

RAPPORTEURS' REPORTS**Rapporteur's Report on Sustainable Agricultural Growth,
Diversification and Farm Income****Rapporteur: Bidhan Chandra Roy***

I

Despite having achieved self-sufficiency in food, the problem of poverty, hunger and malnutrition still persists in India and the real income of farmer has declined. Agriculture-led growth is the key to sustainable development as it reduces poverty by raising farm incomes, generating employment, stimulating the non-farm economy, and lowering prices of staple foods. Therefore, the three major challenges- feeding a growing population, providing a decent livelihood, and protecting the natural resource base- must be tackled together if we are to make agricultural development sustainable. This calls for adoption of a new strategy evolved around scaling of technologies and innovations, through an enabling policy environment and better governance. The new strategy should promote new agriculture on the principles of efficiency, equity and ecology, innovative institutions, public-private partnership and higher public investment (Government of India, 2019).

Though the focus of the theme was on recent trends and regional pattern of agricultural growth, diversification and farm income, the scope in the indicative outline was intentionally kept wide with the objective of inviting contributions on a wide ranging and even overlapping issues related to sustainable agricultural growth and farm income. Accordingly, under this theme, a total of 76 papers were received out of which 66 were accepted for discussion. The accepted papers covered broad areas like sources of agricultural growth and instability; crop and livelihood diversification; regional evidence on sustainability of production systems; climate change impacts, climate resilience and vulnerability of agricultural systems; adoption of sustainable farm practices; profitability of farming enterprises; and strategies for sustainable agricultural growth with enhanced farm income. The accepted papers, therefore, are categorised into six sub-themes as follows:

II

CROP, INCOME AND LIVELIHOOD DIVERSIFICATION

There has been significant transformation in rural areas through structural changes like crop diversification towards high value crops; diversification towards allied activities like livestock, poultry and fisheries; and livelihood diversification

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towards non-farm activities (Dev, 2019). The theme received a good number of papers on crop diversification, as cropping pattern in a region has major implications for the overall agricultural growth as well as farm income besides ensuring sustainability of natural resources. As many as twelve papers have examined the extent of crop diversification and their determinants across the regions. The paper by S. H. Malik examined the changes in the extent of crop diversification and its determinants in 21 major states during 2012-13 and 2018-19. The results show that though there is a positive correlation between the extent of crop diversification and farm income, the extent of crop diversification has decreased in most of the states. The study identified household size, occupational profile of a household, education of the head of the family and size of landholdings are important determinants of crop diversification. However, it is not clear why a log-linear model is used to identify the determinants where the dependent variable is bounded between 0 and 1. In such cases, even a logit transformation may not be appropriate, because in a cluster of observations the dependent variable may take value of 0. Therefore, use of a Tobit model would have been ideal so as to avoid any loss of information. Further, is it fact that proportionate area under fruits and vegetables has decreased over time? because the studies by Nidhishree R. as well as by Aniruddha Roy *et al.* reported higher level of crop diversification towards horticultural crops. Another study by Amit Kumar Basantaray and Shailesh Acharya also confirmed declining trends in crop diversification across the states particularly among the marginal and small households. This may dampen the scope of increasing their farm income and should be a serious cause of concern for policy makers in India. The paper by Nikkita Gupta and Elumalai Kannan too examined the extent of crop diversification and its determinants. The southern, western, and central regions in India have highly diversified cropping pattern, whereas the eastern and northern regions follow a specialised cropping pattern. Results show that irrigation, urbanisation, literacy and per capita income had positive and significant effect on crop diversification; while fertiliser use and cropping intensity are associated with specialisation. The study also that there exists industry-crop relationship leading to cultivation of certain specialised crops required for the industry. The paper by Avisweta Nandy *et al.* too identified irrigation as the driving force for crop diversification in Odisha. But as per the study by Rakesh Meher and Lopamudra Mishra, irrigation intensity, fertiliser consumption, and high-yielding variety seed promote mono-cropping culture, whereas access to credit, cropping intensity, and rural roads positively influence crop diversification.

The issue of farmer income has been an important point of discussion in India particularly since last two decades now. In this context, the paper by A. Narayanamoorthy *et al.* attempted to examine the regional pattern in farm income growth in recent years. By using SAS data of three-time points, namely 2002-03, 2012-13 and 2018-19, an attempt is made in this paper to find out whose (state) and which (source) farm income increases in India. Although the total annual income per

