
Rapporteur's Report on Agriculture and Allied Sectors in Nutritional Security

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Malnutrition can be tackled through the consumption of nutrition-sensitive food and an agriculture production system focused on ensuring food and nutritional security. In a subsistence production system diversification of food production with an emphasis on allied sectors can fulfil the requirement for micro nutrients. Allied activities have the potential of ensuring dietary diversity that is cost-effective and can be produced in a sustainable way by small land holders. Needless to add, in order to encourage diversity, adequate nutrition and sustainability it is essential to reorient the food, nutrition and agricultural policies. While agricultural intensification is inevitable for ensuring food security, the former has threatened agro-biodiversity that is the basis of sustainable food production systems as well as off-farm livelihoods. This calls for mainstreaming biodiversity-led agricultural development models that could augment nutritional security and rural livelihoods.

Economic growth has a positive effect on reducing malnutrition, improving incomes and fostering greater spending on food, health care and education. The incidence of child malnutrition has been low in states with high per capita gross state domestic product (GSDP), with some exceptions. Mothers' nutritional status and education explain to a large extent the inter-state variations in child malnutrition. Women's role is critical for participation in livestock and other allied activities to meet the nutritional requirements of the households. Their participation can be encouraged by ensuring property rights and through direct cash transfers.

The quantity of food consumption is crucial for nutritional security, yet most people cannot access or afford a healthy diet. Nutritional access and outcomes differ when disaggregated by age, income, gender, ethnicity, sexuality, disability, migration status, etc. Inequities in food and health systems exacerbate inequalities in nutrition outcomes that in turn can lead to more inequity, perpetuating a vicious cycle. The focus of the 2020 Global Nutrition Report on "Action on equity to end malnutrition" highlighted inequities in the burden of stunting, wasting, obesity, micronutrient deficiencies and diet-related non-communicable diseases. It laid emphasis on deficiencies in health and food systems that limit the ability of vulnerable populations to receive the nutrition and care required for healthy and productive lives. Nutrition interventions have to be more 'equity sensitive' to comprehensively address malnutrition. How can the nutrition impacts of agriculture and agri-food value chains

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be enhanced through appropriate policies and strategies is the moot question? Institutional interventions, such as producer organisations, women's self-help groups and farmers' collectives can play a decisive role in reducing the transaction costs for producers and in creation of market linkages for small farms leading to better nutritional outcomes.

In addition to the existing micronutrient interventions such as food supplementation, industrial fortification and dietary diversification, bio-fortification is widely viewed as a cost-effective strategy to address malnutrition amongst the poor rural populations. It is a process of increasing the density of vitamins and minerals in a crop through conventional plant breeding, transgenic techniques or agronomic practices. Bio-fortified staple crops, when consumed regularly generate measureable improvements in human health and nutrition.

Under this theme 32 papers were received, out of which 22 were accepted for discussion and two papers were withdrawn. The papers have covered the broad themes of crop sector responses and adoption patterns resulting in dietary diversity; role of bio-fortification of crops and its implications for the policy; differentials in nutritional intake, household food security and the impacts on labour productivity, poverty and livelihoods; constraints and determinants of adoption of allied sector activities and their role in mitigating chronic hunger; the impact of mitigating strategies/programmes to address food insecurity such as the NFSM, public distribution system etc. One of the papers analysed the prevalence of nutritional deficiencies through the lens of vulnerability of population for a group of less developed states. Another paper mapped the global research on bio-fortification using the bibliometric approach in an attempt to review the current knowledge on the theme. Majority of the manuscripts were based on primary data, a few papers utilised the unit (household level) data from the official data generating agencies. Most of the papers have attempted in identifying the measures to combat nutritional insecurity and made an economic assessment of raising productivity of the sub-sectors through technology adoption and policy interventions.

Four papers were submitted on the broad theme of Crop sector adoption patterns, technologies and responses for attaining nutritional security. Since the beginning of the last century, concerted efforts have been made to deal with the chronic problem of malnutrition. The Public Distribution System (PDS), now the targeted PDS, is one of the prominent mechanisms for fighting hunger and poverty in the country. The paper by Anjani Kumar *et al.* has examined the potential for introducing bio-fortified crops in the Public Distribution System in states of Bihar and Odisha, two of the country's most poverty-stricken states. To address the challenges of micronutrient deficiencies, potential increase in zinc and iron intake was estimated by replacing the popular varieties of wheat and rice with bio-fortified zinc- and iron-rich varieties. The household consumption expenditure data of the NSSO was used to estimate the contribution of rice and wheat to the total intake of iron and zinc. The incremental gains in zinc and iron intake were estimated from the consumption of bio-fortified

rice and wheat that indicated that the replacement by bio-fortified varieties had the potential to increase the intake of zinc and iron by nearly 33 per cent. Econometric estimation to ascertain the probability of a household's purchase of rice and/or wheat from the PDS in Bihar and Odisha, indicated that the largest beneficiaries were the poor and the illiterate, who participated to a greater degree in the PDS.

