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Rapporteur's Report on Rural Transformation and Inclusive Development

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I

CONTEXT

Rural transformation refers to a multidimensional shift in rural areas, driven by on- and off-farm diversification, livelihood security through enhanced income, and the fostering of community- and institution-based innovations that link rural settlements to urban proximity. On the other hand, inclusive development refers to equitable access to resources and public-private services, benefit-sharing, environmental protection, and the empowerment of economically deprived populations. The ideals of the Bharatiya Model of inclusive development are Sabka Sath, Sabka Vikas, Sabka Vishwas, and Sabka Prayas (Virmani, 2023). In this context, ISAE thought it appropriate to discuss the theme on Rural Transformation (RT) and Inclusive Development (ID) at the 85th Annual Conference of the Society to be held at Chaudhary Charan Singh Haryana Agricultural University, Hisar, during November 26-28, 2025.

The theoretical and empirical applied research contributions covering these issues are invited by the Indian Society of Agricultural Economics to address the occupational diversification, structural & consumption changes and changes in inter & intra community relations and their dynamics, going beyond programmes' driven rural development mainly focusing on the topics (i) livelihood diversification and increasing importance of non-farm sources of income; informal and casual employment as drivers of rural income, casualisation of workforce; and an increasing number of pluri-activity households and its implications for the land market, (ii) changing dynamics of rural labour market, rural wages, gender, assets creation, household consumption, poverty, vulnerability, & income inequality, (iii) changing livelihood strategies and interventions as pathways to rural/agrarian transformation at the village/household level, including changes in agrarian structure, tenancy, interlinked agrarian markets, agrarian distress, and depeseantisation & de-agrarianisation, (iv) micro/village level studies on the process of livelihoods increasingly becoming de-linked from farming; poverty and inequality from land ownership, and poverty & inequality from occupational diversification, (v) diversification of agriculture, including crop & crop-related enterprises, & off-farm diversification, including issues related to part-and full-time farming, (vi) drivers of

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rural transformation including the role of migration, gender & caste; the emergence of rural towns as hubs of employment generation, increased rural connectivity, mechanisation, technology, microfinance, rural banks and skill development initiatives in hastening the process of rural transformation, (vii) role of different rural development programs and policies like MGNREGS, NRLM, and NFSA-based PDS in facilitating the ongoing process of rural transformation, (viii) comparative analysis and assessment of the ongoing process of rural transformation in India vis-à-vis rural transformation in other developing economies in Asia and Africa, (ix) role of community institutions/organisations like FPOs, SHGs, Cooperatives, APMCs, Panchayats and NGOs in rural transformation, and constraints and issues of inclusion in the working of these bodies, including their activities and projects in facilitating or constraining rural transformation, (x) the nature and extent of participation of households of different categories, including scheduled castes, scheduled tribes, religious minorities, and landless and near landless, in the ongoing process of rural transformation and its impacts on their livelihoods and levels of living and (xi) the effect of ongoing rural transformation at the national/regional/state/district levels and impact of rural development as measured by quantitative indicators including implications for attaining SDGs.

The theme has very comprehensive coverage, encompassing almost all aspects of RT and ID, and thus a large number of research papers have been received; however, the distribution of these papers across sub-themes has been quite uneven. The society has accepted 147 research papers from esteemed researchers across the country for discussion on the theme; each research papers focus on specialised issues of ongoing programmes of RT and issues concerning ID. For meticulous expression of research ideas, these research papers are categorised into seven sub-heads:

1. Livelihood Sustainability
2. Diversification for Rural Livelihood
3. Public Policies
4. Community Institutional Innovations
5. Climate Change and Inclusive Development
6. Transforming Food Systems for Nutritional Security
7. Natural Resource Management for Resilient RT

The first issue related to livelihood sustainability in RT comprises (a) capabilities, (b) assets, and (c) activities that are essential for a living. If a livelihood can cope and recover from stress and shocks, and maintain its assets and capabilities while taking care of natural resources, it is regarded as sustainable (DFID, 2000). Research papers received by the society for the first issue mainly addressed regional variability, socio-economic regional disparities, agrarian crises, shifts in feminisation, etc.. Still, researchers have paid very little attention to the situation of marginal and small farmers and backward classes, who are the backbone of the rural economy. By far, the largest number of research papers has been received on the second issue

related to crop, farming systems, livestock, labour force diversification, and on-farm and off-farm income-generating activities. Research papers on agri-technological aspects and cost-profitability structure for the introduction of new crops like kiwifruit, organic fruits, HDP apple, sapota, lilium, cabbage, oil palm, drumstick, etc., for crop diversification are also delivered by the researchers. But paper writers did not address issues related to the role of agri-based enterprises such as beekeeping, mushroom production, lac production, sericulture, inland fisheries, poultry, MSMEs for agri-product processing and value addition, etc., for agri-income diversification, off-farm employment generation, and gender empowerment. India has developed several prototypes of Integrated Farming System (IFS) models across various ecosystems, tailoring them to regional needs through combinations such as crop-livestock-poultry, crop-fish-duckery, or agroforestry systems, to increase farmers' income, recycle agri-waste, and generate additional employment, especially for family labourers. But only a single research paper has been received by the society on this issue. Many research papers are received on issues related to public policies for RT. Public policies for rural transformation in India encompass programmes, schemes, and initiatives focused on improving rural livelihoods, infrastructure, risk mitigation, backwards and forward linkages for the agriculture sector and digital inclusion. Researchers focus on most public policies related to agriculture, such as digital inclusion, PMFBY, NRLM, KCC, MSP, PM KUSUM scheme, PMKSY, MGNREGA, E-NAM, PM-KISAN, Bhavantar Bharpai Yojna (BBY), Custom Hiring Centres, Agricultural Subsidies, etc. Indian agriculture has a vast network of 731 KVKs, but the role of KVKs as a rural ecosystem-transforming nodal agency is not in-depth narrated by the researchers. Only 13 research papers were accepted under the sub-theme Community Institutional Innovation. These institutions help to improve community well-being by empowering people, fostering collaboration, and developing new ways to address local needs. From researchers, research papers are expected on the Agri-Startup ecosystem of the country as a grassroots-level service and an innovative agri-tech-driven sector to increase efficiency, sustainability, supply chain transformation, and farmers' empowerment, or the rapid transformation of the rural socio-eco system. Researchers are mainly focusing on the roles of FPOs, SHGs, and Cooperatives. Climate change has severely hindered inclusive rural transformation and increased vulnerability, especially in the agriculture sector. Rural livelihoods face greater income losses due to extreme weather, requiring significant robust climate adaptation and mitigation strategies. Researchers are expected to focus on adaptation and mitigation strategies to climate change for rapid, inclusive RT. Accordingly, research papers are received on adaptation and mitigation strategies, including crop insurance, climate-resilient infrastructure and crops, green technology, and climate-smart agriculture. A few research papers have also been accepted on GHG efficiency. The sixth sub-theme examines research papers on transforming food systems to ensure the nutritional security of rural populations. Very few research papers are received on this sub-theme. Researchers mainly focus on consumer

preferences, distress sales, rural welfare, and changes in consumption patterns and food demand. Research papers are also expected on the changing patterns of promoting nutrient-rich foods, strengthening the forward value chain for the supply of affordable food, and the role of PDS in food security. Natural resource management for resilient rural transformation involves sustainable, adaptive management to enhance the resilience of rural households and the agricultural sector. Researchers submitted high-quality research papers on the impacts of land and water degradation, floods, slum settlement and migration, renewable energy, management of agri-waste, natural farming, groundwater resources, and the trade-offs in electricity pricing policy. A few research papers were also expected on changing the land tenure system (land ownership, use and transfer) and legislative compliance. In this brief report, we do not intend to spell out the details of the research outcomes of the papers under discussion; rather, we shall draw out key issues from their analyses and conclusions. In his incisive keynote research paper, Singh has focused on the extent and nature of RT, as well as its dynamics, at the national, regional, local, and household levels in India. He also analyses the roles of the corporate sector, the state, and producer collectives in RT, and explores policy approaches to more inclusive and equitable RT. Singh's insightful and provocative research paper provides a lead for setting out major issues in a broad perspective. Research papers under each of these sub-themes are discussed in the next seven sections, and the issues emerging for discussion are identified in the last section.

II

LIVELIHOOD SUSTAINABILITY

In all, 29 research papers addressed the different components at the micro, meso, and macro levels. These research papers are further categorised into four groups based on the nature of the issues they have addressed. Most of the researchers (16) have analysed socio-economic indicators of rural development; some of the research papers (7) deal with inequalities and agrarian crises, only three research papers have been accepted on the issue related to agricultural labour, wages and employment and three research papers dealt with women's participation in agri-entrepreneurial development.

