Kumar



Chair	Dr. Suresh Kumar Chaudhari, DDG (NRM), ICAR
Co-Chair	Dr. R. N. Chatterjee, Director, DPR, Hyderabad
Rapporteurs	Dr. Gokuldas P.P., ICAR-CCARI Dr. Sreekanth G.B., ICAR-CCARI
Speakers	
Dr. M. R. Dinesh, Former Director, ICAR-IIHR, Bangalore	Innovative Technologies to Augment the Productivity and Sustainability of Horticultural Crops in the Coastal Regions
Dr. Parveen Kumar, Director, CARI, Goa	Integrated Farming System Approaches for Sustainable Intensification, Livelihood Security and Diversification of Coastal Agriculture
Dr. Grinson George, Head, MBEMD, ICAR-CMFRI, Kochi	Reframing Indian Coastal Aquaculture and Fisheries: An IPCC Risk Assessment Framework Perspective
Dr. Sejian V, Dean, Rajiv Gandhi Institute of Veterinary Education & Research, Pondicherry	Impact of Climate Change and Mitigation Strategies for Sustainable Livestock Production in Coastal Regions
Dr. N. Ravisankar, Principal Scientist, ICAR-IIFSR Modipuram	Natural Farming for Systemic Transformation of Coastal Agriculture
Dr. R. Solomon Rajkumar, Sr Scientist & Coordinator, Agro-Ecotourism Centre, CCARI, Goa	Agro-ecosystem for Livelihood Diversification and Scaling of Entrepreneurship among Rural Youth

Recommendations

1. Crop diversification, emerging novel propagation techniques, entrepreneurship development and innovative marketing for fast availability of quality planting material can greatly aid in productivity and income enhancement and sustainability of horticultural crops in the coastal region.
2. Adoption and promotion of region-specific IFS models have potential to ensure food, nutritional and livelihood security for small and marginal farmers of coastal region besides delivering numerous ecosystem services.
3. Climate change-induced extreme weather events are posing serious threats to the coastal fishery and livestock sectors, therefore assessing vulnerability, devising



and promoting appropriate coastal adaptation strategies are urgently required for handholding of small and marginal coastal farmers and fishermen.

4. Area-specific promotion of Natural Farming through IFS can enhance profitability, sustainability, climate resilience and conservation of biodiversity in the coastal region.
5. Agro-eco-tourism offers greater potential in the coastal region as a tool for doubling farmer's income, attracting youth to agriculture, and conserving natural resources and agro-biodiversity.

Symposia 2

IYM 2023: Mainstreaming Millets

Convener: Dr. C. Tara Satyavathi



Chairman	Dr. D. K. Yadav, ADG (Seed), ICAR
Speakers	Topic
Rapporteurs	Dr. Rekha Devi C, ICAR-CMFRI Dr. Ritesh Ranjan, ICAR-CMFRI
Dr. D. K. Yadav, ADG (Seed), ICAR	Chairman’s Address: IYM 2023: Role of India and Global Expectations
Dr. C. Tara Satyavathi, Director, ICAR-IIMR, Hyderabad	Mainstreaming Millets for Food and Nutritional Security
Dr. O. P. Yadav, Director CAZRI, Jodhpur	Enhancing Productivity of Millets
Prof. K. C.. Bansal, Former Director, ICAR-NBPGR	Genome Editing for Enhancing Productivity in Millets
Smt Shubha Thakur, Jt Secy., IYoM DA&FW, MoAFW	The Push for Nutricereals: The Vision and Roadmap of the Indian Government
Dr. Dayakar Rao, CEO, NutriHub, IIMR, Hyderabad	Value Addition and Promotion of Millets – The Journey, Challenges and Roadmap
Panel Discussion	Promoting Millets Production, Value Addition and Consumption: Experience of the Stakeholders

Recommendations

1. Exploring the germplasm for millet production.
2. Using various tools and techniques for increasing the millet productivity.
3. Continuous support beyond IMY2023 for incentivizing the farmers and industries who are involved in production, processing and distribution.
4. Mapping of areas for increasing millet production by going through an integrated cropping system.
5. Adopting agronomy practices for increasing millet production.
6. Establishing grades and standards for production and enhancement of millet shelf-life.
7. Determining the degree of millet polishing.