Millets are considered to be 'nutri-cereals', even though their area and production have declined tremendously over the decades. Marketing opportunities for millet are imperfect and the tastes and preferences of people are shifting away from millets. In an important paper by Umanath Malaiarasan *et al.*, the determinants of choice probability of millet production along with the area adopted under millets were estimated. Adopting a rigorous analytical framework [Heckman sample selection (maximum likelihood) model] the impact of farm-household level, institutional, and economic character was assessed on the area under millets. The functional relationship revealed that price of millets and extension contact were the key factors affecting the choice of millets. Essentially millets production can be made profitable through price stabilisation process by ensuring minimum support prices and streamlining the procurement and distribution processes. The third paper by Diptimayee Jena and Srijit Mishra also advocated mixed cropping and cultivation of nutri-cereals (millets) given their nutritional advantages and climatic resilience. The authors examined the growth and instability of production, area and yield and decomposed production into area, yield and interaction effects for nutri-cereals and other crop groups from the sixties decade to the present. Recent policy initiatives to revive nutri-cereals in Odisha (Government of Odisha, 2016) and the Union government by declaring millets as nutri-cereals were welcome developments, yet the authors agree that further action is required for ensuring the importance of millets in cropping patterns. Good nutritional outcomes are dependent on the availability and supply of food. In the paper by Smrutirekha Mohanty and Minati Mallick, effort was made to study the production pattern of major food crops in the state of Orissa and ascertain the linkages of achieving nutritional security through implementation of programmes like TPDS, MDM, and ICDS. The results of the study showed that production of total cereals and pulses was increasing in the state, although growth had been relatively slow in case of pulses. Rice and wheat were the major food crops distributed to recipients of various programmes; whereas nutri-cereals notably, maize is lacking.

Nutritional security is asymmetrical and is marked by considerable inter-group variations across space, regions, resource base, classes, caste, age and gender. A set of seven manuscripts were accepted under the general theme of 'Differentials in nutritional intake, household food insecurity and consequences'. The average calorie intake in the mountain states of India, particularly amongst farm communities, tends to be lower than the national average. In this context in a comprehensive study Deepak Bhagat has assessed the magnitude of household food insecurity and its consequences on the nutritional status of children among the indigenous Garo tribe of

Meghalaya. The tribal communities of north-east living in relative isolation, were chronically food deficient and child under-nutrition was a significant public health problem. The study investigated the household Food Consumption Score (FCS) - a proxy indicator for household access to food and compared it with nutritional indicators of children under 59 months. While the anthropometric indicators of malnutrition and gender of children were found to be independent, a significant and positive correlation was observed between the household FCS and BMI of children. The authors agree that this necessitates emphasis on programmes for improving dietary diversity. The study also called for improvement in agriculture productivity under mountain specificities on a priority basis for strengthening the local food systems.

In another state-specific study Jyoti Chowdhary and H.P. Singh have looked at the rural-urban differentials in nutrient intake in Himachal Pradesh. The state witnessed income and economic transformation and rise in the consumption of high-value agricultural commodities. However, disparities prevail amongst income groups, with the poor households' major source of nutrients continuing to be cereals and pulses. The paper analysed the shift in per consumer unit nutrient intake to estimate the income-wise nutritional security status. Low-income households were the victims of nutritional insecurity owing to their low purchasing power. Given the dominance of agriculture in the state's economy consumption of diversified and high value food was noted to be higher in rural areas. Trends in the per consumer unit intake of nutrients across income groups show that there has been diversification in consumption basket. The findings could be more nuanced if the analysis had considered impact of the underlying socio-economic dimensions of households such as occupation, education, gender dimensions etc. In a somewhat similar vein the paper by M. N. Waghmare *et.al.* examined the pattern of production, consumption of nutrients by cultivators and sources of nutrients in the rain fed tract of Maharashtra. Calorie intake - an indicator of nutritional status was analysed for the size groups of farmers. Demographic status, landholdings, employment status of households in addition to production pattern of major crop/crop groups were considered for differentiation. Per consumer unit per day consumption pattern showed an increase with rise in the size of holdings. Diet diversification, essential for improving the nutritional status also increased with farm size and income. Diversification of food production through the introduction of horticultural crops, fish and livestock suited to local agro-ecological conditions was a useful policy suggestion with reference to households practicing subsistence farming.

