

RAPORTEURS' REPORTS

Rapporteur's Report on Reassessing Agri-Food Systems for Sustaining Nutritional Food Security Evidence, Imperatives and Way Forward

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I

INTRODUCTION

Food and nutritional security are a fundamental global concern intimately intertwined with the availability, accessibility, and utilisation of safe and nutritious food for all at all times. Food systems are complex and consist of diverse actors, activities, and their interactions, which must be considered in the context of rapid population growth, urbanisation, growing incomes, changing consumption preferences, and globalisation, as well as climate change and the depletion of natural resources. However, often, the system does not deliver the expected food and nutritional security outcomes due to deeply embedded social and economic inequalities. The transformation of food systems towards sustainability, efficiency, and nutritional security is widely acknowledged in research and policy circles. However, as we stand at the intersection of complex challenges, the impact of climate change on food and nutritional security looms large, especially in recent years. Climate change is unleashing a cascade of environmental transformations, from altered weather patterns to increased instances of extreme events, which collectively pose formidable challenges to food production, distribution, and, ultimately, the nourishment of communities worldwide (Roy, 2019; Lawrence *et al.*, 2020).

The paper contributors to this theme and session of the Conference have provided rich insights through their observations, assessments, and analysis, covering a wide range of issues, regions, etc. Their contributions - as many as 36 papers were reviewed in the accompanying paragraphs under four headings. Finally, an attempt is also made to present a critical evaluation of the issues addressed and their limitations in these papers. This evaluation seeks to set the framework for discussion in this session and also to recommend a further research agenda in the broad area of the theme.

1. Leveraging Technology and Diversification to Ensure Food and Nutritional Security

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India's agricultural landscape presents a dynamic mix of challenges and prospects across various sectors, including millets, horticultural crops, fish production, and dairy farming. The diversification of food systems mitigates the risk of crop failure and access to sufficient and diversified food, which improves not only food security but also dietary diversity and nutritional security. Millets are of paramount importance due to their exceptional nutritional value, climate resilience, and sustainability. Their ability to thrive in adverse weather conditions, requiring minimal water and withstanding the challenges of climate change, underscores their significance in ensuring food security. Moreover, millet promotes sustainable agricultural practices, enhances soil health, and supports local food traditions. Their economic potential and role in diversifying diets make them a vital component of global efforts to address nutrition, environmental, and food security challenges. Minor millets too offers significant opportunities for smallholder farmers to diversify their income, improve food security, and contribute to environmental sustainability. A large number of studies focused on millets, including minor millets, addressing issues related to production growth, profitability, price stability, including strategies to enhance their production share.

Though, millet is recognised for its potential as climate-resilient food, a study by Anju Yadav *et al.* indicated that the cultivation of pearl millet and finger millet has faced negative trends in area and production but with positive yield trajectories in recent years. The other study findings (Divya Sharma *et al.*) also revealed that the profitability of small millet cultivation offers a promising avenue for the farmers, especially in high-mountain regions (Himachal Pradesh). The findings of a study on minor millets by V. K. Choudhary *et al.* estimated the average cost of cultivating Kodo millet at Rs. 26,838 per hectare, little millet at Rs. 11,674 per hectare, and finger millet at Rs. 33,281 per hectare in tribal areas of Chhattisgarh. The overall input-output ratio was obtained as 1:1.20, 1:1.40, and 1:1.16 for kodo millet, little millet, and finger millet, respectively. These results have shown the low cost of cultivation and also the profitability of millet cultivation in tribal areas of Chhattisgarh. However, a study by Chetti Praveen Kumar revealed a gradual decrease in the area under small millets cultivation in the Visakhapatnam district of Andhra Pradesh. The study by Ashish Kumar *et al.* revealed that the area growth estimates for all millets turned out to be negative. The estimates of production growth were also negative except for pearl millet. The findings from Markov chain analysis showed that among crops like groundnut, sugarcane, cotton, rice, wheat, maize, and all millets, rice is the most stable crop, followed by wheat, maize, and sorghum. The findings of some studies amply showed that farmers are discouraged from growing nutri-cereal crops due to low profitability, suggesting a clear preference for other cereal crops, which is exacerbated by the low yield of millets and other socio-economic challenges such as lack of market access and awareness about MSP, and meager percentage of trained millet farmers (A. Narayanamoorthy *et al.*, A.K. Basantaray and S. Acharya).