In the keynote paper by Singh, a conceptual framework for livelihood sustainability is developed. According to him, it refers to processes by which rural economies and livelihoods shift from subsistence-oriented food production and low incomes to more productive, diversified economic activities that are part of national and global markets. These observations are implicitly reflected in most of the research papers. A research paper by Bhatia et al. assessed the economic, ecological, and social factors that influence sustainability across various districts of Haryana. They selected 18 economic, ecological, and social sustainability indicators and revealed notable disparities between rural and urban districts of Haryana across all dimensions of sustainability, and suggested that economic indicators are crucial for

ensuring long-term livelihood sustainability. To reduce disparities between urban and rural areas, they have suggested strengthening infrastructure and services, especially to ease access to agricultural credit, healthcare, and education in rural locations. Harish et al. developed a state-wise composite sustainable development index for 28 states, using principal component analysis to assess agricultural sustainability across economic, social, and environmental dimensions. They observed significant regional disparities across the states. Kerala, Tamil Nadu, and Maharashtra states performed better on sustainability outcomes. Meghalaya, Gujarat, and Uttar Pradesh demonstrated relatively balanced progress across all pillars, while Goa, Telangana, and Haryana continue to lag due to resource degradation and weaker social indicators. They further observed that higher sustainability scores are strongly associated with improved rural poverty and resilience to climate variability. The study demonstrates that such a composite index can help policymakers to identify priority areas for investment and intervention, particularly in water-use efficiency, diversification, climate-resilient practices, and social inclusion. Khan et al. track trends in rural change indicators through a sustainability lens across different districts of Meghalaya. Agricultural sustainability is measured by them using the same three dimensions. Authors observed that Meghalaya experienced notable improvements in crop productivity as irrigated areas increased; social sustainability indicators showed significant gains in female literacy rates, the sex ratio, and infant mortality; and rural road connectivity expanded, thereby enhancing mobility. A marginal decrease in forest area coverage but an increase in crop diversification in the state is a positive sign for ecological sustainability. Based on the study, the authors observed that improvements in economic and social factors can strengthen the overall sustainability index. Still, they could lead to a trade-off with ecological sustainability in the long run. To assess agricultural and social transformation, Kumar and Nath conducted a study of inter-district disparities in agricultural and social development using principal component analysis. The authors select 12 disparity indicators, one for each of agricultural and social development. They observed a strong positive correlation between agricultural and social development. They reported that, out of 38 districts of Bihar, five districts — Jamui, Khagaria, West Champaran, Banka, and Rohtas —are the least developed in terms of agricultural and social development. The study on the factors responsible for rural transformation and the linkages among urbanisation, industrialisation, rural-industrialisation, and the livelihoods of rural people in Haryana is carried out by Tanwar using panel data regression and Pearson correlation analysis. She revealed that rural unorganised manufacturing industries, urbanisation, literacy, and agricultural & allied sectors' GDP per hectare of net sown area have contributed significantly to the transformation of rural areas in Haryana. She further argued that urbanisation is not directly associated with rural livelihoods, but it does strongly create opportunities for the rural sector. In the Northeastern states of India, the traditional form of agriculture is often considered an ideal way to balance current livelihood needs with the conservation of natural resources and the protection of the

environment for the benefit of future generations. On this line, Datta explores possible avenues to accelerate farmers' incomes by nurturing the growth of low-volume, high-value agriculture, transforming the state into a leading hub of sustainable livelihoods that typically suit the needs and aspirations of small and marginal farmers in the northeastern state. He observed that the region's rich agro-biodiversity and traditional knowledge systems have created a path-breaking potential towards rural transformation through Agro-based Micro, Small, and Medium Enterprises (MSMEs). It can fulfil the growing demand for niche, organic, and value-added products through home-based farming, engaging family labour. Malik et al. examine sectoral shifts in GSDP, changes in employment patterns, rural and agricultural infrastructure, and productivity trends in the state of Haryana. It is reported that agrarian transformation over the five decades (1970-2023) reflects significant structural, technological, and institutional changes in the state's agricultural economy, along with improvements in socio-economic status.

Nisha and Malik examine the trajectory of inclusive growth and rural transformation in India, review the literature, and use secondary data from various sources, concluding that policies that enhance equity contribute to sustained growth. At the same time, failure to ensure inclusiveness can lead to deep social divisions and instability. To ensure sustainable and inclusive development, public policies must adopt a comprehensive approach that encompasses education, healthcare, skill enhancement, and social integration, alongside employment generation in rural India. Choudhary et al. analyse the levels and trends in dairy income and expenses of agricultural households of different districts of Madhya Pradesh using unit-level data from the NSSO 70th and 77th rounds of Situation Assessment Surveys. They observed that between 2013 and 2019, real dairy expenses declined, while real dairy income increased in the state; this overall improvement masked regional and social disparities. Districts in the southern region progressed vis-à-vis districts in the south-western region, which experienced a decline, and incomes of the scheduled groups remained well below the state average. They reported that efficiency gains are evident due to a decline in real dairy expenses over time, but rising input costs for small farmers remain a concern. Kalamkar et al. conducted a comprehensive study of RT and ID in Moti Khadol village, Gujarat, comparing the benchmark survey data with the recent resurvey. The authors reported that the village has developed over the period, some people have migrated outside for children's education and jobs, but the livelihood of the village is still mainly based on agriculture and allied activities. They further reported that there is an improvement in economic condition, infrastructure, agriculture and livestock. Bhatia examined structural transformation in India's agricultural and allied sectors over six decades and reported that they have undergone significant change, driven by sustained higher growth. Convergence of employment, livelihood, and food security interventions has advanced sustainable livelihoods and inclusive growth in rural areas of Chhattisgarh, as reported by Sinha and Choudhary. They reported persistent challenges in capacity building, monitoring, and timely fund

allocation for strengthening rural transformation. Another research paper by Anuhya and Verma evaluates the disparities and trends in agricultural and economic development over a decade (2014 to 2024) using the Sustainable Livelihood Security Index across 33 districts of Chhattisgarh. The authors observed that high population density exerts pressure on natural resources, while forest coverage varies significantly, affecting biodiversity. Cropping intensity, net irrigated area, and livestock density emerged as the key factors influencing ecological sustainability. Economically, Raipur (0.751), Bemetara (0.814), and Balodabazar (0.71) showed strong infrastructure and resource efficiency, while disparities in food grain and milk production persist. Socially, higher female literacy, road connectivity, health centres, and commercial banks contributed to improved social equity. They further stated that 22 districts are moderately sustainable and 11 districts are sustainable during 2024-25. Kanwal et al. examine the impact of the digital divide (access and ability) on sustainable development outcomes, using socio-economic survey data from the 79th round of the NSO, which comprises 173,096 rural households. They constructed a sustainable development composite index (SDCI) using four indicators from the SDGs: safe water, better sanitation, health, and clean energy. Authors reported that both digital access and ability strongly determine sustainable development outcomes. They further observed that income is the primary driver of development outcomes, and digital skills amplify the benefits of income, particularly for households with lower and middle incomes. Socially disadvantaged groups are performing the worst on sustainable development indicators, even when controlling for digital interventions. They pointed out that, owing to better digital infrastructure in rural India, the majority of households have access to digital devices. Still, surprisingly, the parameters of digital ability paint a dismal picture: one-sixth of households are not acquainted with email or digital transactions. Tiwari et al. have examined the income structure of agricultural households in India using unit-level data from the Situation Assessment Surveys (70th round and 77th round, 2018–19) of the National Sample Survey. They reported that nominal household incomes are rising, but real incomes paint a gloomy picture, reflecting inflationary pressures. Their disaggregated analysis reveals stagnation in crop income in several states. In contrast, wage and salary earnings, livestock income and non-farm enterprises income exhibited relatively robust growth, indicating an increasing reliance on off-farm labour markets and allied agricultural activities. They further observed that regional disparities are pronounced; the northern region records the highest average incomes, while the North-Eastern region shows the fastest real income growth, and inequality remains high. Das et al. studied agricultural sustainability across the eight NE states through a composite index based on economic efficiency, ecological security and social security. Authors reported that there are wide interstate variations and complex trade-offs among the economic efficiency, ecological security, and social security dimensions. Assam shows strong economic and social performance but weak ecological outcomes; on the other hand, Arunachal Pradesh shows strong ecological

performance but poor social and economic indicators. They further noted that Meghalaya and Mizoram performed moderately, whereas Manipur, Nagaland, Sikkim, and Tripura lagged due to weak economic efficiency and inadequate social infrastructure. The authors suggested strengthening water resources, irrigation, rural infrastructure, and livestock integration, while reducing input-intensive practices to enhance the region's agricultural sustainability.

An agrarian crisis is a severe and systemic problem characterised by economic distress, productivity and growth stagnation, challenges to market and rural infrastructure, policy failure, rising input costs, and the loss of livelihoods, leading to widespread distress and a slowing of RD and ID. The extent of agrarian crisis in five districts of Tamil Nadu and Puducherry is examined using the distress proneness index, which comprises 15 factors of farmers' distress by Pouchepparadjou et al. They reported that a greater number of marginal farmers are indebted to institutional loans, which causes several physiological issues, viz., stress, sleeplessness, headaches, high blood pressure, and diabetes. Authors further observed that low yields, insufficient income, crop failure, and high input costs are the major reasons for indebtedness. They suggested some measures to reduce distress among farmers, such as introducing suitable cropping patterns based on soil conditions, availing loans from appropriate agencies with CIBIL score benefits, improving production technologies (crop varieties, advanced irrigation systems), and providing marketing facilities. Gogoi and Das studied livelihood strategies of rural households in the Lakhimpur district of Assam using a mixed-method approach (quantitative & qualitative). Authors reported a shift from agriculture to various non-agricultural activities, such as wage labour, non-farm business, and non-agricultural self-employment, for livelihood diversification. However, households still face challenges of declining agricultural productivity, climate variability, soil quality degradation, and natural calamities such as floods. Sustainable farming practices, climate adaptation strategies, and improved institutional support are essential to secure sustainable livelihoods, as the authors suggest.