The fourth paper authored by Y. Melba and K.R. Ashok assessed the food consumption pattern and dietary diversity among farmers of Tamil Nadu. This study empirically investigated the consumption habits of the farmers along with the relationship between food quality and agricultural production portfolio. Econometric analysis was carried out to explain the variation in diversity index for consumption across groups of households, with socio-economic and demographic determinants of

households being the regressors. Predictably higher levels of household expenditure allowed access to more food groups. In addition to income, education emerged as a major factor influencing the dietary pattern and nutritional status of the households. The paper authored by Sant Kumar *et al.*, explored the situation in eastern India where per capita availability of food grains is below the national average. Consumption pattern of major food commodities was analysed temporally and spatially. Calorie, protein and fat intake depicted increasing trend in both rural and urban households, mostly attributed to increase in cereals, milk, and horticultural consumption. Compared to the states' contribution in total production of rice and wheat their share in procurement is less, coupled with inadequate availability of storage facilities. In this context the recent trend of decline in financial assistance to food corporation of India is worrisome. The paper dealt with an important link, however, the absence of a coherent framework of analysis resulted in generic findings. The paper by A. Pouchepparadjou *et al.* also explored the consumption pattern and proportion of expenditure on different food groups for the younger Indians who form the major share of the demographic dividend. Through a primary survey the study gathered information on demographic profile, family income, consumption details of food items and average expenditures. The analysis was descriptive in nature and was confined to calculating frequencies. Inability to conceptualise the problem within a coherent framework resulted in a lost opportunity to address the nutritional needs of the adolescents and young adults and its possible future implications.

Poverty-nutrition traps often lead to labour market discriminations. There exists a two-way relationship between nutrient intake and productivity implying that workers with poor nutrition have low productivity which results in low wages and low purchasing power. An interesting paper by Ishita Varma and G. Mythili explored the role of micronutrient deficiency on labour productivity in rural India. The impact of consumption of five micronutrients - beta-carotene, thiamine, riboflavin, ascorbic acid and iron was ascertained on wages of individuals engaged in labour intensive activities. A wage equation examined the existence of nutrition-poverty trap and impact on wages. The authors have shown considerable skill in the use of estimation techniques to avoid estimation and selection biases. Engel curves for the nutrients considered revealed that intake levels were always below the RDA for all levels of real expenditure. Results support the contention that micronutrient consumption impact the earning capacity of workers. The study underscores the need for interventions that enable people to escape the vicious cycle of low nutrition and low productivity, in the realm of property rights and non-labour assets. However, theoretical underpinnings of the linkages with productivity enhancement and diversification in the agricultural (crop and allied activities) sectors were poorly conceptualised.

Allied activities mainly livestock rearing, dairying, poultry, fisheries, plantation sector significantly influence the nutritional security particularly of small and

resource poor producers, by way of increase in incomes and enhanced consumption of high value food items. Under the theme of 'Allied sectors and nutritional security' four papers were selected for discussion. In an in-depth paper, Mrinal Kanti Dutta and Baban Bayan examined the constraints in the adoption of crossbred cattle and its contribution to nutritional security in Assam, a milk deficit state. The paper explored the factors influencing the adoption of crossbred cattle by the dairy farmers, impact of adoption on net dairy incomes and effect on consumption of farm households by skilfully employing a Probit estimation technique. RBQ technique was used for ranking constraints according to their severity as perceived by the dairy farmers. Education status accounted for the adopters' access to government programmes, extension services, credit, cooperatives, marketing avenues. The findings revealed that herd size, knowledge about artificial insemination (AI), membership of dairy cooperative society, access to government programmes, and price of milk significantly and positively influenced the adoption of cross-bred cattle varieties. The findings on constraints indicate the need for active government intervention for feed and fodder scenario in the state.