Symposia 3

Repurposing Agriculture for Achieving SDGs

Convenor: Dr. P.S. Birthal



Co-Chair	Dr. M. L. Jat, ICRISAT
Co-Chair	Dr. K. Srinivas, ICAR-NAARM
Rapporteurs	Dr. B. Santosh, ICAR-CMFRI Dr. D. Lingaprabhu, ICAR-CMFRI
Speakers	Topic
Dr. K. Srinivas, ICAR-NAARM	Keynote Lecture: Repurposing Agriculture for Improving Resource Use Efficiency, Environmental and Human Health: Technological, Institutional and Policy Requirements.
Dr. C. S. C. Sekhar, Professor, Institute of Economic Growth	Invited Lecture: Reorienting Policy for Food and Nutrition Security, and Viability and Sustainability of Smallholder Agriculture.
Dr. Shivendra Kumar Srivastava, ICAR-NIAP, New Delhi	Invited Lecture: Repurposing Agricultural Subsidies for Higher and Sustainable Agricultural Development.
Dr. Ranjit Kumar, Principal Scientist, NAARM, Hyderabad	Invited Lecture: From Farm to Fork: Role of FPOs and Agri-Start-ups.
Session Presentation	Dr. Raka Saxena

Recommendations

1. For repurposing agriculture, investment in developing the complete supply chain through effective market access, strengthening institutions and development of human resources are essential.
2. Technology is the main driver, and policies need to be supported for better adoption of the technologies for repurposing agriculture.
3. Rationalize and repurpose subsidies for sustainable development of agriculture, and alternative mechanisms like area-based, ecosystem service-based and direct benefit transfer can be effectively implemented.
4. Convergence of FPOs and Agri-startups is essential and needs incubation membership and complete support of NARS.

Symposia 4

Towards Youth Empowerment and Gender Equity for Meeting the SDGs

Convenor: Dr. Malavika Dadlani



Co-Chair	Dr. V. Geethalakshmi, Vice-Chancellor, TNAU
Co-Chair	Dr. S. K. Sharma, ADG (HRM), ICAR
Rapporteur	Dr. Anuradha Agarwal
Speakers	Topic
Dr. V. Geethalakshmi, Vice-Chancellor, TNAU	Empowering Youth and Women for Entrepreneurship driven Economic Development
Dr. Neeru Bhushan, ADG, ICAR	Creating a Startup Ecosystem to Empower Youth and Women in Amrit Kaal
Dr. Satendra Arya, CEO, ASCI	Empowerment of Youth by Skilling in Agriculture
Dr. Swati Nayak, IRRI	Empowering Farm Women through Seed System
Dr. Malavika Dadlani, NAAS	Bridging Gender Inequity in Agriculture through Innovation and Technology

Recommendations

1. Role of women and youth in agriculture is increasing due to favourable ecosystem but the focus on enhancing active participation of women to be Agri-entrepreneur need to be taken up with more speed and scale.
2. Empowering youth and women in creating Agri start-ups including traceability, market price reduction Agri-inputs supply chain management etc.
3. Skilling the youth should be the focus for future and sharing of learning materials and knowledge through joint exchange programmes should be encouraged.
4. Comprehensive women friendly capacity building framework in seed chain should be strengthened and promoted.



5. Unpaid work by women in agriculture should be counted and should be the part of contribution of women in agriculture and society.

Farmer-Scientist Interface

Chair: Dr. Ashok Kumar Singh



The Farmer-Scientist interface in connection with XVI Agricultural Science Congress hosted by ICAR-Central Marine Fisheries Research Institute (CMFRI), Kochi was held on 12th October 2023, 10.45 am at hotel Le-Meridian, Kochi. Total of 178 farmers representing 17 states of the country including 5 Padmashree awardee farmers participated. The interface was chaired by Dr. Ashok Kumar Singh, Vice Chancellor, Rani Lakshmi bhai Central Agricultural University, Jhansi and co-chaired by Dr. V. Geethalakshmi, Vice Chancellor, Tamil Nadu Agricultural University, Coimbatore. Twenty numbers of experts from various research, developmental, financial organizations and commodity boards were present as panelists.

The PadmaShree awardees shared their success stories. Padmashree Cheruvayal K Raman from Wayanad, Kerala informed that he conserves 60 local varieties of rice in his farm and according to him, the seeds being gift of nature should not be a priced commodity. He also urged the young farmers to carry forward his variety conservation efforts to future. Padmashree Seth Pal Singh from Uttar Pradesh shared how his income could be enhanced through crop diversification and prompt pest management. PadmaShree Chandrasekhar Singh from Uttar Pradesh shared his experience of producing new lines of seeds. He has 3 seed processing plants in his farm. Padmashree Sabarmatee Tiki from Odisha opined that Scientists should also take responsibility for all the negative aspects of their technology as well. She urged to explore the potential of conserved varieties instead of merely conserving them. She called for attention towards a solution to the wildlife menace caused in field crops resulting huge loss to farmers. She also opined that women friendly designs in agricultural machinery should be developed for the benefit of small and marginal farmers. Padma Shree Batakrushna Sahoo from Odisha shared his journey in the field of fish culture adopting improved technologies.

During the open session, farmers raised various issues including enforcement of fair pricing for farm produce, formulation of developmental policies by considering needs and challenges of small and medium farmers, ensuring social dignity to farmers particularly when approaching financial institutions and government offices, provision of interest free loans to FPOs, inclusion of farmer's produce in public distribution system to enhance market reach, etc. Crisis faced by coconut farmers due to falling prices and disease outbreak was also highlighted.