The expansion of peri-urban and urban areas results in the conversion of fertile agricultural land to non-agricultural uses, potentially threatening food security and disrupting established rural livelihoods. To analyse these facts, Dagar et al. conducted a study on the impact of urban proximity on farm households in Punjab. They reported that villages near Ludhiana have larger families, improved education, more non-farm income and better access to formal credit, which intensifies their capacity to absorb socio-economic shocks as compared to households in rural areas. The authors further observed that the values of farm assets, household assets, and total income differ significantly between urban and rural areas. Zero tillage of wheat and mechanical rice planters, as resource-conserving technologies under stress conditions, have a positive relationship with the number of livestock in Punjab and Haryana, as reported by Rana. Shaharshad and Manikandan studied the crisis of

agrarian indebtedness in India, focusing on the socio-economic vulnerabilities of landless agricultural labourers, and highlighted how neoliberal policies, rising input costs, land fragmentation, and limited access to credit have exacerbated rural distress. They reported that caste, class, and gender inequalities, along with declining farm incomes, lack of secure employment, and limited access to institutional credit, have forced vulnerable rural communities into a cycle of hardship. Singh and Kaur studied socio-demographic inequalities among rural labour and marginal farmers in the border area of Punjab. They reported that illiteracy is a major constraint on rational decision-making, generating new sources of income, and on awareness of different government schemes. The study by Tyagi and Kathpalia found that crop residue management and soil conservation technologies can help reduce agrarian stress caused by stubble burning. They reported that the majority of farmers recognised that the super seeder is one of the best options for crop residue management due to its dual technology: a rotavator (for soil management with crop residue) and a zero-till drill (an energy- and time-saving device). Thus, it offers a practical, eco-friendly alternative to a more productive, environmentally friendly, and resilient system that relieves the stress of residue management for farmers.

Singh, in his lead paper, narrated the changing labour-hiring arrangements due to high demand driven by the transformation of farming (towards commercialisation), which led to increased income inequality. Apsara and Nayak reported a declining trend in agricultural labour in several states, including Karnataka, mainly due to urban migration and sectoral shifts. Another research paper on the trend in women's labour participation in northern states by Isha et al. reported significant disparities across states. Haryana and Uttar Pradesh show relatively lower participation rates, while Himachal Pradesh shows the highest, owing to commercial agriculture and an extended household service. They also reported that rural women increasingly have a significantly higher labour participation rate than urban women. The gender wage gap is analysed by Krishnan et al. in Haryana and Kerala, and they report that Kerala consistently offered the highest wages. Still, across all operations, male workers were paid higher wages than female workers, highlighting a persistent gender wage gap in the agricultural labour market. Their analysis of employment distribution revealed a clear shift away from agriculture and allied activities over the past three decades, driven by ongoing economic transformation.

Women's participation for livelihood sustainability is well highlighted in the lead paper by Singh. He observed that organisations that cover only women or are predominantly women have been important potential vehicles for rural transformation. He further observed that microcredit led to economic gains (increases in individual and family income) and to social freedom and decision-making power for women within the family and outside; lastly, he addresses the issue of landless women. Structural, economic, and personal constraints to women's participation in the agri-tech sector are examined by Khandre and Wakodkar, who reported that

women are redefining farming by blending traditional knowledge with modern techniques, forming FPOs, adopting organic methods, and leveraging government- and NGO-led support systems. Thus, empowering women in agri-tech leads to sustainable agriculture, strengthens food systems, enhances household incomes, and builds community resilience. Structural shift of feminization of farm operations is evaluated by Laura et al., and reported that participation rate of women in agriculture has been increased, western states being first in average female participation in agriculture, whereas, states like Gujarat show a more intricate interaction, with women's participation in allied industries such as dairy and cotton cooperatives significantly increasing, on the other hand North-eastern states reflecting growing women participation in agriculture. Koundal et al. conducted a study to analyse enabling factors, case evidence, and challenges affecting women's participation in agricultural enterprises. They suggested that strengthening women's role in agri-entrepreneurship requires an integrated policy approach spanning legal, financial, institutional, and socio-cultural domains. They further indicated that women-centric training in value addition, digital marketing, and export readiness, delivered through KVKs and NGOs, will increase their participation rates.

III

DIVERSIFICATION FOR RURAL LIVELIHOOD

In this section, 41 research papers are discussed, focusing on the different components of livelihood diversification in rural areas. These research papers are categorised into four groups based on the nature of the issues they have addressed. Very few researchers (5) have studied livelihood and income diversification; eight research papers deal with farming systems and crop diversification, five research papers have been accepted on the issue related to farm and non-farm diversification, and a large number (23) of research papers accepted are assessing production technology and new crops as an intervention for diversification.

Singh, in his lead paper, highlighted the importance of rural livelihood diversification and stated that it helps make small farmers commercially successful. According to him, the rural non-farm sector is also an important livelihood diversification and risk management strategy when their agricultural holdings do not produce enough marketable surplus. He further suggested that smallholder viability needs to be assessed not only from a commercial perspective but also from a livelihood portfolio and landscape perspective, where the livelihood portfolio recognises the pluri-activity of households, with a significant focus on diversification of income sources and risk mitigation. He questioned the land landscape viability approach for relying on a single crop yield-based measurement of productivity, without considering the role of small farmers in delivering ecosystem services and promoting nutritious diets, as well as the value of nurturing family and cultural heritage. With this background, the accepted papers on this aspect are reviewed for the report. Singh conducted a study in Northeastern Indian villages on the patterns of

employment, determinants of household income diversification and its inequality, and their impact on poverty, using a census-based approach. He reported that the majority of workers are engaged in the non-farm sector for livelihood, with on-farm engagement mainly in agriculture, followed by allied activities (livestock rearing & fishing) and agricultural labour. His findings confirm that income diversification positively impacts household income and reduces poverty. According to the analysis, the major determinants of income diversification are education, household size, landholding, non-farm employment, worker population ratio, and access to formal credit. He further observed that the non-farm sector plays a significant role, but the farm sector does not help in reducing inequality. Narayanamoorthy et al. studied income diversification among household farmers across 18 states using data from three rounds of the Situation Assessment Survey (2002-03, 2012-13, and 2018-19). They reported modest improvements in income diversification across states over the period. They further noted that states like Gujarat, Rajasthan and Haryana show significant and sustained diversification, driven by increased contributions from livestock and non-farm activities; on the other hand, states such as Madhya Pradesh, Chhattisgarh and Bihar show a high dependence on farm income. Kaushal and Patra studied livelihood diversification among tribal and non-tribal households in Chhattisgarh and reported higher diversification among tribal households than among non-tribal households. Also, the degree of diversification is not evenly distributed over the districts in the state due to remote geographical location.

Singh et al. assessed income inequality across agroclimatic zones and farm categories in Punjab and reported that the rural poor in the state tend to diversify their income portfolios towards non-farm and livestock income. They further pointed out that agricultural income contributes the most and has a positive marginal effect on inequality. In contrast, livestock and non-farm income are potential sources for bridging the inequality gap. They observed substantial income disparities within zones, especially for livestock and non-farm income, but income disparities between zones are relatively lower. Husssain and Hussain examine livelihood diversity in the Kargil district of Ladakh and reported that the major sources of household income are salaried employment and business activities. In contrast, income from agriculture and livestock rearing is minor. They further reported that the majority of rural households relied on multiple sources of income to sustain their livelihoods, with high variation in the extent of diversification between blocks. Their findings also show that livelihood diversification increases with greater distance from the main city, reflecting adaptive strategies to overcome limited local opportunities. They have identified marketing facilities as the most critical constraint to livelihood diversification, indicating that the absence of reliable markets restricts households from deriving sustainable income despite diversifying activities, and other constraints reported are a lack of awareness about government schemes, a lack of training opportunities, and inadequate credit access, reflecting limited access to institutional support. They suggested strengthening market linkages, improving awareness of

government programs, and enhancing training, credit, and infrastructure support to promote adequate livelihood diversification in this economically deprived area of the country. Regional analysis of crop diversification is carried out by Bagaria across 25 states and one Union Territory using Location Quotient, Crop Versatility Index, and State Versatility Index as an analytical tools and revealed significant regional disparities in crop diversification, with states like Kerala, Tripura, Odisha, West Bengal, and Chhattisgarh exhibiting low versatility and a reliance on a limited number of crops, thus they are vulnerable to climate variability, market fluctuations, and pest outbreaks. She further observed that states such as Gujarat, Maharashtra, Rajasthan, and Karnataka are more diverse and resilient; they cultivate a range of crops, thereby enhancing their capacity to withstand external risks. Bhuyan et al. reported that Manipur recorded the highest growth in area, and Arunachal Pradesh recorded the highest increase in foodgrain production and yield. They further reported that Tripura recorded the highest growth in oilseed area and production. That yield effects contributed the most to the production gains for both food grains and oilseeds across the entire North East region.