Apart from nutri-cereals, diversification towards horticultural crops is crucial for enhancing food and nutritional security by offering a wide range of health benefits, supporting sustainable agriculture, and providing economic opportunities for both farmers and consumers. They are an integral part of a diverse and balanced diet, ensuring that people have access to the essential nutrients needed for good health and well-being. Sourakanti Sarkar *et al.* investigated crop diversification trends in West Bengal and found an overall increase in diversification. The determining factors include landholding size, literacy rate, cropping intensity, and fertiliser consumption. Improved irrigation, education, and capacity-building programs were suggested as the measures to encourage diversification and enhance food security in the region. In Tamil Nadu, P. Alli highlighted that the cost of cultivation has been rising, squeezing profits for many crops and leading farmers to shift towards more profitable high-yielding variety (HYV) crops like horticulture. This shift reflects the challenges faced by farmers in the region and underscores the need for strategies to make cultivation more economically viable.

The findings of Ram Singh *et al.*, reported progress toward food self-sufficiency in the Northeastern region of India, but self-sufficiency was achieved in specific food categories. The study highlighted the potential for further improvements in vegetable production. The study of Debasmita Baruah showed that Assam lemon witnessed substantial growth in area, production, and productivity, while the Nalbari district in Assam faced considerable instability.

Livestock and fisheries sectors have also played vital roles in India's food security and helped in enhancing livelihood security for millions. Fish farming contributes to protein intake and addresses the increasing demand for aquatic products, reducing the pressure on wild fish stocks. Both sectors offer opportunities for small-scale and sustainable practices, boosting the income of farmers and improving the nutritional security of the nation. The fisheries sector has witnessed a structural transformation over time, and inland fish production has surpassed marine fish production. The growth performance of the states with respect to both inland and marine fisheries differed widely. A. Suresh *et al.* reported that more than three-fourths of the total fish produced in India continues to be utilised fresh, and only about 15 per cent is processed, mainly targeting the export market. The study identified that the potential to augment fish production by using under-utilised resources is high. In view of increasing urbanisation, population growth, and changes in the tastes and preferences of consumers, the demand for fish is poised to rise in the future. Due to the high demand, fish as a commodity may become inaccessible to several low-income consumers unless its production is increased to meet the demand. This warrants strategies to increase production through sustainable intensification through technologies, institutions, and policies while keeping the ecosystem healthy. Dinabandhu Bag evaluated net earnings and benefit-cost ratios of traditional, integrated, organic, and allied farming experiments and suggested specific policy interventions for their promotion to enhance the incomes of small and marginal

farmers. However, the study acknowledged that the findings need to be revalidated with a larger set of experimental data and actual farming conditions.

Food accessibility, food availability, food utilisation, food stability, and food security index were highest among the households that belong to the General category of social group and lowest among the households that belong to the SC category (Surendra Singh Jatav and Srija). Tribal women are relatively more vulnerable to chronic energy deficiency across different social groups in Odisha (Balram Kumar and Vijay Laxmi Pandey). These studies emphasised the need for occupational and crop diversification to ensure more equitable access to food and suggested that efforts are needed to enhance the overall dietary diversity, increase pulse consumption, and leverage the existing PDS infrastructure to address nutritional deficiencies. Similar evidence was also reported in Kalimpong district, West Bengal, which examined the effects of COVID-19 on the calorie intake of the local population. The results indicated a significant negative impact of the pandemic on food security and socio-economic well-being. There was a notable decrease in daily calorie intake and dietary diversity among the surveyed households in the post-COVID period, highlighting the adverse consequences of the pandemic on nutrition and livelihoods (Auindrila Biswas *et al.*). A significant observation by study (D. Tata Rao) is that reverse migration caused by the COVID-19 crisis is a substantial risk to agriculture and rural economies, possibly pushing 400 million informal workers further into poverty. Additionally, he suggested that immediate actions like cash incentives and wage subsidies are crucial to aid migrant labourers and small-scale farmers. These short-term measures should complement the predominantly long-term strategies outlined in the government's economic package. The study by K.R. Prakruthi *et al.* also highlighted the severe impact of the COVID-19 pandemic on dairy producers and the dairy cooperative in the Mandya district.