Student's Elocution Contest

Convenor: Dr. Anupama Singh

Selection: The Student Elocution Contest, in the ASC, is open to students enrolled in Agricultural Universities across the country, including SAUs, CAUs, and deemed universities. Contestants are selected based on a two-tiered process. In the first round, two students are selected from each zone of the country, which is divided into six zones. One Vice Chancellor is designated as the Zonal Coordinator for each zone, who conducts the contest at the zonal level. Following the zonal level contest, two students, i.e. winner and runner-up from each zone, are selected.

Contest: The final elocution contest of the XVI ASC was held at Le Meridian Kochi, organized by CMFR Kochi on 12th Oct 2023 sponsored by NANSEN. There were twelve students competing on the topic "Transforming Agri-Food Systems for Achieving Sustainable Development Goals", also the theme of the Congress. Prof. Anupama Singh, the National Coordinator, and Dr. Kajal K Chakraborty, the local chairperson, convened the contest.



Lakshmi Manohari
College of Horticulture, GKVK
Bengaluru

Zone-1



Keerthana Nayak N
College of Horticulture, GKVK
Bengaluru

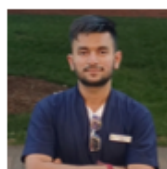


Trada Naitri Nileshbhai
Junagadh Agricultural University
Junagadh

Zone-3



Zala Omdeepsinh Niteshsinh,
Anand Agricultural University
Anand



Aditya Maheshwari
UP Pt. Deen Daval Upadhyay Pashu Chikitsa
Vigyan Viswavidhyalay Evam
Go Anusandhan Sansthan, Mathura

Zone-5



Shambhavi
GB Pant University of Agri. & Tech.
Pantnagar



Zone-2



M. Umeshwar Reddy
Prof. Jayashankar Telangana State
Agricultural Univ. Rajendranagar, Hyderabad

Srilekha V Chintha
Acharya NG Ranga Agricultural Univ.
Guntur



Zone-4



Abhilash Panda
College of Veterinary Science & Animal
Husbandry, Univ of Agricultural and
Technology, Bhubaneswar

Kopal Karishma
College of Fisheries, Kisangani
Bihar Animal Sciences University, Patna



Zone-6



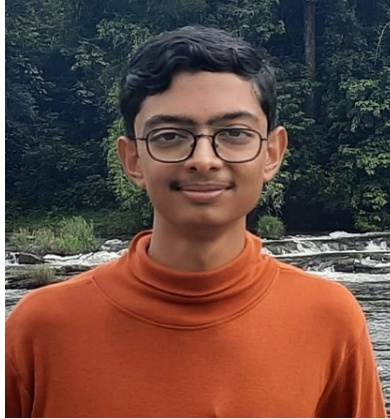
Ariu
Lala Lajpat Rai University of Veterinary
& Animal Sciences (LUVAS), Hisar

Beenish Khuroo
Sher-e-Kashmir University of Agricultural
Sciences & Technology
of Jammu (SKUAST-Jammu)

The participants were given 10 minutes to present a PowerPoint presentation, followed by 2 minutes for discussion. In their presentations, students provided us with fresh perspectives and insightful ideas on key issues facing the agriculture and agri-food sectors today. They highlighted the importance of sustainable practices, the importance of investing in technology, and the importance of collaboration between all stakeholders. Their ideas provided valuable insight into the challenges and opportunities facing the sector. A jury of three experts from the field evaluated the presentations based on the following criteria: language, introduction, scientific criteria supporting the matter, expression, slides, time coordination, and questions and answers. The level of competition was very high and each of the participants had done exceptionally well. Winners were announced at the valedictory session of the XVI ASC on 13th Oct 2023. At the valedictorian ceremony, all contestants were invited to take group photos with dignitaries. This was followed by the announcement of the competition's winner. Third prize was bagged by Ms. Lakshmi Manohari, College of Horticulture, GKVK, Bengaluru, Second prize Mr. Zala Omdeepsinh Niteshsinh, Anand Agricultural University, Anand, and the first prize Ms. Shambhavi, GB Pant University of Agri. & Tech., Pantnagar. Ms Shambhavi, 1st prize winner, then presented the same presentation she had made during the competition, which was greatly appreciated by everyone.



I Prize
Ms. Shambhavi
GB Pant University of Agri. &
Tech., Pantnagar



II Prize
Mr. Zala Omdeepsinh
Niteshsinh
Anand Agricultural
University, Anand



III Prize
Ms. Lakshmi Manohari
College of Horticulture,
GKVK, Bengaluru



Industry Interface

Convenor: Dr. S.N. Jha



Session I –Initiatives and Perspectives)	
Dr. C. R. Mehta, Director, ICAR-CIAFE, Bhopal	Agro industries
Dr. R. Bhatta, Director, NIANP, Bengaluru	Veterinary industries
Dr. George Ninan, Director, ICAR- CIFT, Cochin	Fishing industries
James P. George, DGM, NABARD, Trivandrum	Service industries including financial services
Session II – Interventions and Innovations	
Mr. Elongo – CEO, Global Coconut Farmers Producer Company Limited	Coconut Neera and Marketing & Challenges: FPO Perspective
Dr. Bharat, Chief Science Officer, Mahyco	Future of Farming and Food
Dr. Sangeeta Dawar, Lead- Government Affairs, Bayer Crop Science,	Bayer crop science presence and commitment in South Asia
Mr Mohammed Sait, Indian Marine Ingredients Association	Fishmeal Industry for the livelihood of Fishers
Session III – Interactions	