Livestock diversification in Rajasthan was examined by Yadav and Sharma, who reported that the distribution of indigenous cattle, crossbreeds, and buffaloes is becoming more balanced in Ajmer, Bhilwara, Churu, and Udaipur districts; however, Hanumangarh and Ganganagar districts show higher livestock diversification. They further observed a shift in rural livestock economics, showing a consistent trend throughout Rajasthan towards economically advantageous cow populations. Panda examines the extent and pattern of growth of high-value agriculture (HVA) and observes that the output value of HVA, measured in absolute terms and as a proportion of gross agricultural output, shows wide and increasing inter-state disparity. His interesting finding is that better-off states have recorded lower HVA growth, while relatively poorer states have exhibited higher HVA growth. Vaishnubharathi et al. evaluated structural changes in the cropping pattern resulting from labour scarcity in the UT of Puducherry. They inferred that the transition trend is towards the cultivation of less labour-intensive crops, and that labour demand exceeded labour supply during November and December, which are the harvesting and sowing periods for kharif and rabi crops, respectively. They further reported that the labour supply-demand gap is mainly due to labour migration, the implementation of MGNREGA during the peak season, and the regular availability of off-farm work. Linkage between farm and non-farm sectors is studied by Rohlupuii et al., and it is observed that non-farm income exceeds farm income in most states, except Gujarat, Karnataka, Madhya Pradesh, Punjab, and Telangana, along with declines in crop income shares and a rise in income from non-farm business, wages, and salaries. Their multivariate probit estimates show that larger landholdings raise farm income dependence but reduce non-farm work, while education promotes salaried jobs and business over casual labour. Mritunjay and Singh examine the relationship between agricultural credit and rural non-farm employment diversification in India, Brazil,

and Mexico and report that, in India, institutional credit drives livelihood diversification, supporting multiple income sources for rural households. At the same time, Brazil demonstrates agro-industrial complementarity, where credit aids both farming and integrated off-farm activities, and Mexico reflects a classical sectoral shift, with non-farm employment growth linked to liberalisation and trade policies. Their study affirms that agricultural credit, when delivered through inclusive, well-targeted, and institutionally robust mechanisms, can be a powerful enabler of rural economic diversification; however, its effectiveness depends on the broader development environment, including labour markets, demographic pressures, and infrastructural capacity.

Cropping systems and crop diversification, along with the introduction of production technologies and new crops, are addressed in this section of the diversification of rural livelihoods. Crop diversification to overcome the adverse climate effect and reduce unseen losses due to the introduction of lower water and emission of greenhouse gases in the environment that has an adverse effect on climate (substitution of pulses, oilseed and cereals in the rice-based cropping system) is studied by Singh et al., in Udaipur and Bhilwara districts of Rajasthan. The authors have reported that maize, soybean, and groundnut are more profitable crops than rice in both districts. Thus, crop diversification from rice to other crops (maize, soybean, and groundnut) is beneficial for farmers and environmentally friendly. Akashdeep et al. analysed the extent of crop diversification and its determinants at the national level using diversity indices and ridge regression techniques. They reported a significant decline in the share of coarse cereals and an increase in the shares of rice, wheat, fibre crops, sugarcane, and horticultural crops, indicating high diversification. They identified rural literacy and urban population growth as major determinants of diversification towards horticulture. Smriti and Basantaray conduct a comprehensive review of crop diversification and observe that diversification decisions are shaped by a complex interplay of household-level factors (farm size, irrigation access, and education), economic drivers (net returns and credit access), and structural conditions (climate vulnerability and institutional support). Empirical evidence from their literature review demonstrates that crop diversification significantly contributes to rural livelihoods by enhancing income stability, employment, food and nutritional security, and resilience to climate and market risks. They reported that diversification poses challenges, especially for smallholders, including high input costs, perishability of high-value crops, and infrastructural constraints. Batth and Kumar visualise the role of contract farming in crop diversification and rural employment generation in the Amritsar district of Punjab, and they report that contract farmers had the highest levels of diversification and cropping intensity, along with better education, larger landholdings, and leased-in land. They also reported that it created significantly more employment compared to non-contract and conventional farming. They have suggested that vegetable contract farming is a strategic approach to addressing the challenges of monoculture and underemployment in Punjab's agrarian economy.

Another study on farming system diversification was carried out in the same state by Saini et al., who reported that the crops + dairy system is adopted by the majority of farmers, followed by the crops + agroforestry system. Still, the crops + poultry system is found to be the most remunerative farming system, although all these systems are more remunerative than producing crops alone. They further reported that net farm income across different farming systems was affected by the area under annual crops, the area under agroforestry, and the number of broilers. Another study of IFS by Naskar and Choudhury evaluates the impact on income and employment among farming households in Ri-Bhoi district of Meghalaya and reported that IFS farmers have significantly higher average household per capita incomes and experience moderate income inequality compared to non-adopters. They further observed that the number of IFS components, landholding size, and farmer experience positively influence employment generation. In contrast, household size negatively affects employment, suggesting that IFS adoption enhances economic well-being and creates greater employment opportunities, highlighting its potential as a sustainable strategy for improving rural livelihoods in hilly agro-ecosystems. Various researchers have examined the economic viability of introducing new crops across India's different states. In this line, Mehta et al. examine the Kiwifruit value chain in Arunachal and observe a negative net return due to lower production economies of scale, with a high impact of marketing channels on farmers' earnings and market efficiency. Sajjad and Dar examined the determinants of total factor productivity for apples, pears, and cherries in the Kashmir Valley. They found that access to artificial irrigation positively affects TFP, but also observed significant regional disparities, with South Kashmir outperforming Central and North Kashmir due to better infrastructure, stronger cooperative networks, and favourable socio-economic conditions. They suggested that improving TFP can help to integrate the horticulture sector of Kashmir into national agri-value chains and facilitate cross-border trade. Barwal et al. examined the technical efficiency of potato cultivation on small holdings in Himachal Pradesh. They observed a mean technical efficiency of 78 per cent, suggesting that potato growers could increase efficiency by better utilising resources and technology. In minor millets, Thirumarudhan et al. examined profitability and resource-use efficiency in Tamil Nadu and reported that foxtail millet offers higher profitability; kodo millet also remains viable; fertilisers and seeds are significantly underused, whereas human and machine labour are often overused, especially in kodo millet cultivation. The economics of sapota production in Haryana are examined by Mehala et al., who reported that investment is economically viable, that direct sale to consumers is the most efficient marketing channel, and that key constraints faced by growers include pest incidence, a lack of quality saplings, and gaps in market information. For the same state, Bishnoi et al. examine the economics of cauliflower and indicate that cultivation of normal sown (August to October) cauliflower is more beneficial than Mid-Sown (July). Lalrinsangpuii and Devi examine the sustainability of oil palm cultivation in Mizoram and report a decline in

area and production, primarily due to low fresh fruit bunch prices, high labour & transportation costs, and limited market access. An economic assessment of drumstick plantation in Haryana was carried out by Papang et al., who reported increases in per-hectare yield of moringa up to the 5th year, after which yields began to decline. It gives a very high benefit-cost ratio, but this will only continue if farmers get an assured market for both moringa leaves and pods. In the Kullu district of Himachal Pradesh, Divyanshu et al. observed a notable shift from apple to pomegranate cultivation, due to its profitability, with an average technical efficiency of 74 per cent, indicating a 26 per cent gap between current and potential performance. They observed that socioeconomic factors, including family size, number of farm workers, and literacy rate, significantly influenced technical efficiency. In Arunachal, Apatani paddy cum fish farming is economically viable, as reported by Pertin et al. Kapadia examines changes in the production and consumption of edible oilseeds in India and reports that total oilseed area grew at a modest rate. In contrast, production and yield increased more significantly, and only soybean and rapeseed mustard exhibited positive growth rates in the area, along with rapid productivity growth in seven oilseed crops (groundnut, linseed, rapeseed mustard, castor seed, safflower, sesame, and nigerseed). The potato crop contributes 11 per cent of household income, and resource-use efficiency analysis indicates underutilisation of seed, labour, and land, and overuse of fertilisers on small farms, as reported by Bala and Bhardwaj for Himachal Pradesh. They reported high seed costs, low market prices, labour shortages, lack of irrigation, non-availability of quality seed, and high transportation costs as the main constraints in potato production. In Haryana, the profitability of onion cultivation was assessed by Kumar et al., who reported that it remains profitable despite persistent challenges such as price volatility and post-harvest losses. Some researchers assess the economics of production technologies. In Arunachal Pradesh, adopters of organic orange technology yielded significantly higher household income, with lower income variability and more equitable income distribution compared to non-adopters, as reported by Sahoo et al. In Himachal Pradesh, HDP apples are found to be more profitable than traditional apples, as HDP productivity is 4-5 times higher than that of traditional apples, as reported by Rani and Sharma. In Sikkim, users of power tillers for paddy cultivation exhibit more efficient seed, FYM, and tillage operations as reported by Lather et al. Economics of basmati paddy seed production in Kurukshetra, Karnal, and Kaithal districts of Eastern Haryana is examined by Sumit et al., and reported that it is an economically viable proposition with some of the constraints like lack of technical guidance, inadequate skilled manpower, high input requirements, delayed payments by processors and poor processing facilities. Socio-economic characteristics of growers of the improved safflower variety PBNS-12 in Parbhani district, Maharashtra, were evaluated by Kayande et al. They reported that adopting variety is associated with higher incomes, better access to resources, and greater social participation. Another study in Haryana on Lilium cultivation under protected

structures by Nimbrayan reported the highest net returns in net houses, followed by naturally ventilated polyhouses and walk-in tunnels. The economics of high-tech cabbage farming in Chhattisgarh is evaluated by Sahu and Pathak, who report that it is a profitable and economically sustainable proposition under high-tech polyhouse structures. Study on good animal husbandry practices and their impact on milk production among dairy farmers of Bihar, Punjab, and Uttar Pradesh is carried out by Katoch et al., and reported that there is strong regional disparities, Punjab reports higher adoption of vaccination, high compliance with food safety measures, and well-structured artificial insemination (AI) services, whereas, Bihar and Uttar Pradesh show lower adoption and herd size, training, and contamination awareness significantly influenced adoption. They further reported that adoption increases milk productivity, though marginal gains diminish at higher levels of adoption. Similarly, in Haryana, Bishnoi et al. assess the economic viability of Shrimp farming and report that high costs are incurred despite high net returns per acre, due to systemic bottlenecks in feed, seed, credit, and marketing infrastructure. Devi et al. reported a significant structural shift in fruit cultivation in Haryana, with citrus emerging as the dominant fruit in terms of area and production; guava maintained moderate and stable growth. At the national level, banana and papaya showed strong early growth that stabilised in recent years, and their export performance indicates limited global competitiveness.