farm household has increased over time, significant changes have taken place in its composition i.e., share of different sources of income. Whereas the share of income from crop production has declined, the share of income from wage earning and rearing of animals has increased substantially in most states. Declining trend in income from crop production does not look good from the perspective of development of farm households. The univariate regression analysis shows that the factors determining each source of income are different and tend to vary over time and across regions. However, the study suggests that the rural infrastructure variables like irrigation, electrification and pucca road seem to play a significant role in determining farm income across the states as well as over time. Therefore, it is essential strengthening these infrastructure facilities to accelerate the farmers' income. Tapas Singh Modak and Madhura Swaminathan, in their study from Tamil Nadu, show that rural people are diversifying their livelihoods mainly due to low return and high risks in agricultural production. While 90 per cent of villagers are engaged in farming, only 13 to 19 per cent of their total income. Further, not all sections of society have benefited equally from growth in non-farm sector. Caste and gender still remains a predictor of income with very little non-farm employment opportunities. The livelihood of the poor is mainly getting diversified towards marginal and casual works like wage earning from MGNREGS and/or wage-employment in nearby urban centres. However, the survey was conducted in a bad agricultural year thus requires further investigation. The paper by Khumukcham Stina *et al.* also examined the effect of employment generation programmes implemented by the Government of India on the livelihood of rural poor in Manipur. A positive impact on livelihood security was observed on the beneficiaries of employment generation programmes in comparison to non-beneficiaries. But the study requires further examination with larger samples and employing better analytical tools of impact assessment. Using SAS data, Laishram Priscilla *et al.* examined the level of income diversification and determinants for the same in north-eastern region. The study found a very low level of income diversification among the agricultural households in the north-eastern region. Overall, crop cultivation (43 per cent) and wages and salary (38.22 per cent) are the primary income source for households. Since several obstacles limit the region's potential for agricultural and allied sectors development, there is a need to increase productivity and farm income through technological, market-driven interventions and infrastructure development. The rural enterprises of the region can be strengthened with the improvement of the tourism sector, particularly agro-tourism. Besides assessing the extent of crop diversification in Bihar, the study by Aniruddha Roy *et al.* also identified potential crops for diversification that can enhance farmers' income in the state. According to the authors, due to emerging marketing scenario, high value crops (mainly fruits and vegetables) may be given priority in the diversification strategy to raise farm income. In another paper, Madhavi Gautam *et al.* analysed the impact of crop diversification on farm income and employment in Himachal Pradesh. There appeared a direct

relationship between the level of diversification and per hectare net agricultural income in the study area. The study also reveals that income gets diversified with increase in the farm size. Therefore, efforts should be made to create more off-farm and non-farm employment avenues in the study area. The paper by Jahidul Haque and Nissar A. Barua also finds income and crop diversification as an important strategy for improving rural farmers' livelihoods in Assam. In a similar paper, B. B. Barik suggests that smallholders in Odisha can augment their income through agricultural diversification. The study by A. Prema *et al.* also revealed that rice based integrated farming system models ensured income and a sustainable livelihood for the farming communities in Kerala. A. A. Amrutha *et al.* found that that apiculture can be practiced as a sustainable agricultural diversification strategy in Kerala with proper government support for marketing and input supply. In order to increase farmers' income there is a distinct need to develop livestock sector that remained constrained by poor breeding as well as feed and fodder scarcity. Adopting robust econometric estimation techniques the paper by Biswajit Sen *et al.* finds that breed diversity in cattle and buffalo in India is declining. Efforts were also made to delineate various environmental and ecological factors that might affect the diversity of bovine breeds. Temperature, rainfall, pasture cover along with artificial insemination (AI) practice was found significant in determining breed diversity in cattle and buffalo in India. Contrary to popular belief, it was found that AI helps to enhance breed diversity in cattle and buffalo by reducing breeding effort needed by the individual farmer and thus stressed the need to popularise it. Besides a pathway to poverty alleviation, agricultural diversification is also considered as one of the most ecologically feasible, cost-effective, and easier ways of reducing the effect of uncertainties among small holders (Diana Feliciano, 2019). A paper by R. N. Barman and Amvrin Baruah, suggests risk minimizing optimal crop diversification plans for the riverine farmers of the Upper Brahmaputra Valley Zone of Assam. According to the authors, the riverine areas should have well laid out contingency plans with crop diversifications to tackle the high-risk flood situations leading to total damage of crops. The suggested risk minimization plans with diversified crop enterprises are considered feasible for the study area under the situation of resource availability. Such areas could be promoted, as production clusters, for a number of cash crops including *rabi* season vegetables.

In a nutshell, the papers received under this sub-theme, shows that the extent of crop and livelihood diversification have not remained uniform across the states/regions/crops/enterprises as well as over time. There appears to be one disturbing new trend of declining crop diversification in various parts of the country. This necessitates the need for region/sector specific crop plans considering natural resource endowments and local demands for agricultural commodities. This will help both to conserve stressed natural resources and manage price volatility, and thereby, leads to sustainable agricultural growth and enhanced farm income. Further, the papers received on crop diversification mostly examined the extents of crop diversification

and their determinants. Few papers also examined the scope to increase farm income through crop diversification. However, there is hardly any paper that examined the impact of crop diversification on sustainability of natural resources and building resilience to climate change.

III

CLIMATE CHANGE, VULNERABILITY AND ADAPTATIONS

Another important issue is climate change that presents a major risk to sustainability of agricultural system. The resource poor farmers are already faced with several challenges and their hardships get further compounded due to climate change which has now become a reality in India too with increase in both frequency as well as in magnitude of extreme climatic events. The latest UN report, therefore, has warned that climate change repercussions for India will be irreversible if New Delhi does not take drastic measures by 2030 (IPCC, 2022). Therefore, a major challenging issue in agricultural development is how to cope with climate change, which accompanies deteriorating stock of natural resources and growing water scarcity.