Technology Product Promotions

Speakers	Industry
Mr. Tarunendu Singh	Indian Farmer Fertilizer Cooperatives: Initiatives
Mr. Ramesh Reddy	Agrihort Technologies Corporate
Mr. Tridev Chakraborty	LifeCELL

Recommendations

1. Developing need-based / demand-driver research with research institutions/ farmer co-operations to develop new product/ technology
2. Increase Private investment in research and development programs
3. Research on indigenous feed formulation (for both) animal husbandry/ fisheries to reduce feed cost (or) import substitution
4. Appeal to increase the industries CSR funding to develop the socio-economic conditions of the fisher/ farmer in their locality, which will ultimately improve the economic performance of the industry
5. Identification of low-cost alternatives for the existing feed (or) any other input that is costly
6. Industry to conduct market servings for expanding their production market-driven research with industry institutional collaboration
7. nurturing new ideas through incubation



Exhibition

Convenor: Dr. A. Gopalakrishnan



The XVI Agricultural Science Congress Agri-Expo held during 10th to 13th October 2023 inaugurated by the Hon'ble Minister for Fisheries, Animal Husbandry & Dairying Govt. of India, Shri. Parshottam Rupala, showcased a dazzling array of institutions, with prestigious ICAR establishments at the forefront, representing the dynamic realms of Agriculture, Fisheries and Animal Husbandry, State departments, renowned universities and innovative private organizations, all gathered together to unveil their cutting-edge technologies and services. There were 107 pavilions and 5 interactive kiosks with a remarkable congregation which transformed knowledge into a captivating visual experience, employing a rich tapestry of eye-catching Audio-Visual presentations, vibrant posters, captivating charts and vivid illustrations. It also featured real-life specimens, intricate models, and lifelike mock-ups, delivering an immersive journey into the world of agricultural innovation and practical utility.

Best Agri Expo Stall

An esteemed panel of experts, meticulously curated to represent the zenith of knowledge in agriculture, fisheries and animal husbandry sectors, undertook the challenging task of evaluating the pavilions. Guided by carefully defined parameters, encompassing the realms of content, attraction, audio visuals and the depth of interaction, the judging committee found themselves during a formidable conundrum. The competition was fierce, with but a hair's breadth separating the top contenders for the coveted title of 'Best Agri Expo Stall'. In recognition of the impressive efforts and remarkable displays, every pavilion was honoured with a precious Memento of Appreciation, accompanied by Participation Certificates, personally awarded by the Organising Secretary & Director ICAR-CMFRI himself.

Nevertheless, after much deliberation and thoughtful consideration, the committee harmoniously reached a verdict, presenting their findings in the following distinguished order: Amid the grandeur of the XVI Agricultural Science Congress-2023 Expo, a thrilling competition unfolded to determine the 'Best Stall' that left a lasting imprint on all attendees. The coveted First Prize was triumphantly seized by the ICAR-Indian Institute of Spices Research, Kozhikode, a beacon of excellence in the world of agricultural innovation. The Second Prize, a distinguished honour, was evenly shared by two standout contenders: The Directorate of Fisheries, Government of Odisha, Cuttack, whose aquatic wonders captivated all who visited and ICAR-National Research Centre for Banana, Trichy, a hub of ingenuity in the realm of tropical agriculture. In a testament to the extraordinary quality of exhibits, the third Prize was jointly awarded to: ICAR-Directorate of Medicinal & Aromatic Plants Research, Anand, an institution dedicated to the potent and fragrant world of

medicinal plants and ICAR-Directorate of Floricultural Research, Pune, where the beauty and artistry of floriculture blossomed. These accolades exemplify the excellence that graced the expo and the remarkable contributions of these esteemed institutions. The directors of the concerned Institutions received the awards. The expo was wound up in the AN of 13th October 2023.



Agri-Expo inauguration by honourable minister Shri. Parshottam Rupala



First Position
ICAR-Indian Institute of Spices Research,
Kozhikode



Second Position
The Directorate of Fisheries, Government of
Odisha, Cuttack



Second Position
ICAR-National Research Centre for
Banana, Trichy



Third Position
 ICAR-Directorate of Medicinal &
 Aromatic Plants Research, Anand



Third Position
 ICAR-Directorate of Floricultural Research, Pune



Poster Presentation

Theme 1

Ensuring Food and Nutritional security: Production, consumption, and value addition

Session 1: Problems of Malnutrition in India

Out of the total 7 registered abstract under the Session 1 of theme, 4 were presented at the ASC on 12.10.2023 (16:30-18.30). The session addressed issues like prevalence of malnutrition in hilly area and their mitigation strategies, pandemic induced changes in fish consumption pattern and fortification of food commodities for enhanced nutrition. The other topic of discussion includes bivalve extract as a rich source of micronutrients and valuation of marine fish and its dynamics in time and space.