IV

PUBLIC POLICIES

Singh gave an introductory remark in his lead paper that rural areas remain central to transformative policies and action to achieve global food security, and according to him, the absence of proactive policies and investments for inclusive RT leads to inequitable outcomes due to unequal access to resources and power in societies. Regarding gender inequalities, he stated that policies and programs for rural transformation need to address the underlying social institutions that reproduce gender inequalities and disempower women. Keeping this background in mind, the research papers received under this sub-theme are categorised into four streams: market link (9 papers), support, subsidies, and credit link (5 papers), rural extension services (8), and rural infrastructure & technology development (5). Rural market linkages are the process of developing better connectivity between producers and consumers to facilitate the efficient and effective flow of goods, services, information, and capital, thereby improving productivity and incomes in rural areas for inclusive development. The research paper by Kumar examined the gap between ragi MSP and farm harvest prices (FHP) in Odisha and found that MSP has increased significantly. At the same time, FHP has lagged and remains consistently below MSP, with the gap widening over time. To narrow the gap between MSP and FHP for Ragi (mainly grown by small, marginal and tribal farmers), he suggested developing a comprehensive market ecosystem to support efficient procurement and demand

creation. A study on agricultural market infrastructure development in Punjab was carried out by Shergill and Kumar, who reported that, over time, the number of regulated markets remained the same, the number of sub-yards decreased, and the number of regulated markets serving villages per square km was scanty. They further reported that the number of cold storage facilities and their capacity remained lower, but the private sector's share of warehousing capacity is high and increasing over time. The e-NAM portal is not functioning properly due to the lack of infrastructure, core facilities, service facilities, and support and maintenance facilities at the mandi level. Thakur and Singh report better price realisation by farmers using e-NAM in Himachal Pradesh. Dhivya reported that buyers in the market prefer dark pink onions over yellow and white onions, with medium pungency and large size; on the other hand, price and colour are the important attributes in consumers' preferences in Tamil Nadu. Kathpalia et al. assessed farmers' knowledge of the Bhavanter Bharpai yojna in Haryana. They found significant associations between knowledge and socio-economic factors, such as education, income, landholding, occupation, extension contact, and socio-economic status, with moderate to high knowledge of the scheme. Prajapati examines the impact of direct cash transfers on paddy productivity and reports that irrigation infrastructure, farm harvest prices, and targeted fiscal interventions all play significant roles. Still, direct cash transfer schemes have a smaller impact on enhancing paddy yield across different Indian states. The author does not discuss promoting financial inclusion by encouraging beneficiaries to use formal banking services and digital payments, which is the main aim of this scheme. Negi reported that Arhtiyas, an intermediary, has emerged as the dominant agent in apple marketing, overtaking local traders in Himachal Pradesh since they offer the highest prices for their produce. Verma and Vani studied structural breaks in terms of trade for Indian agriculture. They analysed their implications in the context of the Prebisch-Singer hypothesis and reported that this hypothesis doesn't hold good for Indian agriculture over the period 1982-2002. Fluctuations in terms of trade are influenced by economic reforms, trade liberalisation, global price volatility, domestic price and subsidy policies and technological shifts. A study by Sehal and Sing revealed a consistent increase in fertiliser production, consumption and import in India. The highest fertiliser consumption is reported for Uttar Pradesh, followed by Maharashtra and Madhya Pradesh. They further reported that the adoption of farmyard manure, cow dung, and poultry litter, as organic sources, reflects a shift towards integrated nutrient management practices. But the authors do not discuss many challenges in fertiliser use, such as the heavy reliance on imports for some key fertilisers and a supply-demand mismatch. In subsidy and credit-related public policies, the study by Sen et al. reported that Pradhan Mantri Fasal Bima Yojana (PMFBY) has demonstrated mixed outcomes in Odisha, reflecting both achievements and persistent challenges and instability in financial performance, particularly in terms of claim settlement. This remains a major barrier to building trust among farmers. The Kisan Credit Card (KCC) scheme is a vital initiative to expand access to

agricultural credit and promote financial inclusion in rural areas. Thus, its impact is assessed by Anbukkani in Maharashtra, and it is reported that this scheme reduces transaction costs, increases input use, and enhances income levels, while offering concessional interest rates that encourage responsible use and reduce the probability of loan diversion.

With access to banking infrastructure, utilisation of funds for farm inputs, and the number of cropping seasons positively influencing benefit intensity from the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme, this represents a landmark initiative in India's rural policy framework, aimed at providing direct income support to landholding farmers, as reported by Balamuruga and Sitadevi. India has shown a phenomenal rise in both food and agricultural input subsidies during the last three and a half decades, as reported by Shah. Devi et al. also examine the economy-wide effects of reducing the urea subsidy and explore compensatory mechanisms to safeguard farmers' incomes. and reported that subsidy cuts ease fiscal pressure, but they negatively affect agriculture and spill over to other sectors, reducing Gross Value Added across the economy. They suggested a well-designed, phased approach to subsidy reforms, combined with investments in sustainable alternatives, precision farming, and farmer education. Extension and support services in rural areas play important role in rural transformation and livelihood sustainability, the impact of National Rural Livelihood Mission (NRLM) in Uttarkhand is assess by Adhikari et al., using livelihood Index comprising five components (human, physical, financial, and social capital, along with food security) for pre and post-mission period and reported significant improvement across all components, with the overall increase in index but they suggested for stronger institutional convergence to maximize developmental outcomes of the scheme. Another study from the North Eastern states on the effectiveness of NRLM on women's participation in economic activities by Dkhar et al. reported that this mission significantly increased women's income and financial independence, thereby increasing involvement in small businesses, skill development, and community leadership. In Assam, this scheme helps in the participation of women in political, social, and technological domains, empowering them to contribute more effectively to social processes, as reported by the authors. They have suggested that this mission can catalyse poverty reduction. Still, its long-term success depends on sustained investment in capacity building, financial education, and adaptive policies tailored to the region's unique socio-cultural landscape for entrepreneurial activities. Krishi Vigyan Kendra serves rural communities with the vision of enhancing the productivity, profitability, and sustainability of agriculture through science and technology. Impact of KVKs on productivity and income enhancement is assess by Panwar et al., for Uttarakhand and by Bharti and Sharma for Himachal Pradesh and reported that in Uttarakhand KVK beneficiary farmers adopted better management practices for cereal and vegetable crops which resulted in higher productivity and income, similarly for Himachal Pradesh authors reported that improved management practices like proper irrigation,

diversification of farm and KVK patronage are found to be the most significant factors for higher farm income. In green gram, substantial gains in both yield and profitability are reported by Singh et al., under cluster frontline demonstrations conducted by Krishi Vigyan Kendra (KVK), Bhiwani, Haryana. In drought-prone regions of Marathwada interventions such as commitment savings, simplified choice architecture, goal-setting, and norm-based messaging influence the adoption of beneficial practices including water conservation, soil health management, and crop insurance using behavioural economics approach by Rath et al., Study carried out by Praveen et al., examines perceptions and attitudes of farmers towards adoption of sustainable fertilizer practices in the Indo-Gangetic Plains (Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal). They estimate state-level nitrogen budgets to assess nutrient surpluses, while descriptive statistics, social network analysis, and causal loop diagramming are employed to capture farm-level behaviour and institutional linkages. They reported that nitrogen budgets across states show large surpluses, indicating inefficiencies in fertiliser use and the urgent need for balanced nutrient management. Their social network analysis shows the central role of fertiliser traders and family networks in information exchange, with institutional and digital channels playing a smaller role. A causal loop diagram demonstrates the adoption of sustainable fertilisers, which is driven by reinforcing cycles of income gains, awareness, and policy support, but also faces balancing constraints related to weak institutions and market access. In Meghalaya, investment in custom hiring centres as a common-pool resource is economically feasible; it increases farmers' income, as reported by Bhuyan et al. Research papers on infrastructure and technology development-related policies are also accepted for discussion. A technology-related policy study by Bhuvaneshwari and Kumar on the adoption of sensors as IoT-enabled precision agriculture technologies by grape growers in the Nashik (Maharashtra) and Vijaypur (Karnataka) districts, using the Cragg Double Hurdle model, is notable. They reported that individual capabilities, institutional proximity, and economic conditions jointly shape digital inclusion outcomes in rural high-value agriculture, and training is consistently the most influential factor across both adoption and usage stages. They further reported that the cost per acre was positively associated with the extent of use; this may reflect that farmers investing in more expensive technologies are commercially oriented and aim to intensify IoT use to enhance quality and meet export compliance. Still, paradoxically, farm income and farm size negatively affect usage, suggesting that wealthier farmers may diversify their investments and not prioritise digital farming tools, possibly due to logistical challenges and reduced marginal returns from scaling sensor deployment across large plots. Sihag et al., carried out socio-economic assessment of the PM-KUSUM scheme with special reference to solar pump as renewable energy technology integration in agricultural among farmers in Haryana and reported that users enjoy improved irrigation efficiency, enhanced crop productivity, and reduction in input costs, particularly related to electricity and diesel cost along with environmental