Lastly, valuable insights into the research landscape of agri-food systems and nutritional security and research gaps were identified by Raka Saxena *et al.* The study provided insights and directions for future research efforts based on a bibliometric analysis of 1057 documents listed in the SCOPUS database from 1984 to May 2023. The thematic progression emphasised mitigation strategies to counter the impact of climate change, abiotic stress, and, most importantly, the COVID-19 pandemic on nutritional security in recent times. These research efforts collectively contributed to a better understanding of the complex interplay between food security, nutritional security, and the challenges posed by the COVID-19 pandemic. The study also emphasised futuristic research ensuring interdisciplinary collaboration, technological advancements, and a holistic approach to achieve long-term food and nutritional security, climate adaptation, biodiversity, and equitable access to nutritious food.

2. *Improving Agricultural Value Chains for Sustainable Food Systems*

Pyush Salhotra *et al.* analysed the value chain dynamics and farmers' willingness to join the value chains of the black gram crop in Punjab. The study showed that black gram cultivation in Punjab provides consistent returns for the farmers, with the involvement of Farmer Producer Organizations (FPOs) and Self-Help Groups (SHGs) adding value to the value chain. More than 53 per cent of growers expressed interest in participating in value chains with government support, indicating the need for incentives and capacity building. The other study in Chhattisgarh highlighted that factors like productivity changes, market access, and quality assurance significantly influence FPOs' performance. (Sanjay Kumar Joshi and Ajay Kumar Gauraha). Thongam Kanyalaxmi Devi and Hulas Pathak's study on the Chakhao rice (Black Scented Rice) value chain in Manipur emphasised the potential of Chakhao to contribute to food security due to its unique traits and organic nature. The study advocated for multi-stakeholder partnerships, including small-scale farmers, to ensure sustainable food security and nutrition, particularly in terms of black rice protein. The study on the marketing of tomatoes in the Balangir district of Odisha revealed the significant post-harvest losses at the farm level and recommended the establishment of Krishak Bazars for direct marketing and the development of cold storage and processing facilities (M. Udhayanithi *et al.*). In Punjab, the challenges in market infrastructure found that various markets in the region lacked adequate facilities, with deficiencies in areas such as covered sheds, canteens, price display boards, and parking areas (Lovepreet Singh). The other study by Braja Bandhu Swain and Nils Teufel showed that 70 per cent of produced milk is consumed as a liquid, while 30 per cent is processed into products like curd, ghee, and cheese. In areas with weak dairy co-operatives, farmers undertake milk processing themselves and sell to intermediaries and sweet shops, with intermediaries playing a vital role in marketing milk and cheese (55 per cent). In contrast, co-operatives play a more minor role (38 per cent), and only 20 per cent of ghee is sold through co-operatives in Odisha. Women manage the dairy farmers at the household level. Yet, their contributions remain undocumented, with income control typically in the hands of male household members and often diverted to non-productive purposes. Policy changes are needed to integrate producers and consumers and enhance women's capacity for confident negotiation.

3. *Strengthening Agriculture's Resilience to Climate Change*

The study in flood-prone areas of Assam focused on climate-resilient cropping patterns and their impact on food security and found that factors such as flood hazard zones, total cultivated area, crop diversification, access to irrigation, and extension services significantly influenced the proportion of land devoted to climate-resilient crops. These practices can help reduce climate risks, enhance agricultural productivity, and improve food security (Aktar Hussain and Pradyut Guha). The study on tomato growers' awareness and willingness to pay for environmentally safer

pesticides (Anjali Tewari and S. K. Srivastava) revealed low awareness, inadequate pesticide handling practices, and a majority of farmers willing to pay 5-10 per cent extra for eco-friendly pesticides. Factors such as education, perception, net returns, and age positively influenced the willingness to pay, which highlights the potential for promoting sustainable agriculture and reducing health and environmental risks associated with chemical pesticides.