Session 2: Farm and Food-based strategies for combating hidden hunger.

Out of the total 18 registered abstract under the Session 2 of theme, 9 were presented at the ASC on 12.10.2023 (16:30-18.30). The session commenced with a presentation on contribution of agriculture interventions towards nutritional security followed by discussion of nutritional security of marginalized section of the society. Papers focused on improving the yield of crops from available genetic pool, identifying and combating disease outbreak, potential biocontrol for pest and pathogens, livelihood and economic viabilities studies from marine capture fisheries sector were presented.

Session 3: Resource efficient, environment friendly production of pulses

Out of the total 44 registered abstract under the Session 3 of theme, 30 were presented at the ASC on 12.10.2023 (16:30-18.30). This session had several presentations on different aspect of seaweed production and its efficient utilization. Few papers were directed towards optimization of seed production of several aquatic organisms. Topics presented covered intervention in production system to improve efficiency, climate resilient, system integration and better farm economic to farmers. Molecular intervention for enhanced production, productivity and resilience were also deliberated during the session. The other topics were innovative products from the plants and animals for agriculture and industrial application. The crops that got major thrust were millets, potato, pulses, fishes, rice etc.

Theme 2

Climate Action for sustainable Agri-food systems

Out of the total 54 registered abstract under the theme, 33 were presented at the ASC on 11.10.2023 9 (10:45-12.45). The theme was specifically related to climate research actions targeted towards ensuring sustainable food systems. The major areas addressed during the theme were development of food crop varieties tolerant to climatic stressors like drought, salinity etc. The theme also addressed critical ecosystem like corals and mangroves and



their ability to moderate climate change. The species distribution models and how climate is altering distribution and abundance of aquatic resources also featured in the presentations. The climate smart and resilient food production systems like IMTA also featured during the systems. The impact of extreme climate weathers on aquatic ecosystem and coastal communities, alteration in marine production cycle and incidence of HABs were also presented.

Theme 3

Frontier science and emerging genetic technologies: Genome breeding, gene editing

Session 1: Advances in genomics and CRISPER-Cas systems for crop improvement

Out of the total 13 registered abstract under the Session 1 of the theme, 7 were presented at the ASC on 12.10.2023 (16:30-18.30). The presentations were mostly towards genetic manipulation to achieve desired phenotype. The application CRISPER-Cas, cytogenetic approaches, genome assisted breeding, various molecular markers and incorporation of artificial intelligence were covered. The diverse crops including rice, wheat, maize, black pepper and livestock such as buffalo, cattle etc. highlighted in the presentations.

Session 2: Applications of CRISPER-Cas systems for crop improvement and sustainable development.

Session 3: Genome editing: IPR policy for product development and socio-economic consideration

Out of the total 5 registered abstract under the Session 2 & 3 of theme, 2 were presented at the ASC on 12.10.2023 (16:30-18.30). Successful application of CRISPER-Cas and other gene editing protocol for achieving desired phenotypes in crops like cassava, sugarcane, rice and pomegranate, Intellectual Property Rights (IPR) aspects related to CRISPER-Cas based technological innovations were emphasised.

Theme 4

Livestock-based Transformation of Food System

Session 1: Towards livestock production sector transformation

Out of the total 27 registered abstract under the Session 1 of theme, 18 were presented at the ASC on 11.10.2023 (13:45-15.45). The presentations were specifically related to advancement and innovation in livestock-based production system, mainly, the application of genetic tools including whole genome sequencing, gene expression studies towards improvement in fertility and production, adoption of scientific practices and proper breed selection for increased production, performance evaluation of developed breed and its ecological impacts, importance of optimization of inputs and nutritional requirement of animals for livestock productions. Need for upgrading the production system using advanced technology like “Drones” were also discussed.

Session 2: Livestock products, health and support sciences



Out of the total 20 registered abstract under the Session 2 of theme, 13 were presented at the ASC on 11.10.2023 (13:45-15.45). During the session major emphasis was given for disease outbreak, disease diagnostic and health management of major cultivable livestock. The topics also covered novel method for detection of cold chain abuse in value chain of animal-based food products, nutritional profiling of milk of captive reared animals and detection methods for pregnancy in ruminants.

Theme 5

Horticulture-based transformation of Food systems, Session 1: Fruit and Plantation crops

Out of the total 13 registered abstract under the Session 1 of theme, 10 were presented at the ASC on 11.10.2023 (16:30-18.30). The topics of discussion spanned over topics like genetic diversity, disease outbreak at different stages, parasite infestation and its dynamics. The important horticulture crops like coconut, litchi was covered in the presentation including their disease, economics and pre and post-harvest management.