Quite a few papers have looked at climate change aspects in agricultural sector in India. The first paper by Ratna Kumari Tamang and Utpal Kumar De, with the help of adaptive capacity, exposure and sensitivity analysis, assessed the impact of climatic vulnerability on rice crop yield in Assam. The results show that the exposure to climatic variability has increased from very low in 2008 to a very high level in 2018. At the same time the adaptive capacity too increased substantially, but the level of vulnerability is still at very high level. High vulnerability would hamper rice production and food security in the region, considering the fact that rice is the staple diet of Assam. Increase in adaptive capacity leads to climate change mitigation, which is possible due to adoption of climate resilient agronomic practices, technological adoption and socio-economic progress. Therefore, steps need to be followed for the introduction of more climate resilient crops, technologies (soil testing, machineries, pest, drought and flood resistant seeds) to support the same. The second paper by Rajesh Moulkar and Dayakar Peddi examined the historical functional relationship between climate change and major crops yield in Telangana. With robust analysis, the authors find idiosyncratic climatic impacts on agriculture in Telangana and thus call for location and season-specific adaptation policies. *Kharif* crops are found to be more sensitive to temperature and precipitation changes, whereas crops in *rabi* remain largely resilient to changes in the levels of climate variables. The study recommends adaptation policies like installing climate information systems, index based insurance, encouraging climate resilient crops (example, heat resistant and drought tolerance crop varieties) and diversified cropping system at national and regional levels to minimise the future climate change effects on agriculture. Various strategies to achieve sustainable growth of agricultural sector includes conservation agriculture, organic agriculture, climate-smart & climate

resilient agriculture, etc. All of these have a common goal to improve soil health through use of lesser chemical inputs. Of late, researchers and policymakers in India also called for promotion of natural farming or zero-budget farming. As a concept this sounds very attractive but the pathways to ensure its growth is not clear. Taking a few case studies, the third paper by M. Srinavasa Reddy and Brajaraja Mishra has analysed the positive impact of climate resilient Zero Budget Natural Farming (ZBNF) in Andhra Pradesh in improving soil quality, raising crop yield, reducing cost of production, and generating sustainable farm income. The vision of the state government to scale up the programme by converting entire cultivated area in the state into natural farming is expected to promote sustainable agricultural development in the state. The fourth paper by Rajani Adikarla too assessed the sustainability of ZBNF in AP in contrast to chemical-based agriculture. Following “with and without” approach, the study concludes that ZBNF has contributed to sustainable agriculture through raising crop yields and improvement in soil fertility and farmers’ annual household income in Andhra Pradesh. However, both the papers, should have highlighted the link between climate change and ZBNF. It is also important to know how the ZBNF can be scaled up and what interventions are needed for the same.

Hilly and mountainous regions are particularly vulnerable to climate change. A sustainable approach for development of NER’s agricultural sector is need of the hour to mitigate the adverse effects of climate change on agriculture as well as to increase food production. A good balance between the need for food production and the preservation of the ecological system within the environment should be the primary objective. The paper by Anwasha Mahanta and Ratul Mahanta focuses on exploring how farmers in North East India have perceived climate change and the shift in the agricultural practices that they have adapted to mitigate this crisis. The majority of the sample farmers have clearly perceived increase in temperature, decline in rainfall, and increased fluctuation in the rainfall pattern. All these led to decrease in availability of water resources, decline in soil fertility and increased incidence of pests and diseases. Accordingly, farmers in this region also adopted a number of adaptation strategies like crop rotation, crop diversification towards fruits, increased use of micro irrigation, modern farm machineries, chemical fertilizers and pesticides. Although these strategies have a significantly positive impact on agricultural production but the influence is very negligible because the farmers have to face constraints while applying these strategies individually. Effectiveness improves when they form informal economic association (SHG) in agricultural system. Thus, a holistic and integrated approach must be adopted that enhances farmers’ ability to take suitable adaptation strategies. In a review paper, Jigyasa Singh shows that the north eastern hill region is experiencing climate change leading to loss of human livelihood, changes in the condition of livestock, and the emergence of infringing species. People living in mountainous areas are experiencing a wide range of adverse effects because of climate change on environmental degradation, loss of biodiversity, and deterioration of socio-economic conditions. Farming

techniques that helped people to succeed in the past may not continue to work effectively as the environment shrinks, population fluctuations, and rapid changes taking place in the world put a lot of pressure on different communities. It is important to educate people about climate change, mitigation, and adaptation options, equip them with the necessary skills, and encourage them to develop sustainable practices. However, the methodology and analytical tools used in support of this paper is very poor.

It appears from the contributed papers that climate change impacts are significantly more adverse in the rainfed and hilly areas and the resource poor are the most vulnerable groups. The coping mechanism to reduce climatic risks falls largely under the domain of diversifications of crop and livelihood activities as well as promotion of sustainable farm practices. Crop diversification is arguably one of the most rational and cost-effective approaches to cope with the vagaries of climate change and thus is vital for creating healthy agro-ecosystems, and to enhance farm income. However, very few studies empirically examined the contribution of crop diversification in reducing vulnerability of poor farmers. It is also important to study why ZBNF is not being popularised beyond Andhra Pradesh?