benefits with zero carbon emissions and reduced noise and pollution levels. They further reported that it offers higher returns and a shorter payback period than conventional pumps, but faces several critical challenges, including procedural delays in registration and implementation, technical failures during cloudy weather, high initial installation costs, and insufficient advisory support for farmers in adopting solar pumps. Shreekantharedy et al. explore the impact of Pradhan Mantri Krishi Sinchai Yojana (PMKSY) on water-use efficiency in major field and horticultural crops among beneficiary and non-beneficiary farmers of Karnataka and reported that beneficiary farmers achieved higher technical and economic efficiency compared to non-beneficiaries. Yashpal et al. reported that MGNREGA has contributed positively to rural employment and asset creation in Haryana, with a balanced distribution of work, suggesting a more integrated development strategy for rural areas. They reported challenges with women's participation and delayed wage payments. The study on public investment in irrigation in north Indian states (Haryana, Punjab, Himachal Pradesh, and Uttarakhand) was carried out by Shubham et al. and reported the Accelerated Irrigation Benefits Programme (AIBP). The National Mission on Micro Irrigation (NMMI) and PMKSY (Pradhan Mantri Krishi Sinchayee Yojana) have enhanced irrigation infrastructure and efficiency, underscoring their pivotal role in boosting agricultural productivity and ensuring food security. The authors clearly highlighted the direct benefits and challenges of different public policies, but there is a need to explore direct and indirect benefits separately of such policies e.g. the use of solar panels contributes to saving in electricity bill, thus reduce cost of production but indirect benefit is a healthier environment for everyone in the long run, similarly crop insurance scheme covers risk associated with crop failure but it has broader societal benefit which needs to measured separately.

V

COMMUNITY INSTITUTIONAL INNOVATIONS

Singh, in his lead paper, referred to the role of collectives like co-operatives and producer companies in rural transformation through strengthening marginalised producers and workers and in terms of their input and output market interfaces. He further pointed out that they can also help build a more sustainable agricultural production system through good, sustainable agricultural practices, enabling better market access, value addition, capital support, and institutional support. Twelve research papers are considered for discussion related to the impact and various issues of SHGs, FPOs, FPCs, and Cooperatives. The study by De et al. found that microfinance is vital for the economic upliftment of the economically weaker section, as well as a catalyst for sustainable rural transformation and women's empowerment in the North Eastern region (NER) of India. They further observed that striking disparities between NER states, like Assam and Tripura, have enabled significant SHG integration, while states like Nagaland and Arunachal Pradesh lag, yet microfinance remains a crucial catalyst for economic development, supported by

infrastructure and capacity-building. Study by Pandey et al., examined the impact of the two important initiatives for the farmers, the Farmer Producer Organization and Pradhan Mantri KISAN Scheme, on the technical efficiency of the rice growers of Uttar Pradesh and reported that member farmers of Farmer Producer Organisation and financial assistance programme PMKISAN are helpful to rice producers for efficient management, assistance, and utilization of economic resources. Gauraha and Dubey, in their study on women's empowerment through the business of selected food-based microenterprises managed by women-led Self-Help Groups in Chhattisgarh, reported that products demonstrated positive net returns, highlighting the income-generating potential of food-based microenterprises in rural contexts and suggesting that SHGs can significantly contribute to rural livelihoods and women's empowerment. They further reported that, despite profitability, there is a need for cost optimisation, market access, price realisation, and business planning training, with appropriate institutional support, marketing linkages, and capacity-building. Deshmukh and Kumar examine the impact of FPOs' participation of grape growers in Maharashtra using the New Institutional Economics (NIE) framework and reported a significant positive impact of farmers' participation on farm income due to enhanced farmers' bargaining power, input access, and market linkages, which strengthen institutional mechanisms to enhance smallholder integration into value chains. Mehata et al. assessed the impact of Self-Help Groups (SHGs) on the empowerment of rural women in Ri-Bhoi district, Meghalaya. They reported that the majority are highly satisfied, with moderate to strong feelings of empowerment, especially in self-confidence, social life, and monetary independence. They further reported that entrepreneurship development and improved access to financial resources have resulted in economic benefits that improve the status of women within the family and the community at large. Laldinmawii et al. examined wine cooperatives through the lens of market analysis in Mizoram and reported that the cooperatives did more than just aggregate produce; they created a new value chain that shares profits and risks among producers. They further reported that the successful branding and commercialisation of wines such as Champwine and Isabella demonstrate that even remote rural communities can integrate into higher-value markets when provided with organisational support and legal sanction. Yogitha examines the economic impact of FPOs on farm profitability in the Madurai district. She reported that FPO members can earn a higher income from paddy and coconut than non-members, thanks to inputs provided at below-market prices. Another study by Singh et al. reported that transparency in communication significantly contributed to the performance of the Farmer-Producer Organisations through addressing the need-based requirements of their farmer members, prominently manifested through efficient input availability and unfettered market access. Ramya et al. stated that simply expanding FPO membership or relying on MSP is not sufficient to enhance cotton production unless institutional capacity is strengthened, costs are managed proactively, and farmers are empowered with effective technology awareness of Bt

cotton. They suggested that a coordinated strategy combining high-quality FPO leadership, cost-reducing interventions, mechanised operations, and Bt/IPM-led training offers a clear pathway to revive cotton production in Tamil Nadu. A study conducted by Chauhan and Pani in the tribal region of Odisha revealed that technology adaptation, innovation, processing, value addition, convergence, collaboration, and institutional governance are key traits that distinguish better-performing FPCs from poorer ones. Dairy cooperative value chains in Nagaland are assessed by Houmai and Bhandari, who consider two dairy cooperatives, and they report that performance in terms of value addition and profit margins differs due to higher transportation costs and a lower final selling price despite similar channels. They reported that the overall profitability of the milk cooperatives is affected by challenges of transportation, poor infrastructure, poor storage facilities, inconsistent milk supply, stiff competition from larger national brands, and low consumer demand for local dairy products. Jyotshna, in her study, observed that farmers' decisions on selecting marketing channels for paddy are influenced by a complex interplay among landholding size, irrigation access, financial inclusion, education, caste, gender, and state-specific institutional frameworks. She further reported that government procurement influences participation in cooperatives, Agricultural Produce Market Committees (APMCs), and private markets, which are considerably influenced by resource endowments and social standing. Above all, studies on community institutional innovations clearly show that these institutions' interventions empower farmers and women. Still, it is the role of agricultural economists to examine the impact of NGOs as community institutional innovations for inclusive development in India because they act as catalysts for social change by implementing grassroots initiatives, bridging gaps in public service delivery, and creating innovative solutions to address poverty, inequality, and a lack of access to education and healthcare specially for tribals and socially deprived classes in remote areas.

VI

CLIMATE CHANGE AND INCLUSIVE DEVELOPMENT

Climate change directly and indirectly affects farmers' incomes and thus their capacity to adopt innovative technologies and invest in farm infrastructure to mitigate its adverse effects. This section discusses studies on climate change and inclusive rural transformation under four headings: adaptive capacity (4), GHG emissions (2), climate risk (4), and climate-smart technologies (6). An agroclimatic zone-wise study of adaptive capacity is carried out by Jatav, using 29 indicators across six dimensions — physical resources, financial resources, human resources, social resources, livelihood diversity, and information accessibility —to capture the regional extent and dimensions of climate change adaptation in Indian agriculture. He reported that the Gujarat Plains and Hills zone has the highest adaptive capacity, while the East Coast Plains and Hills zone has the lowest. He emphasised the need for further investigation into the feasibility of engaging in local and regional methods of

vulnerability assessment and for improving adaptive capacity. According to him, possible adaptation options for the most vulnerable region include diversifying agricultural systems by cultivating crops that require less water; adopting advanced farming technologies, such as using different crop varieties, harvesters, and irrigation pumps; constructing dams and roads; and improving the mangrove plantation programme in the coastal area. Another study on barriers to adaptation in Asian countries was conducted by Singh and Sahoo, which revealed that smaller farms in Nepal adapt more effectively due to their flexibility. At the same time, Pakistan and China face severe institutional and water-related challenges, economic sustainability is a key issue in Sri Lanka's arid regions, and Bangladesh and Nepal struggle with technological deficiencies. They further reported that financial constraints and socio-cultural barriers, including gender norms, are prevalent in Turkey, Pakistan, and India, disproportionately affecting women and exacerbating their vulnerability. Farmers often grapple with balancing short-term economic gains with long-term sustainability, as seen in decisions around zero-tillage and agroforestry practices. In Haryana, Choudhary et al. conducted an empirical analysis of farmers' adaptation strategies and influencing factors and reported that increased irrigation, enhanced fertiliser application, adjustments in crop sowing time, crop insurance, soil-water conservation techniques, and intercropping are the most frequently adopted adaptation measures. In their probit regression analysis, age exhibited a negative impact, suggesting that older farmers are less likely to adopt adaptation strategies. Conversely, landholding size, education level, income level, and access to climate change information positively influenced adaptation decisions. Jadhav et al. examine the impact of climate-resilient agricultural technologies for NICRA beneficiaries in Marathwada, the most drought-prone region of Maharashtra, and report that the majority of farmers recognise key climate risks, including erratic rainfall, fewer rainy days, extreme heat, and resource degradation. They observed that climate-resilient technologies help farmers enhance resilience, productivity, and income in climate-vulnerable farming systems by increasing cropping intensity, irrigated area, net income, and crop diversification.