Session 2: Vegetable and Tuber crops

Out of the total 13 registered abstract under the Session 2 of theme, 3 were presented at the ASC on 11.10.2023 (16:30-18.30). The major crops under discussion were Garden pea and cucumber. The discussions were centred towards host-parasite interactions and physiological and yield dynamics of crops under varying culture conditions.

Session 3: Spices, Ornamental and Medicinal plants

Out of the total 18 registered abstract under the Session 3 of theme, 13 were presented at the ASC on 11.10.2023 (16:30-18.30). The presentations were mostly on common spices, flowers and medicinal plants. The topics of discussion included intercropping of spices, their medicinal properties, and biochemical characters, insecticidal and anti-microbial properties. The other topics were constraint analysis in production system, nutritional profiling of selected species. The potential use of leaf waste of Curcuma as bio-insecticide was also elaborated in the session.

Session 4: Nutraceuticals and value addition

Out of the total 4 registered abstract under the Session 4 of theme, 3 were presented at the ASC on 11.10.2023 (16:30-18.30). The session gave special emphasis on extraction and characterization of bio-active compounds from endemic varieties of orchid and pomegranate seeds for potential use as Nutraceuticals. The preservation technology for enhancement of shelf life of tender coconut water was explained for potential commercialization.

Theme 6

Aquaculture & Fisheries-based Transformation of Food Systems

Session 1: Aquaculture systems & Fisheries



Out of the total 158 registered abstract under the Session 1 of theme, 139 were presented at the ASC on 12.10.2023 (10:45-15.45). The session included both culture and capture fisheries across different aquatic ecosystem. Under aquaculture the major thrust were on breeding, growth, survival, seed production and survival of commercially important and potential candidate species for aquaculture. Among the recent aquaculture research, the focus was on biofloc technology, hybrid ornamental fishes, high density rearing. The environment manipulation studies like alteration in thermal and photoperiod regime were also discussed during the session. Different culture system and innovation like in raft culture and aquaculture innovation also featured in the session. Research finding in feed technology both artificial feed and live feed were presented and discussed. In the domain of sustainable aquatic resource harvest and management, topics like ecosystem, fisheries and fish stock assessment were covered. The species distribution, their abundance and their spatio-temporal dynamics and its implication in sustainable management were discussed. The concept of conservation aquaculture of corals and other indigenous species were also the part of the session. Innovations and modifications in gears and crafts, life cycle assessment of fishing practices were among the other important topics.

Session 2: Genetics, health and nutrition

Out of the total 76 registered abstract under the Session 2 of theme, 68 were presented at the ASC on 12.10.2023 (10:45-15.45). The presentation under the theme included the recent research and advances in the field of cell lines and gene banks, gene identification, characterization and expression studies. Several Metagenomics and transcriptome-based studies also featured in the session. Development of different, substitution of conventional ingredients, their nutritional profile and its effect of growth and health of target organism were also discussed in several presentations. The studies on the occurrence and prevalence of pathogens, potential compound for application in aquaculture based on anti-microbial properties, development of vaccine, methods of disease screening, genetic characterization of pathogens were other major topics.

Session 3: Processing, value addition, quality control & social sciences

Out of the total 34 registered abstract under the Session 1 of theme, 27 were presented at the ASC on 12.10.2023 (10:45-15.45). The presentation under this session were, preservation techniques for value-added seafood products, quality and spoilage indicator methods, evaluation of different value-added products, utilization of agro or fishery based waste or secondary raw materials. The incidence, prevalence and identification of bacteria in seafood and real time identification of shrimp species to avoid seafood fraud were among the other topics that drew attention during the session. The studies on potential of fish-based products to improve health in marginalized population or area, women empowerment in aquaculture sector, risk and credit system in marine fisheries, fish consumption, fish demand & international trade dynamics, occupational hazards, and vulnerability of coastal livelihood in climate change regime were major studies addressing socio-economic aspects of fisheries sector.



Theme 7

Nature based solutions for sustainable Agri-food systems.

Session 1: Water harvesting and enhancing water productivity.

Out of the total 2 registered abstract under the Session 1 of theme, 2 were presented at the ASC on 12.10.2023 (16:30-18.30). The session presentations were on innovation in drainage system, ecosystem approach to water management and sewage treatment based on nature-based approach to achieve water conservation and efficient water utilization.

Session 2: Soil health and its restoration

Out of the total 13 registered abstract under the Session 2 of theme, 10 were presented at the ASC on 12.10.2023 (16:30-18.30). This included the presentations on physical, physiological, chemical and microbial profiling of soil and methods for its reclamation and restoration. The impacts of agriculture practices on soil health were also deliberated upon. The nutritional management of soil for enhanced and sustained production was also stressed during presentations. The topics like carbon sequestration and climate change mitigation were other topics of discussion.