IV

SUSTAINABLE AGRICULTURAL PRACTICES AND POLICIES

In the first couple of decades after Independence, the government had to increase food production and ensure self-sufficiency in food through input-intensive green revolution. While India did achieve rapid agricultural growth, the revolution left in its wake a number of questions about its sustainability. Sustainable agricultural practices (SAPs) offer a much needed alternative to input-intensive agriculture. However, SAPs are far from mainstream in India and only a select few like crop rotation, rain-water harvesting, agro-forestry, organic farming, vermi-composting and natural farming received some level of adoption (Gupta *et al.*, 2021). Available literature also revealed that impact of SAPs varies across the crops, agro-climatic regions and range of other conditions. In this context, the paper by Deepa B. Hiremath *et al.* examined the impact of adoption of water efficient drip irrigation technologies/practices in banana cultivation in Gujarat. The results, based on 120 banana growers, revealed that drip irrigation technology alone contributed 24.02 per cent increase in farm income both by reducing cost of production and increased yield. Despite higher initial capital investment, average total cost under drip method was found to be 11.52 per cent lower than conventional irrigation method. Thus the paper calls for intensive extension efforts through appropriate institutional support systems for rapid up scaling of the technology. An attempt has also been made by P. Harigovind to explore the economic advantage of use of bio-pesticide in organic cultivation of cabbage in Meghalaya. By usage of bio-pesticides, cabbage farmers were able to control pest and diseases up to a great extent and thereby resulting increase in their

farm income. The study also concluded that the bio-pesticide use has an added advantage in maintenance of biodiversity. The paper by B. Suresh Reddy examined the changes in adoption of soil fertility enhancing practices and to identify the factors influencing the same in semi-arid regions of Uttar Pradesh, Madhya Pradesh and Jharkhand. As high as 44-63 per cent respondents are in the opinion that soil fertility has increased over time. This is surprising when there is a decrease in the average number of soil fertility enhancing practices adopted by them. Continuous cropping and lesser crop diversity perhaps influenced soil fertility decline in several farms. Further, the study is based on memory based recollected information for the years 1995 (or 1985?), 2005 (or 1995?) and 2015 (or 2005?). This is a perception based study (how the sample farmers perceived the increase or decrease in the fertility level of their soils) which has its own limitations and should have been supported by long term soil fertility experiment data generated by the research institutes. Using data from 596 randomly selected farmers from 40 villages of Andhra Pradesh and Telangana, Vijayalaxmi D. Khed *et al.* examined farmer's willingness to accept legume crops as sustainable intervention to cope with climate change. Using 'Contingent Valuation Technique', the study examined the factors determining farmers' willingness to cultivate legume crops as an important SAP. The study found that agricultural land use patterns in the study districts moved toward monoculture over time and there is a dire need to reverse the trend. Financial incentives are necessary, at least at the beginning of the project intervention, and to realize the potentials of legume crop cultivation and fallow land utilization. The study also found that more than 60 percent of surveyed farmers were willing to include legume crops on farm for fallow intensification or intercropping. However, the effectiveness of these mechanisms has to be examined through further empirical research. Adoption of SAPs are key to sustainable agricultural growth.

From the contributed papers, it is clear that, SAPs are context specific and so are the research needs. Therefore, larger number of papers were expected. Further, the contributed papers critically lack long-term assessments of SAPs across the three sustainability dimensions (economic, environmental and social). The role of Civil Society Organisations (CSOs) in promoting SAPs also did not receive much attention from the paper writers. Both these aspects call for further research and discussions.

V

SOURCES OF AGRICULTURAL GROWTH AND INSTABILITY

Analysis of past sources of growth forms the basis for identification of future sources of growth. In a comprehensive study by K. B. Susanto and S. J. Balaji, using both descriptive and panel data analysis, a detailed analysis of the factors influencing agriculture growth in 535 districts from 20 states is taken up. Results showed that 28 percent of the variation in agriculture's share of GDP is explained by the terms of trade, capital-labor ratio and technology. While terms of trade and capital-labor ratio are negative and significant, implying an inverse relationship with agricultural

growth, technology has influenced agricultural growth positively and significantly. Adoption of new technology minimized costs, enhanced production, enabled multiple cropping systems, and in that process increased farm income. Hence, the study suggests an expansion of technology adoption to accelerate agricultural development. The analytical treatment in the study is very good but the figures and charts presented in the papers looks very congested. The paper by Alok Kumar Pandey *et al.* examined the time series behaviour of agricultural production and yield per hectare for the period starting from 1951 to 2021 and highlights the structural break and cointegration in the time series. As per the findings of the study, several factors are responsible for low productivity in the agriculture sector, such as illiteracy, lack of adoption of modern technologies, insufficient finance, insufficient irrigation facilities, and inadequate marketing of agricultural products. Therefore, creating a high productive and diversified agricultural sector would require a shift in public expenditures away from subsidies to productivity-enhancing investments. The agricultural research and extension systems also need to be strengthened to improve access to productivity-enhancing technologies. A. K. Sharma *et al.* too identified the past sources of growth in sugarcane production in India and found technology as the main drivers of growth. The authors suggested discontinuation of sugarcane in few areas (tropical regions) and also attempted to identify the potential areas (sub-tropical areas) for sugarcane cultivation in major sugarcane growing states. The cutting edge yield enhancing technologies will remain the drivers of sugarcane growth in future too. In addition, a better and innovative institutional mechanism for effective guidance and monitoring of technology use and transfer to the farmers is also required.