The country is targeting net-zero emissions by 2070, not just for environmental reasons but also as a pathway to inclusive and sustainable development in rural areas. The study conducted by Rajput and Chaturvedi on rice productivity and GHG emission, considering data on production, CO2 emissions, and CH4 emissions for major rice-producing countries, i.e., China, India, Bangladesh, Indonesia, and Vietnam, reported that emission intensity has decreased in all rice-producing countries with moderate rice production gains in Vietnam and China. They further noted that although rice systems have become more greenhouse gas-efficient, delivering higher yields with lower emissions, policy and research efforts should prioritise the transfer of proven mitigation technologies, such as optimised irrigation and fertiliser scheduling. Another study by Chaturvedi et al. on emission efficiency and buffalo meat production in India, Pakistan, and China, using

logarithmic mean Divisia index decomposition analysis to decompose total emissions into production, emission intensity, and distribution effects. They observed that India led global buffalo meat production with the highest growth rate and a significant decline in emission intensity. At the same time, China showed rising emissions and stagnating efficiency, and Pakistan showed a minor increase in production but a significant increase in emissions. Their decomposition analysis showed that production effects are the dominant contributors to the rise in carbon dioxide equivalents (CO_2eq) emissions from buffalo meat. In contrast, the emission intensity effect significantly offset this increase, indicating improved efficiency over time. Still, the distribution effect had a relatively minor and fluctuating impact, suggesting limited influence on total emissions compared to production and efficiency changes.

Studies on crop insurance as climate risk mitigation strategy is carried out by researchers, on this line study by Chouhan and Dutta, examine determinants of crop insurance adoption in soybean producing regions of Madhya Pradesh using double hurdle model approach and reported that adoption of crop insurance and area under insurance by farmers is determined by age, education, and access to credit, on the other hand availability of alternative income such as livestock rearing and off-farm income discourages farmers to insure larger areas. Sahoo et al. reviewed the literature on the demand for crop insurance to manage climate risk and observed persistently low demand, characterised by spatial and temporal variability. They suggested that future research should focus on the role of institutional trust in improving insurance uptake, particularly in developing countries where institutional credibility and transparency remain major barriers. Areef, in his study, reported that crop commercialisation increases productivity and raises adult per capita income during price, yield, and climatic shocks, underscoring its potential as a risk-coping mechanism that enhances agricultural household resilience. From a development economics perspective, vulnerability embodies the deficits and disparities in socio-economic development at the community or regional scale. In the era of climate change, vulnerability has evolved as the contemporary parallel to poverty, characterised by its multidimensionality, with social, economic, and ecological factors at the core of sensitivity and adaptive capacity. Socio-economic vulnerability of Sagar district of Madhya Pradesh at village (micro), tehsil, and district (meso) levels is analysed applying the Socio-Economic Vulnerability Index which encompasses sensitivity and adaptive capacity with 22 social and economic indicators by Mohammad et al., and reported that this district exhibited the highest concentration of highly vulnerable villages, They noted that drivers such as high proportion of agricultural labour, extensive net sown areas, and remoteness of villages affected the entire district. In contrast, issues like limited household assets, inadequate infrastructure, poor transport, and low irrigation levels are concentrated in specific areas. Their assessment highlighted how high sensitivity values, compounded by insufficient adaptive capacity, aggravated the vulnerability levels.

The introduction of climate-smart technologies in agriculture, which help increase food production, enhance farm resilience to climate change, and reduce greenhouse gas emissions, is a pressing need. Some of the researchers are carried out studies related to such technologies like study by Mattoo et al., identified high machinery costs, limited access to rental equipment, and insufficient awareness of other options as reasons for stubble burning in Punjab and observed strong preference for adopting multiple technological strategies, followed by Balers and MB ploughs, which lead in adoption along with other machinery, like the Super Seeder and Happy Seeder, is often used in multi-machine strategies, reflecting cautious adoption due to cost and availability constraints. Another study by Ingersal and Sharif from Bihar on the role of Self-Help Groups (SHGs) in promoting Climate-Smart Agriculture (CSA) reveals that SHG membership significantly enhances women's awareness and adoption of low-cost, knowledge-intensive agricultural technologies, such as nutrient management, intercropping, and crop diversification. However, SC/ST women remain structurally excluded, even within SHGs, and access to Krishi Vigyan Kendras (KVKs) emerges as a strong predictor of awareness, adoption, and intensity. Study carried out for western zone of Tamil Nadu on awareness and adoption of climate smart agricultural practices by Selvi and Raj reported pronounced awareness-adoption gap and reasons are socio-behavioural factors (labour shortage with higher wage rates, youth migration), technical limitations (inadequate training, lack of demonstratable CSA models), financial constraints (delayed returns on investment, absence of premium pricing) and institutional weaknesses (insufficient support mechanisms and limited policy frameworks). Garba and Pooja evaluated the socioeconomic benefits and adoption challenges of integrating climate-resilient infrastructure and green technologies, specifically solar-powered irrigation systems and biodigesters across four agro-climatically diverse districts of Haryana. They reported that adoption is significantly influenced by technical awareness, access to subsidies, and social capital, along with high initial investment and technical skill gaps as major barriers, despite annual income enhancement, reduced irrigation costs, and enhanced crop yield stability by adoption of solar irrigation systems, and biodigester adoption contributed to a reduction in household fuelwood consumption. Ecological and economic implications of climate change on root crops across regions with varying vulnerability levels are assessed for Himachal Pradesh by Singh et al., who reported that farmers in the low-vulnerable group demonstrated superior economic performance and sustainability of root crops, attributed to better resource access and adaptive capacity as compared to the highly vulnerable group. They further reported that rising maximum temperatures and erratic rainfall have negatively impacted the profitability of the ginger crop in the moderately vulnerable group and of potato in the highly vulnerable group. In contrast, garlic remains relatively climate-resilient across all vulnerability groups. They observed that adaptation strategies, such as crop diversification, organic amendments (e.g., farmyard manure), irrigation, balanced fertilisation, and integrated pest management,

enhanced the resilience and profitability of root crops. Potato emerged as the most carbon-intensive crop, while garlic showed the highest sustainability index. Myat et al. examined farmers' willingness to pay for bioagents as an eco-friendly practice in Haryana. They reported a positive attitude among farmers toward investing in eco-friendly agricultural technologies, especially when they perceived tangible benefits or had access to credible information. They further reported that non-adopters are often willing to pay more, suggesting untapped market potential for bioagents that remain unaware of their on-the-ground efficacy.

VII

TRANSFORMING FOOD SYSTEMS FOR NUTRITIONAL SECURITY

In his lead paper on food system transformation, Singh stated that the process and outcomes of rural transformation can be examined from multiple perspectives, including food systems, political economy, and institutions. He has argued that productivity growth remains necessary for small-scale farmers as a primary or complementary source of income and to enhance food security and healthy diets. According to him, an unsustainable food system, in terms of environmental damage and nutritional challenges, requires alternative food system governance, justice movements, food as cultural identity, and protest and advocacy in education and lifestyle. His observations are quite consistent with the conclusions drawn in the eight research papers discussed in this section.

The decadal change in Indian food consumption pattern is examined by Negi and Sahoo evolving consumption behaviours across 19 major Indian states over the period from 2011-12 to 2022-23 and reported that there is substantial growth in per capita income (PCI) and monthly per capita expenditure (MPCE) along with decline in the proportion of expenditure on food items and an increase in non-food items, suggesting a diversification in consumption patterns driven by increased incomes and urbanization. They further observed that states like Maharashtra, Gujarat, and Tamil Nadu have higher PCI and MPCE than economically lagging states such as Bihar and Uttar Pradesh. Jharkhand shows the largest increase in non-food expenditure in rural areas, while Uttarakhand shows the largest increase in urban areas. They have suggested that the government should formulate policies that focus on lagging states to promote agricultural technology, market access, rural infrastructure, education, and healthcare, to ensure balanced regional development. Likhitha et al. assess the socio-economic, agrarian, occupational, income, and dietary impacts of industrialisation on rural households in Kurugal, a village 5 kilometres from the Vemgal industrial area in Karnataka. They reported that industrial proximity led to significant changes in landholding patterns, occupational shifts from agriculture to non-farm sectors, and higher average household income; however, income inequality also increased. They reported notable diversification in food consumption patterns, with a lower share of income spent on cereals and a higher share on fruits, pulses, vegetables, and eggs.

Overall, their study shows that industrialisation appears to improve income and dietary access but simultaneously contributes to land alienation, occupational transitions, and widening disparities in food choices and income distribution. The NSSO consumer expenditure survey (unit-level data), 68th round, is used by Chaudhary and Singh to derive different demand elasticities for different food groups in Himachal Pradesh. They have reported that estimated income elasticities vary among vegetarian and non-vegetarian households in both rural and urban sectors, and are lowest for cereals and highest for milk and milk products and horticultural products. They further observed that cereals inhibit inelastic demand among all food groups. The responsiveness of food commodities like milk, eggs, fish, meat, vegetables, and fruits is higher with improved household income, both in non-vegetarian and vegetarian households. However, milk and milk products are highly elastic with respect to income in both rural and urban households, indicating very high consumer demand.