Session 3: Ensuring Nutritional security through Natural Resource Management

Out of the total 21 registered abstract under the Session 3 of theme, 14 were presented at the ASC on 12.10.2023 (16:30-18.30). There was emphasis on nature-based approaches to increase production and productivity without compromising sustainability of the system. The topics included intensification and diversification of production system and other nature-based innovations in system for enhancing production. Micro-level environment management, ecosystem appraisal, ecosystem monitoring and restoration and application of nanotechnology were other topics.

Theme 8

Next Generation Technologies: Digital agriculture, precision farming and AI-based system

Session 1: Digital Agriculture

Out of the total 13 registered abstract under the Session 1 of theme, 6 were presented at the ASC on 11.10.2023 (13:45-15.45). The theme was specifically related to application of digital technology in agriculture sector which includes online services, digital hubs. The presentation covered the important themes like automation of agriculture production practices and application of modern technologies like spectroscopy in soil health assessment. The theme also covered issues like occupational hazards and importance of like saving equipment in small-scale motorized fisheries.

Session 2: Artificial Intelligence based systems.

Out of the total 12 registered abstract under the Session 2 of theme, 9 were presented at the ASC on 11.10.2023 (13:45-15.45). Thrust area of discussion under the theme was



application of artificial intelligence and machine learning models towards assessment and improvement of agriculture production system. The presentation included the evaluation of biodiversity, species distribution and habitat modelling. The potential of AI tools for nitrogen deficiency detection, the use of Large Language Models (LLMs) in digital agriculture and patents related to AI in aquaculture sector were presented.

Theme 9

Policies and Institutions for Transforming Agri-food systems.

Session 1: Food systems Transformations: Role of policies and Institutions

Out of the total 17 registered abstract under the Session 1 of theme, 9 were presented at the ASC on 11.10.2023 (16:30-18.30). The session witnessed presentation on the importance of Buyer-Seller meet, governance gateway and value chains assessments. The importance of incubation centre, role of institution and policies in entrepreneurship development in different production sector were discussed. The potential of aquaculture in engaging youth for livelihood security and employment was highlighted.

Session 2: Diet Diversification and Food System Transformation

Out of the total 3 registered abstract under the Session 2 of theme, 2 were presented at the ASC on 11.10.2023 (16:30-18.30). The session emphasised the importance of crop diversification and integrated farming system to widen the diet spectrum of the domestic consumers, leading to more balanced nutrition among the consumers.

Session 3: Agri-food system transformation towards high-value commodities

Out of the total 7 registered abstract under the Session 3 of theme, 4 were presented at the ASC on 11.10.2023 (16:30-18.30). The major discussions were on integrated farming and sustainability assessment of commercial crops like Litchi and Banana. The concept of Urban Agriculture for enhanced agriculture produces and sustainable production in urban region were pressed upon during the session.

Theme 10

International Partnership for Research, Education and Development

Out of the total 2 registered abstract under the theme, 2 were presented at the ASC on 12.10.2023 (16:30-18.30). The impact of academic system in fisheries science towards sector's development through human resource development was highlighted in the session. The importance of agriculture sector and news value were also presented during the session.



Best Poster Awards

Theme 1: Ensuring Food & Nutritional Security:

Production, Consumption and Value Addition

Abstract No: T1S3-43

Title: Cold anaesthetization of *Liptopenaeus vannamei* for waterless transportation

Authors: Parvathy, U.*., Vishnu R. Nair, Jithin, T. J., Madhusudhana Rao, B., Binsi, P. K., Sathish Kumar, K. and Murali, S.

Theme 2: Climate action for Sustainable Agri-food Systems

Abstract No: T2-44

Title: How Does Incorporating Atmospheric CO₂ Concentration into FAO Penman-Monteith Equation Change Reference Evapotranspiration for Future Climate Conditions Projected Over India?

Authors: Surendran, S.*, Pahari, T., Jaiswal, D. and Nandhana Sunil

Theme 3: Frontier Science and emerging genetic technologies: Genome Breeding, Gene Editing

Abstract No: T3S1-06

Title: Genome-assisted breeding for the Integration of triple rust-resistant genes to fast-track improvement for disease resistance in Bread wheat (*Triticum aestivum* L.)

Authors: Prashanth Babu, H*, Manjeet Kumar, Kiran Gaikwad, B., Naresh Kumar and Rajbir Yadav

Theme 4: Livestock-based Transformation of Food Systems

Abstract No: T4S2-03

Title: Microbial Smart Time-Temperature Indicator (TTI) for Determining Thermal Abuse of Packaged Paneer

Authors: Narender Raju Panjagari*, Gaurav Kr Deshwal, Saurabh Kadyan, Rashmi, H. M., Heena Sharma and Ashish Kumar Singh

Theme 5: Horticulture-based Transformation of Food Systems

Abstract No: T5S3-09

Title: Optimization of process parameters for spray dried ginger – lime juice powder using RSM and physicochemical evaluation of the dried powder

Authors: Alfiya, P. V.*, Jayashree, E., Jinto Sebastian and Thankamani, C. K.