Using time series data from 1967-68 to 2020-21, Vinod Kumar analysed the trends and pattern in agricultural growth and crop output in India. The study reveals that diversification towards high value crops (HVCs) offers great scope to enhance farmers' income. The results of the crop output growth model shows irrigation facilities, rainfall and fertilizer consumption as main sources of growth. The study also stressed the need to improve productivity of small and marginal farmers through integrated farming system. There is also a need for coordinated action on the part of State Governments to facilitate the shift towards high value and less water guzzling crops to enable realisation of the objective of doubling farmers' income in a sustainable way. In a similar study, K. K. Bagchi *et al.* provided the scenarios of uneven growth of agricultural sector across Indian states and reasons therein. The study also recommended a list of strategies including proper manpower planning with sufficient training; strengthening of water resources and irrigation systems; modernisation and innovations of agricultural system; stressing on organic cultivation, mixed farming and contract farming; as well as search for new markets particularly international ones. However, in both the papers, the policy inferences are too generic and failed to suggest new strategies based on the findings of the study itself. Over the past 25 years, unemployment has been raised dramatically in almost

all nations of the world. In this context, an attempt has been made by Kanchan Datta to investigate the role of agriculture in reducing the youth unemployment in selected G-20 nations. Using panel data regression, the paper finds that gross fixed capital formation playing an important role for the reduction of youth unemployment across the G- 20 nations. In contrast, the paper by Anjoo Yumnam *et al.* reports differential impacts of agricultural investment on agricultural growth in Manipur. The researchers have come out with debatable finding of negative impact of public investment on agricultural growth. This finding may imply unproductive expenditure under many items of investment and thus require further examination. Analysis on item-wise capital use efficiency may throw some lights on efficient allocation of available investment funds.

Quite a few number of papers (by Sarba Narayan Mishra *et al.*; S. Mishra and S. B. Nahatkar; N. Laitonjam *et al.*; H. R. C. Gowda *et al.*; P. P. Mudoj and R. Buragohain; Debasmitta Baruah; and N. Narmada and K. R. Karunakaran) examined regional pattern of growth and sources of instability in the cultivation of agricultural crops. The instability analysis showed that instability in area, production and yield is relatively low in north-east regions as compared to other implying low uncertainty in production therein. Almost all the papers find yield as the major source of growth. However, there is scope to improve the presentation of results, analysis of data and inferences drawn therein. Last two papers even failed to de-trend the time series before estimating the instability in area, production and yield

In sum, many studies discuss the past sources of growth and instability in numerous crops in specific regions of the country. It appears from the above studies that volatility in agricultural growth has been declining indicating thereby increased resilience to long term climatic fluctuations. Some of the studies also decomposed the sources in growth and variability across the crops and regions. From the review of all such papers, it is clear that the technology was and will continue to remain the main sources of growth in future too.

VI

STRATEGIES & FUTURE SOURCES OF GROWTH

Agriculture sector in India, already facing several problems like unsustainability of land and water resources, declining total factor productivity, volatility in prices, climate change, and tiny size of farms. Narrative of Indian agriculture has been changing in recent years and thus there is a need for transformation of Indian Agriculture in the changing environment with a focus on growth, equity and sustainability (Chand, 2017; Dev,2019). In this context, Kanika Mehta *et al.* have attempted to identify the major challenges faced by the agricultural sector in India and suggested the pathways for its transformation towards green economy. Based on a Meta-analysis of published work covering 276 studies from across a range of disciplines, the study observed that the future requires transformation of agricultural sector with an emphasis towards efficiency, equity and

sustainability. According to them, the environmental pressures will tend to rise in future and should be addressed by technological change, policy reforms and suitable institutional responses. Furthermore, the use of climate-smart agricultural techniques such as precision agriculture and watershed management, as well as dynamic agronomic practices such as diversification, integrated farming systems, and organic farming, will help the country transition to a green economy in tandem with sustainable agricultural growth.

Public investment in agricultural research, irrigation, rural infrastructure and institutions has helped to attain impressive growth in agriculture and reduction in rural poverty. In fact, the public investment is still the major source of growth which has considerably high impact in raising agricultural productivity and reducing poverty (Roy and Pal, 2002). But it is a matter of serious concern that the share of investment in total public expenditure is declining over time. In spite of several policy reforms, corporate investment in agriculture is not picking-up and as expected and farm household investment is also constrained by lower rate of savings and slow growth in agricultural finances. Using data from All India Financial Inclusion Survey (NAFIS) 2016-17 of NABARD, a paper by Seema Bathla *et al.* estimated the income, saving and saving gap among agricultural households to understand their investment behaviour. The descriptive and empirical analysis shows saving and investment of cultivators are determined by income, among several other factors. It further reveals a weak association between household's saving rate and investment in agriculture and allied activities. This may imply households' dependence on borrowings for investment finance. Eastern states like Bihar, Jharkhand, Madhya Pradesh and Uttar Pradesh generally have very low saving rate and thus there is a greater need for higher public investment and increased flow of institutional credit in these states to sustain agricultural growth. The paper suggests state and farm size specific interventions along with increase in public investments, suitably tailored to augment household income and capital formation in agriculture.