The organic wheat cultivation in Punjab and its economic and environmental implications (Mini Goyal *et al.*) found that while organic wheat prices vary, they often surpass the minimum support price (MSP), making it an economically attractive option for farmers. The challenges identified are the availability of farmyard manure (FYM) and relatively lower yields. The study proposed gradually increasing organic wheat cultivation, allocating specific areas, and offering assured marketing support to pyaddress these challenges and enhance both public health and soil quality. D. Ramdas investigated the limited adoption of the System of Rice Intensification (SRI) in dryland villages of central Telangana. Despite 95 per cent of farmers incorporating modified SRI elements, obstacles related to weeding, spacing, transplanting, labor shortages, and uncertainties impede wider adoption, highlighting the need for solutions. In a study by Integrated Farming Systems (IFS) in Telangana (Gayathri Sandrala *et al.*), it was observed that incorporating non-crop components alongside crop farming resulted in increased productivity, job opportunities, and improved nutritional security compared to traditional crop cultivation. This highlights the potential of IFS for enhancing livelihoods and healthy well-being in the area. The recommendations from these studies include encouraging the adoption of climate-smart and climate-resilient practices on farmers' fields such as crop diversification, System of Rice Intensification, usage of eco-friendly pesticides, organic farming, and IFSs, which will contribute to food and nutritional security.

4. *Institutions and Policies Strengthening Food and Nutritional Security*

Policies play a crucial role in addressing the challenges of food and nutritional security in India. Government encompasses a range of policies and programmes, such as the Public Distribution System (PDS), Integrated Child Development Services (ICDS), agricultural credit and insurance schemes, and nutritional education campaigns. These efforts aim to ensure the availability, affordability, and accessibility of nutritious food for all, with special emphasis on vulnerable sections. They promote sustainable agricultural practices, crop diversification, and the inclusion of nutrient-rich foods like millets, bolstering the diversity and quality of diets. Additionally, these strategies empower women and improve child welfare, strengthening overall public health. By addressing food and nutrition challenges holistically, they play a pivotal role in advancing the well-being of India's population and driving inclusive development. A few studies documented valuable insights in addressing India's agricultural and food security challenges.

Integrated Child Development Services (ICDS) is a crucial instrument in advancing the nutrition security agenda among the most vulnerable groups in India. As per the ICDS project, the NFSA identifies Anganwadis responsible for ensuring critical nutritional food and supplements to pregnant women, lactating mothers, and children with the primary objective of improving the nutritional and health status of children in the age group 0 to 6 years. The Public Distribution System (PDS) of India reduces food insecurity and acts as a safety net by distributing essentials at a subsidized rate. Gummadi Sridevi *et al.* have shed light on the critical issues of the ICDS programme in Telangana. Her research findings highlight the barriers and challenges faced by the ICDS program in Telangana, particularly in rural Anganwadi centers, in fulfilling their mission to enhance child nutrition. These challenges are attributed to resource constraints, low wages, and limited support from both markets and political stakeholders. She suggested that addressing these issues is crucial for improving the nutritional status of marginalised children, especially girls, in the region. The study by Gangadhar Banerjee and Sarda Banerjee Ganguly scrutinises the performance of the Public Distribution System (PDS) in India concerning food and nutritional security. They highlighted the ongoing issues related to targeting, diversion, and corruption, affecting its ability to provide food to those in need efficiently. PDS can play a role in addressing food and nutritional security in India but emphasizes the pressing need for policy reforms and improved efficiency to make it a more effective solution for combating hunger and malnutrition.