Theme 6: Aquaculture and Fisheries-based Transformation of Food Systems

Abstract No: T6S1-52

Title: Good Management Practices in Seaweed Farming

Authors: Johnson, B.*, Tamilmani, G., Divu, D., Suresh Kumar Mojjada, Sekar Megarajan, Shubhadeep Ghosh, Mohammed Koya, Muktha, M., Bobby Ignatius, Vinod, K., and Gopalakrishnan, A.



Theme 7: Nature-based Solutions for Sustainable Agri-food Systems

Abstract No: T7S3-09

Title: Coastal habitat restoration and improving community resilience by artificial reefs along the Indian coast

Authors: Joe K. Kizhakudan*, Shoba Joe Kizhakudan, Remya, L., Narayanakumar, R., Dineshababu, A.P., Suresh, V.V.R. and Gopalakrishnan, A.

Theme 8: Next Generation Technologies:

Digital agriculture, Precision farming and AI-based systems

Abstract No: T8S2-03

Title: Long short-term memory-based regression approach for freshness assessment of Genetically Improved Farmed Tilapia

Authors: Murali, S.*, Reshma, R., Sreelekshmi, B., Aniesrani Delfiya, D. S., Murugadas, V., Binsi, P. K. and George Ninan

Theme 9: Policies and Institutions for Transforming Agri-food Systems

Abstract No: T9S1-10

Title: Rebuilding with communities: CIT model analysis of stakeholder consultation in marine fisheries sector in India

Authors: Akhila Kumaran, Shyam S. Salim, Sunil P. V., Narayanakumar, R., Anuja, A. R. and Steny Rebello

Theme 10: International Partnership for Research, Education and Development

Title: No Poster Recommended for Award

Participation of University Students



The Agricultural Science Congress organized by the National Academy of Agricultural Sciences (NAAS) invited nominations of 5 research students from each university falling under the NAAS umbrella to participate in the event. This initiative was fully sponsored by the NAAS, covering all expenses for the students. In total, 106 students from 24 different universities took part in the congress. During the four-day congress, these students actively engaged in various sessions and activities tailored to their specific areas of interest. This allowed them to learn and exchange ideas with experts and peers. On the fourth day, an interaction was organized between the students and the event organizers to collect their feedback and insights regarding the initiative.

The students expressed their appreciation for this opportunity provided by the NAAS. They highlighted the value of attending talks and sessions delivered by eminent scientists in different thematic areas, which greatly enriched their knowledge and understanding.

Furthermore, the host organization took care of the students' accommodation and transportation to and from the venue, ensuring a seamless and hassle-free experience for the participants. Overall, it was a successful and beneficial event for the research students and an excellent initiative by the NAAS to support and promote agricultural science.

The list of universities and number of students participated is detailed in table 1.



Table 1: Agricultural Universities and number of students who participated in the XVI Agricultural Science Congress at Kochi

Sl. No.	University name	Place	Number of students
1	Acharya Narendra Deva University of Agriculture & Technology	Ayodhya, UP	5
2	Agricultural University	Kota, Rajasthan	4
3	Acharya N. G. Ranga Agricultural University	Guntur, AP	5
4	Anand Agricultural University	Anand, Gujarat	5
5	Assam Agricultural University	Jorhat, Assam	5
6	Bidhan Chandra Krishi Viswavidyalaya	Mohanpur, West Bengal	5
7	Central Agricultural University	Imphal, Manipur	4
8	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyala	Palampur, Himachal Pradesh	1
9	Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Ewam Go-Anusandhan Sansthan (DUVASU)	Mathura, UP	2
10	Dr. Y.S. Parmar university of Horticulture and Forestry	Solan, Himachal Pradesh	5
11	G.B. Pant University of Agriculture and Technology	Pantnagar, UP	5
12	Junagadh Agricultural University, Junagadh	Junagadh, Gujarat	5
13	Kerala University of Fisheries and Ocean Studies (KUFOS)	Kochi, Kerala	5
14	Odisha University of Agriculture and Technology (OUAT)	Bhubaneswar, Odisha	5
15	ICAR-Central Institute of Fisheries Education	Mumbai, Maharashtra	3
16	ICAR-Indian Agricultural Research Institute	New Delhi	5
17	ICAR-Indian Veterinary Research Institute	Izatnagar , Uttar Pradesh	5
18	Rajmata Vijayraje Scindia Krishi Vishwa Vidyalaya	Gwalior, Madhya Pradesh	3
19	Sardar Vallabh Bhai Patel University of Agriculture and Technology	Meerut, UP	5
20	SKN Agricultural University	Jaipur, Rajasthan	5



21	University of Agricultural Sciences, GKVK, Bangalore	Bengaluru, Karnataka	5
22	University of Horticultural Sciences	Bagalkot, Karnataka	5
23	Uttar Banga Krishi Vishwa Vidyalaya	Cooch Behar, West Bengal	5
24	Vasant Rao Naik Marathwada Krishi Vidhyapeeth	Parbhani, Maharashtra	5
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