Prices play an important role in changing cropping pattern and thus raising farm incomes. The paper by Sukhpal Singh and M. K. Sekhon finds that though the minimum support price (MSP) is an integral part of agricultural price policy of India, in its present form the announced MSP for 23 agricultural commodities is inadequate, because the declared MSP is not generating sufficient returns over cost and second MSP is not effective for all crops and for whole quantity. According to the authors, the MSP should therefore be used as the 'floor price' for bidding auctions in the market for all private purchase. Further, MSP should be fixed as per formula C_2 plus 50 per cent margin. Keerthika and R. Jayapriya examined the scope to increase farm income in rainfed areas of Tamil Nadu through maize farming. The results of cost and returns analysis indicated a very meagre net return from the production of maize. Fixing a fair minimum support price for maize may help the farmers from the fluctuating market price in improving the return from maize cultivation. Relative contribution of price and non-price factors in agricultural development is the focus of

the paper by Deepak Johnson. Using case studies of rice cultivation from Kerala, India and the Mekong Delta Region, Vietnam, the paper shows that the driving forces or sources of growth in farm income is very much region specific. Price policy, enhanced by local support measures, has been a major contributor to the incomes from rice cultivation in Kerala, whereas in Vietnam, the growth is mostly driven by higher level of public investment in agriculture and availability of short duration high yielding rice varieties. This contrasting experience brings out the conditions in which non-price factors work for improving agricultural incomes. While Kerala also had seen public investment in irrigation, the lack of suitable short-duration rice varieties and limited agricultural research and extension services implied that price support measures were effectively the only means for increasing incomes and sustaining rice cultivation. The effectiveness of price incentive in inducing and sustaining the process of agricultural growth is crucially dependent upon the sensitivity of crop output price response, the relative price movements of input and output and marketed surplus. In this context, using cost of cultivation data, L. K. Atheeq *et al.* are in the opinion that the MSP announced for Jowar are not sufficient enough to recover the cost of cultivation in Karnataka. The analysis clearly shows the method of announcing MSP on the basis of historical growth in prices, for jowar, is unscientific and need to explicitly consider the cost escalation of the vital factors of production and also reckoned with the increase in productivity due to technology. The positive impact of government subsidy on efficiency of farm is studied in a paper by U. Sandhyarani *et al.* The seed subsidies incentivize the farmers to use HYV seeds and also help in crop diversification and farm profitability and efficiency.

A comprehensive review paper by K. K. Datta *et al.* touched a large number of issues pertaining to the theme and explored avenues for accelerated rural incomes in north eastern regions (NER). According to the authors, mere pushing up of the agricultural sector in the NER may not be enough to achieve the targeted income and employment; rather complementary between agriculture and agro business needs to be enforced. For that, more investment in emerging areas like agro-tourism, development of value chains, are important along with brand building to promote GI products from NER. According to L. Geetarani Devi *et al.*, ginger cultivation can generate additional employment and income to the rural households in Arunachal Pradesh. However, in spite of production of quality produce, farmers' lack of information on prices and market linkage were more likely to be exploited by the middlemen. An integrated approach is needed involving both private and public sectors to link ginger growers directly with processors and exporters. The constraints and challenges faced by the tribal agriculture is analysed by M. Gopinath Reddy in his paper on Chhattisgarh. The low productivity and subsistence nature of agriculture in the study regions are mainly due to lack of agriculture extension networks, imperfect markets, non-inclusiveness of financial institutions. The institutions of credit, market, and agriculture extension is rather poor in tribal areas making agriculture therein subsistence and low productive. In order to transform tribal

agriculture from subsistence to economically viable activity, credit, market and extension services should be the priority areas of intervention.

It appears from the contributed papers that technology, policy, infrastructure and institutions will continue to be the future sources of growth in India. Past studies have shown that agricultural growth is more poverty reducing than growth in other sectors, and public investment in agriculture is a better instrument than government subsidy or price support (Roy and Pal, 2002). Therefore, it is necessary not only to increase public investment in agriculture but also to prioritize the investment portfolio across the regions and items of investment. But, there are not many studies received to draw meaningful conclusions on changing role of public investment to promote agricultural growth and farm income. Not a single study could provide any estimate for public investment requirement for achieving desired growth in agriculture. However, though this particular issue has not invited many papers for discussion, the message is amply clear that public investment is not only essential to strengthen agricultural research and rural infrastructure (irrigation, road, market, storage, etc) but also equally important to promote household investment too.