Haryana is a top ranking state in milk production, giving opportunities to a large number of rural households to improve their income and employment in the dairy sector. Devesh Birwal assessed the determinants of livestock holdings in Haryana in his paper by conducting a primary survey in a village. There was unequal ownership of livestock across economic classes and social groups. Regression analysis revealed that the number of bovine animals owned by a household is dependent positively on operated land, number of adult females in the household and the caste status.

The livestock sector faces several risks in the realm of climatic change, technology adoption, marketing, policy etc. Ushering in sustainability in the animal husbandry sector justified the adoption of risk management mechanisms. However, there are numerous challenges to bringing livestock assets of resource poor farmers under comprehensive risk cover. This is a matter of concern, as livestock sector apart from being an important source of food and nutrition comprises an important pathway for poverty reduction. In their study Subhash Chand and Khyali Ram Chaudhary presented the status of livestock insurance policy and ground level evidences on insurance adoption in states of Haryana and Rajasthan. A farm level study of adopters and non-adopters was carried out wherein econometric analysis was used to identify the factors influencing participation in livestock insurance. The perception of farmers was analysed on the desired attributes for insurance products. The farmers reported difficulties such as higher premium, cumbersome claim settlement in addition to lack of knowledge about risk aversion products. The paper suggested awareness programmes to improve the implementation mechanism and cover more risk under the schemes.

Horticulture sector contributes to nearly a third of the agricultural GDP. It has emerged as a potential source for accelerating growth and plays an important role in ensuring nutritional security and poverty alleviation. The last paper in this group was

by Chanchal and Bhagchandra Jain pertaining to nutritional security of a plantation crop namely, cashewnut that is a rich source of dietary minerals. The study's main focus was on ascertaining the establishment and maintenance costs, cost of cultivation and net returns from cashew plantation over a five-year period. The computations were carried out at current prices. The research would have been rigorous and findings amenable to policy had the analysis been extended to assessment of the net present value benefits, as well as the risks and challenges faced by cultivators involved in this sector.

Government has introduced several initiatives to mitigate food and nutritional insecurity and enhance access and consumption of food at the household level. Prominent amongst them are the National Food Security Mission (NFSM), Public Distribution System (PDS), Mid-day Meals, Integrated Child Development Scheme (ICDS), Mahatma Gandhi National Employment Guarantee Act (MGNREGA), in addition to schemes related to the livestock sector, horticulture mission, bio-fortification of crops, insurance schemes etc. The impacts of various programmatic interventions show spatial and inter-group variations apart from inclusion anomalies that call for regular monitoring and improved targeting. The fourth theme was devoted to the 'Impact of schemes and programmes on improving food availability and nutritional security', and included five papers for discussion. The first submission was by Baiarbor Nongbri *et al.* who critically studied the food security schemes (PDS and MNREGA) in Meghalaya. The state, despite having four-fifths of its population dependent on agriculture, had the lowest calorific consumption and faced acute malnutrition. A number of government interventions were in place to bridge the food availability. In the paper an attempt was made to understand the impact of PDS at leveraging food availability across beneficiary households and that of MGNREGA to examine the distribution of income among the beneficiaries. A difference in difference estimator was used to understand the impact of MGNREGA on income levels of the treatment group. The state had benefitted from the two schemes however, there was a need for better distribution of commodities under PDS, that was marked by irregular supply. The authors have stated the need for subsidising food supplements other than cereals for enrichment of nutrition. Income on account of MGNREGA recorded a substantial rise, but scope of the scheme could be expanded further for creation of employment opportunities. The study underscored the important features of the working of schemes in the hill state and made an in-depth assessment of impacts.

In the paper by Khurshid Ahmad Rather and Shaveta Kholi food security for below poverty line (BPL) population was analysed for another hill state- Jammu & Kashmir. The state has nearly a million population below the poverty line. Evidence indicated that the monthly entitlement provided through PDS under NFSA is not sufficient to meet the consumption requirement of PDS beneficiaries exacerbating their food insecurity. The ability of the state to produce food grains locally and the PDS entitlement of food grains were thus examined. The NFSM was launched in the

state in 2016 but led to insufficient allocation of PDS food grains. This necessitated a state sponsored scheme to supplement the shortage of food grains, but it limited the additional entitlement that led to purchase of deficit food grains from open market at high rates. Given such problems, the study aimed at estimating the availability of food grains for the BPL population and the deficit. The field survey substantiated that monthly entitlement provided through PDS was insufficient to meet the consumption requirements and the state scheme too suffered from flaws, increasing the dependence on markets. The paper has not made any suggestions for improving the implementation mechanism of the schemes or for the state's agriculture policy to tide over the supply constraints.