The findings of Aniketa Horo *et al.* emphasise the need to improve production and marketing facilities for sugarcane, especially in regions where productivity lags behind the national average. The Ministry of Food Processing Industries and NAFED (National Agricultural Cooperative Marketing Federation of India Limited) are jointly implementing the One District One Product (ODOP) approach of Pradhan Mantri Formalisation of Micro food processing Enterprises Scheme (PMFME). The study suggested that the "One District, One Product" initiative holds promise for addressing critical challenges faced by sugarcane farmers in Jharkhand. Pricing policy disparities are evident in the study of Neha Thureja and Avanindra Nath Thakur, which highlight the uneven effectiveness of such policies between Punjab and Bihar, impacting farmers' livelihoods. They recommend strengthening procurement infrastructure and re-evaluating the Minimum Support Price (MSP) objectives in Bihar, while in Punjab, a multifaceted approach is essential to achieve MSP and pricing policy goals. The study by Bidyabharati Dash and Lipishree Das revealed that agricultural credit significantly impacted green gram production in the Cuttack district of Odisha but didn't influence other crops. The main reasons for the ineffectiveness of agricultural credit are high interest rates, delays in loan disbursement, high security, and rigid loan procedures.

In summary, the above studies well-documented the importance of millets and horticultural crops for food and nutritional security, agricultural value chains for sustainable food systems, and strengthening agriculture's resilience to climate change.

Some of the authors reported the impact of COVID-19 on agricultural and dairy farmers. Finally, the studies suggested measures for addressing the production challenges, the ineffectiveness of agricultural credit, disparities in pricing policies, and critical issues of nutritional intervention policies in India. Women play a vital role in shaping dietary diversity within households and communities. However, no study has been reported on women's role and empowerment in improving dietary diversity and the overall well-being of households.

II

SOME REFLECTIONS AND SUGGESTIONS FOR IN-DEPTH DISCUSSION

The findings of the studies included for discussion provided rich insights on primary drivers of diversification towards nutri-cereal crops, horticultural, livestock, and fishery sectors among the farmers. The papers have explored issues like how the challenges faced by millet cultivators, such as low yields and limited market access, can be addressed to promote the sustainable cultivation of these crops. However, more insights on strategies/incentive mechanisms for cultivation & value chains of minor millet and other nutri-cereal crops in India, particularly in regions where they face declining trends, is crucial. The constraints faced in agri-food systems have been studied but with limited methodological rigour. Some critical issues did not receive authors' attention but are crucial for achieving food and nutritional security like incorporation of indigenous food into national and regional dietary strategies. By recognizing and supporting the value of indigenous foods, we can enhance dietary diversity, promote sustainable agriculture, and contribute to the overall well-being of communities while preserving traditional knowledge and cultural heritage. Similarly, none of the studies addressed strategies for enhancing biofortified crops, which holds immense promise in addressing both nutritional and food security challenges. There was actually no study on women's contribution and recognition of their pivotal role in achieving food security, reducing malnutrition, and fostering sustainable, healthy communities. Women's empowerment significantly contributes to dietary diversity within households. When women have increased access to and control over resources, they can prioritize nutritious food choices for their families. Their influence extends to diversified diets, including fruits, vegetables, and protein-rich foods. Women's economic independence through empowerment initiatives enables them to access a wider variety of foods. Their knowledge and awareness drive better nutritional practices, resulting in healthier and more balanced diets for their households. This, in turn, leads to improved food and nutritional security. Besides this, I would suggest in-depth discussions on the following questions.

1. What strategies can be implemented to encourage value addition and processing in the high-value crops sector to increase its economic viability? How can the dairy sector be made more resilient to external shocks, such as pandemics, to ensure both income and nutritional security for farmers? In

addition to livestock production, how can inland and coastal fish farming contribute to a more sustainable mode of animal protein production?

2. What is the potential contribution of localized food production to the overall sustainability of food systems?
3. What is the impact of the several nutritional intervention initiatives/programs on the anthropometric status of marginalized children, and how can its effectiveness be improved? How can the Public Distribution System address issues related to targeting, diversion, and corruption to serve those in need better?
4. Innovations in food system technologies may help meet the raising demand for healthy and sustainable food. Emerging markets of new food items & techniques could contribute in strengthening sustainable healthy dietary choices. How urban agriculture can contribute to the food and nutritional security? Evidences on the potential supply, consumer acceptability and their impact are still not well understood.
5. What are the barriers and opportunities related to agricultural credit & insurance in promoting the cultivation of specific crops, and how can credit accessibility be enhanced?