VII

MISCELLANEOUS ISSUES

The United Nations Sustainable Development Goals (SDGs) demonstrate rising global acknowledgement that in order to feed a growing population through 2030 and beyond, agriculture must become more sustainable and equitable (United Nations, 2015). Agriculture is one of the core industries in achieving SDGs, especially in developing nations like India. In fact, sustainable agricultural growth is at the heart of the agenda for SDGs and first fundamental step to securing zero hunger. While India achieved self-sufficiency in food production, it ironically also harbours the largest population in the world suffering from malnutrition

P. Aishwarya *et al.* estimated profitability of six major crops across the regions in India. The paper also looked at the relationship between the Minimum Support Price (MSP) and the cost of production for six major crops from 2009–10 to 2020–21. The study demonstrated that major crops had inter- and intra-regional variations in their profitability. Wheat, sugarcane and gram cultivating farmers were reaping profit from cost of cultivation. While paddy, cotton and groundnut cultivating farmers were not able to meet their cultivation costs due to their increased input costs and yield uncertainty. MSP has not grown as much as the increase in cost of cultivation. In order to increase agricultural profitability across all regions, the government must provide knowledge interventions based on agro-climatic zones. Farm profitability can be increased primarily by improving the crop productivity, so the main goal is to increase the gross value of output by increasing the yield and reducing input costs through mechanisation adoption. The economics of muga culture in Lakhimpur district of Assam is examined by A. Geethika Reddy. Findings show that muga rearer

had to incur some amount of loss in the initial four years, but from fifth year onwards it is a profitable enterprise. L. S. Gangwar *et al.* reported that MGNAREGS reduced outmigration and increased labour availability for sugarcane cultivation in Madhya Pradesh but short supply of quality planting material is an important constraint in achieving higher yield. The study also finds that mechanised cultivation can overcome the labour shortages during peak periods and also results into higher yield and lower cost of production thus raising farm income. The study concludes that the government should take policy decision to address sugar mills and farmers' problem to enhance per unit profitability to realize goals of farmers' income by adoption of technologies, entrepreneurship development and diversifying production, processing and allied activities in villages. However, the sample size of the study is quite small and policy recommendations are very generic in nature. Kalpana Singh and P. Utkarsha Gaware too studied the impact of labour out-migration on agricultural productivity growth in North Bihar. Migration, though a difficult activity, helps the poor households manage their livelihoods. It also helps in judicious use of human labour, which otherwise would have increased disguised unemployment. However the findings are based on a very small sample size of 30. The paper by Md. A. Hussain and P. Guha deals with understanding the question of sustaining agribusiness in times of lockdown. The paper estimated loss in crop and farm income due to pandemic induced lockdown in Assam due to lack of storage and post-harvest processing.

D. T. Kadu *et al.* examined the resource use efficiency and constraints in orange production in Arunachal Pradesh and Sikkim. Various constraints faced by the respondents revealed that the fluctuation of price, pest and diseases infestation, high transportation charges, losses due to weather and inadequate government subsidies were major constraints faced by the farmers in both the states. However the sample size is very small to draw too generic policy recommendations. The importance of marketing in increasing farm income is studied by Taniya Sah in her paper on cultivation of stone fruits in Uttarakhand. This study finds that when the family labour costs are included, cultivation of stone fruits in Uttarakhand is a loss making enterprise. The study also finds that high post-harvest marketing cost coupled with poor infrastructure and information asymmetry helps traders in wielding power over the farmers. Policy implications include an urgent need to develop storage and food-processing infrastructure. Devesh Birwal examined the cost of milk production in Haryana. The study finds that feed and fodder constitutes 80 per cent of total cost. The paper also shows that the presence of marketing intermediaries (dudhiya) within the village helps the small producers getting better price for their output. In contrast, Binodini Sethi *et al.* in their paper finds the marketing middlemen exploitative in case of marketing of potato in East Khasi Hills District of Meghalaya. The potato growers are unable to reap remunerative price due to lack of marketing information and awareness about marketing channels. Therefore, the authors suggested promotion of direct markets like, *Apni Mandis* to raise farmer's income. The paper by Raviprasad

S. and N. Adhikari also shows that direct marketing has the highest efficiency as well as largest producer share in consumer rupee. However, both the paper lacks analytical vigour and sound policy recommendations. Nabanita Borah made an attempt to analyse the status of production of milk, egg and meat in Assam along with their demand-supply gap. It was found that already a huge gap exists between the demand and supply of the commodities and the deficit will continue to increase in future. Therefore, concerted efforts are needed to increase production and productivity of livestock products in the state through commercial venture, and efficient production and marketing facilities.

In order to achieve SDGs, there is an urgent need to adopt a new strategy evolved around scaling of technologies and innovations, through an enabling policy environment and better governance. The new strategy should promote new agriculture on the principles of efficiency, inclusiveness and ecology, innovative institutions, public-private partnership (PPP) and higher public investment (Government of India, 2019). Almost all the state governments have prepared and submitted mid-term progress report on SDGs. However, it is discouraging not to receive a single paper on this particular issue. Some papers have provided just passing remarks to SDGs but none of them provided any empirical basis. Few of the studies could have empirically examined role of agriculture to meet the SDGs, particularly of no poverty, zero hunger and life on land. Similarly, other than price policy, effectiveness of government schemes and policies (like income transfer schemes) in achieving sustainable agricultural growth and farm income hitherto remained unattempted.