The paper submitted by R. Nagarethinam and M. Anjugam assessed the impact of National Food Security Mission (NFSM) on pulses consumption across income groups in Tamil Nadu. Increase in pulses production is crucial for enhancing the availability of food and ensuring nutritional security. The paper adopted a robust methodology used by researchers earlier to estimate the elasticity of demand for pulses across income groups. Using the AIDS model, parameter estimators were categorised as own price-, cross price- and income elasticities during the pre- and post-NFSM phases. The consumption response of major pulses was examined owing to change in price and incomes. The paper however, performed poorly in terms of distilling policy relevant insights aimed at enhancing not only production but also household level pulses availability. Raj Jaiswal and Anil Kumar Dixit's paper also focused on reviewing the combating strategies for micronutrient deficiency. It assessed the important nutrition interventions, the status and trends in the consumption of various commodities. The importance of a multi-faceted strategy for nutrition improvement was highlighted, given that malnutrition, poverty and inequalities, education, water and sanitation, food production, gender concerns, and health are interconnected issues.

The last paper under this theme by Mrutyunjay Swain and S.S. Kalamkar assessed the soil health card (SHC) programme for sustainable agriculture and nutritional security in the state of Gujarat. A logit model was fitted to examine the determinants of adoption of SHC and the three predictor variables that were found to significantly influence the adoption of SHC were net sown area, total area under soil tested plots and years of education of the farmers. The study made an important observation relevant to nearly all the government interventions - that in view to achieve the quantity targets fixed, the quality norms in implementation were often compromised. The recommended doses of fertilisers were not administered due to the complexity of information provided in the cards. Overall, it was indicated that the SHC programme remained target oriented and is required to be made more demand driven for effective results.

Two additional papers were selected for discussion. The first by Yashi Mishra *et al.* introduced the concept of vulnerability to expected nutrient deficiency. A fairly comprehensive and tested methodology was followed for estimating vulnerability to

expected poverty, using the NSSO surveys on household consumption expenditure. The research predictably demonstrated that social stratification and landholdings impact vulnerability to malnutrition. The results indicated that chronic caloric deficiency was more ubiquitous than infrequent caloric deficiency. The interesting finding was that exceptionally vulnerable districts in the group of states being studied outnumbered exceptionally nutrient-deficient districts, highlighting the importance of effective public awareness campaigns. The second study was by Renjini V.R. *et al.* who have adopted a bibliometric approach to map the global research on bio-fortification. For the study the bibliometric details of the published literature on bio-fortification between 2000-2021 were extracted from the ISI Web of Science. Bio-fortification along with maize, vitamin A and carotenoids were the major research themes identified. Most influential authors and top institutes working on bio-fortification were identified. The findings provided clear insights to the researchers interested in the field of bio-fortification about current priorities and the future direction of research.

To sum up, the theme received a good response from researchers across the country, who highlighted the crucial issues related to malnutrition, nutritional security, and how the agriculture and allied sectors through choice of appropriate technologies, crops, and practices can contribute to sustainable production systems and enhancing incomes and the role played by government policies in mitigating hidden hunger. Most of the researches were based on primary survey and some used the consumption expenditure surveys of NSSO. However, the NFHS data offering variegated temporal information on health and nutritional outcomes was largely ignored by the paper writers. Some of the papers suffered from inadequate problem identification, robust methodology and lacked rigorous analysis. Intensive agricultural production to augment output and food security threatens agrobiodiversity that is the basis of sustainability and rural livelihoods. This was largely a neglected theme. More papers addressing the dimensions of gender as well as role of organisations and value chains in mitigating nutritional insecurity would also have further enriched the session.

The discussion in this session may address the following key questions:

- 1) How to promote adoption of appropriate technologies and specific commodities that enable the primary producers with poor resource base and low incomes to attain nutritional security?
- 2) How can non-price factors such as scientific research, investment in technologies and government programmes and schemes be leveraged for ensuring nutritional security in an urgent manner? What are the current implementation challenges facing the government schemes designed to mitigate chronic hunger and nutritional inadequacy?
- 3) What are the socio-economic determinants of nutritional inadequacy including deprivation and discrimination and how have the states performed in terms of fostering sustainable production systems to reduce the burden of under nutrition?