VII

ISSUES FOR DISCUSSION

The theme received a good response from researchers across the country and the contributed papers have addressed a wide range of issues flagged in the indicative outline. At the same time, many issues raised have not been covered by the paper writers. While a large number of papers were received on crop diversification, none showed inclination to address the question of how it leads to sustainability of natural resources. It is discouraging not to have received a single paper on role of agriculture to meet the SDGs or role of CSOs in promoting sustainable agricultural growth. Similarly, one hardly finds any significant contribution on issues related capital use efficiency, water and labour productivity, or adequacy of public investment for achieving desired growth in agriculture. The contributed papers also have not dealt with new methodological issues in measuring long-term sustainability, vulnerability assessment, development of scale-neutral diversification indices, and preparation of comparable estimates of farm income. More papers on these issues, with robust methodology and rigorous analysis, would have further enriched the discussion. Considering the issues indicated under this theme and focus of the accepted papers, the following issues are identified for further discussion and research.

1. Why farmers are not able to get increased income despite significant improvement in agricultural technology and rural infrastructure? How to enhance viability of small holder agriculture, particularly in rainfed regions? What kinds of policy interventions are needed to make small holding agriculture a profitable enterprise without compromising with long-term sustainability of the natural resources?

2. Quite a few studies reported decline in crop diversification. Is the level of crop diversification is now started declining across the states? If so, is it because of price policy or inefficiency in marketing system? How far the present price policy is responsible for promoting specialised farming and unsustainable use of land and water resources? How the diversification helps in achieving sustainability of production systems?

3. A large number of studies also reported inadequacy in minimum support price (MSP) and inefficiency in the procurement system. Further, MSP does not have any meaning unless there are procurements. How to address the issues? What is the performance of decentralised procurement systems? What should be the basis for fixation of MSP to promote sustainable use of natural resources?

4. Why farmers are not able to get increased income despite significant increase in productivity? A large number of studies reported negligible growth in farm income in spite of increase in MSP. This is mainly due to higher increase in cost of cultivation than increase in MSP. What technological and policy interventions are needed to reduce unit cost of production, in order to make farming a viable enterprise?

5. Assessing adequacy of public investment for achieving desired growth in agriculture is need of the hour but unfortunately not adequately addressed. How much investment is needed? What kind of incentives and regulatory framework are needed to promote private household as well as corporate investment in agriculture for higher agricultural growth? What should be the priority areas (both regions and items of investment) of investment?

6. During last few years, Indian farmers protested against the Union Government policy reforms in agriculture and forced the governments to repeal the laws. In this context, what may be the appropriate mechanism for such policy formulations? What type of agricultural policy can make agricultural growth sustainable and also enhance the income of the farmers?

7. Both the union government as well as several state governments like Odisha, Telangana and West Bengal started direct income support to the farm households.

What is the impact of such payments on government sources for public investment in agriculture as well as on farm level household investment?

8. Large variations in productivity and profitability across states/regions have been an important feature of agricultural development in India. How to ensure regional convergence in agricultural productivity, profitability and thus farm incomes? Similarly, how to take care of vulnerable groups and disadvantaged regions is another issue that requires in-depth discussions.

9. What kind of policy interventions are needed to face the impact of climate change in agriculture? Do we need to review the policies towards power, water and fertilizer subsidies? How to improve climate resilience of Why ZBNF is not being popularised beyond Andhra Pradesh?

10. Discussions in the conference must also address some of the basic questions raised in the indicative outline regarding sustainability of agricultural growth. For example, is an agricultural system that is sustainable is also one that is robust and resilient? Are sustainable systems necessarily profitable and equitable?

REFERENCES

- Chand, Ramesh (2017). Doubling of Farmers income Rationale, Strategy Prospects and Action Plan. Policy Paper-1/2017, NITI Ayog, GoI, New Delhi, pp.v+34.
- Dev, Mahendra S. (2019). Transformation of Indian Agriculture? Growth, Inclusiveness and Sustainability, Presidential Address delivered at the 78th Annual Conference of the Indian Society of Agricultural Economics held during November 1-3, 2018, Indian Journal of Agricultural Economics, Vol. 74, No. 1, pp. 9-61.
- Diana Feliciano (2019). A review on the contribution of crop diversification to Sustainable Development Goal 1 “No poverty” in different world regions, Sustainable Development. 2019;27:795–808. [wileyonlinelibrary.com/journal/sd795](https://www.wileyonlinelibrary.com/journal/sd795)
- GoI (2019). Report on Policies and Action Plan for a Secure and Sustainable Agriculture, Report submitted to the Principal Scientific Adviser (PSA) to the Government of India. Pp. xxiv+198.
- Gupta, Niti, Shanal Pradhan, Abhishek Jain and Nayha Patel (2021). Sustainable Agriculture in India 2021 – What we know and how to scale up. The Food and Land Use Coalition Report, New Delhi: Council on Energy, Environment and Water.
- IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press
- Roy, B. C. and Pal, Suresh (2002). Investment, Agricultural Productivity and Rural Poverty in India: A State-Level Analysis, Indian Journal of Agricultural Economics, Vol. 57, No. 4, pp. 653-678.
- United Nations (2015). The 2030 Agenda for Sustainable Development, <https://www.un.org/en/sustainable-development-goals>, Retrieved in 2022.