Study by Saravanakumar and Geethanjali on farmers' and consumers' preferences for rice varieties released by Tamil Nadu Agricultural University (TNAU) and non-TNAU varieties and reveal that farmers prefer TNAU varieties during Kuruvai season (between June and September) on account of high yields, maturity duration, and stress resistance but shift to non-TNAU varieties in Samba (between August to January) and Thaladi seasons (later part of the Samba season and harvested in late winter, around January to February) based on grain quality and price, on the other hand consumers prefer branded rice on account of cooking quality and appearance, while a few rural consumers opt for unbranded rice varieties due to its affordable prices and availability. According to their findings, farmers' choice of TNAU varieties is influenced by experience, extension services, access to inputs, and education. In contrast, consumers' decisions are driven by income, market price, household size, and cooking quality. They have suggested reorienting future rice research to integrate both farmers' and consumers' choices and to strengthen the seed supply chain through FPOs to meet the diverse needs of producers and consumers.

A study carried out by Kumar and Basantaray in rural India using unit-level data from the National Sample Survey on distress sale of wheat and its welfare implications observed that an increase in average income losses per hectare points to a growing number of farmers being compelled to sell their produce below MSP, often due to urgent liquidity constraints and limited bargaining power. There is a significant rise in distress sales, particularly among marginal and smallholders, due to the weakening presence of regulated markets (APMCs) and increasing reliance on private and local traders, highlighting systemic inefficiencies in the procurement framework. They have reported that socio-economically disadvantaged groups—scheduled castes, scheduled tribes, and less-educated farmers are disproportionately represented among distress sellers, indicating structural exclusion from formal marketing channels and economically, distress sales are associated with significantly

lower household income, higher poverty incidence, and greater income inequality. States such as West Bengal, Jharkhand, and Uttarakhand have witnessed a sharp deterioration in farmer welfare, while even traditionally better-performing states like Punjab and Uttar Pradesh are not immune to distress sales, reflecting systemic weaknesses in procurement outreach, timeliness, and infrastructure. According to them, distress sales are not just a symptom of market failure but a reflection of deeper agrarian distress, with serious implications for rural welfare and inclusive development. They have suggested region-specific interventions, including decentralised procurement, improved market access, and enhanced institutional credit and storage infrastructure. The another study on spatial price transmission and price discovery mechanisms in wholesale paddy markets across three states (Karnataka, Kerala, and Punjab) representing distinct institutional and structural contexts using monthly price data across 12 major markets, employing Augmented Dickey-Fuller tests, Vector Autoregression model, Johansen's Cointegration Test, Vector Error Correction Models (VECM), Granger causality tests, and Impulse Response Functions (IRFs) to assess market integration and the directionality of price influence is carried out by Jambagi et al. They reported strong intra-state price dynamics in Karnataka, with Davanagere emerging as a central market influencing price formation across the region. In Punjab, Ferozepur and Ludhiana serve as primary price transmitters, while Amritsar primarily acts as a passive recipient. Kerala markets exhibited limited internal and inter-state integration, with only Wayanad and Kasaragod displaying a significant bidirectional linkage. Their findings highlight regional heterogeneity in market efficiency and integration, which is shaped by procurement intensity, digital market reforms, and production-consumption balances. The findings of Sehgal and Biradar show that Indian farmers sell approximately 90 per cent of their produce to non-regulated markets and mainly have access to private extension services for agriculture-related advice. Participation of farmers in regulated markets is mainly determined by gender, social group status, monthly expenditure, irrigation availability, crop types grown, and prices received for products. In Assam rice growers' perception of the quality of the extension services, their willingness to pay, the amount they would be willing to pay and factors that influence their willingness to pay for agriculture extension services is examined by Tirkey et al., and argued that majority of the farmers are satisfied with the extension services in terms of 'ease of understanding' but willing to pay for an improved extension service. According to them, age (negative coefficient), education, experience, and total production (positive coefficient) are major determinants of willingness to pay, indicating that young farmers remain the primary recipients and that higher education levels foster a favourable attitude towards the benefits of extension services. The researchers need to focus their studies on nutrition-sensitive agricultural and food policies that support a shift toward a nutrient-rich diet, such as the introduction of Shri Anna in PDS in Madhya Pradesh, Ragi in Karnataka, Odisha, and Tamil Nadu, along with procurement, processing, and distribution patterns and challenges.

VIII

NATURAL RESOURCE MANAGEMENT FOR RESILIENT RURAL TRANSFORMATION

The livelihoods of the rural poor are intricately tied to natural resources, as Singh notes in his lead paper. He further stated that collective management systems, such as community management, empower local communities and promote inclusiveness; therefore, sustainable bioeconomy and landscape approaches are needed in the design and execution of rural transformation programs that enhance resource-use efficiency, diversity, and an integrated production system. Considering the importance of natural resource management for RT, 14 research papers are considered for discussion. For ease of discussion, accepted research papers are categorised as studies on degradation of natural resources (3), natural and social calamities and NRM (2), technologies for NRM (6) and policies for NRM (3). Degradation of land and its impact are assessed by Bansal et al., who selected farmers from Karnal and Panipat districts who face problems of soil alkalinity, salinity, water depletion, and waterlogging. Their findings reported that there are economic disparities between normal and problematic farms; problematic farms incurred higher input costs for seeds, fertilisers, and plant protection chemicals, yet achieved lower yields and returns than normal farms. Pawar et al., examines the trends in agricultural growth, crop instability, groundwater depletion, and land degradation in Haryana using time-series data and observed that agricultural sector presents a dual narrative of progress and distress, groundwater levels have declined at an alarming rate, districts like Kurukshetra, Gurugram, and Fatehabad exhibit over 200 per cent groundwater depletion, indicating acute over-extraction and problem of land degradation expanded in most districts over the time, particularly in urban and agriculturally intensive regions. They further reported that growth in production of paddy, bajra, and rapeseed-mustard is encouraging, but stagnation in wheat, a sharp decline in cotton, and the persistent volatility in gram and barley production. In Tamil Nadu, the analysis carried out by Yogeshwari reveals that land deprivation is severe among SCs, indicating a progressive withdrawal of SC households from cultivation as a viable livelihood activity. They further reported that among those retaining small and marginal holdings, restricted access to institutional credit, which perpetuates reliance on informal lending, constrains capital formation and reinforces cycles of indebtedness, highlighting how unequal land distribution, compounded by marginalisation of holdings, continues to reproduce economic vulnerability. Their findings argue for a reorientation of agrarian policy that integrates redistributive justice with institutional support to mitigate the compounded risks confronting SC farmers amid the contemporary agrarian crisis.

Sneha and Sahoo review the multifaceted consequences of flooding on health, education, livelihoods, and infrastructure, with particular emphasis on South Asian countries, a region increasingly vulnerable to climate-induced hazards. They report that floods are not merely natural or environmental events but complex social

phenomena with profound implications for human development. According to them, impacts intersect with existing social inequalities, disproportionately affecting marginalised populations, including women, SCs, informal sector workers, and landless communities due to their restricted access to resources, essential services, and institutional support mechanisms. Their study contributes to the broader discourse on disaster risk reduction by advocating a shift toward integrated, inclusive, and technology-supported strategies that enhance resilience and promote sustainable human development amid increasing climate-related risks. Gautam and Kumar investigate the complex interplay between rural-to-urban migration, urbanisation, and slum proliferation across 30 Indian states and observed the deeply uneven nature of India's internal migration landscape, characterised by distinct "sending" and "receiving" regions that shape patterns of urban expansion and informality. They reported that economic migration remains predominantly male-driven. At the same time, female mobility continues to be shaped by social reasons, and states like Delhi, Chandigarh, and Kerala show high migration and urbanisation levels yet manage to contain slum proliferation, likely due to stronger governance and urban planning mechanisms. Conversely, states such as Andhra Pradesh, Chhattisgarh, and Madhya Pradesh exhibit elevated slum shares despite lower migration intensity. They further reported that high net in-migration rates in metropolitan and peri-urban areas reveal a persistent trend of urbanisation occurring in the absence of adequate infrastructure, contributing significantly to the emergence and entrenchment of slum settlements. This phenomenon of “urbanisation without capacity” reflects a dual challenge: regions of origin experience human capital depletion, while destination areas face increasing pressure to absorb migrant populations without corresponding improvements in housing, services, or employment opportunities, thereby placing additional strain on natural resources. Hussain and Guha reported that diversification towards short-duration HYV crop was higher in very high and highly flood-hazard regions of Assam, and factors like access to irrigation, flood exposure, institutional credit, extension services and size of operational landholdings significantly influence both the decision to adopt and the extent of adoption of HYV crops in problematic regions. Kaur and Singh reported that the introduction of high-yielding rice and wheat varieties in the late 1960s, along with a supportive governmental environment and a forward-thinking agricultural sector in Punjab, is on a high-growth trajectory, but is accompanied by overuse of farmland and a crisis of overexploitation of natural resources, such as soil and groundwater. Greenwashing is the practice of making false, exaggerated, or misleading environmental claims to make a product appear more sustainable than it actually is. Karna uses a multi-scalar, mixed-methods approach to evaluate greenwashing in the global agriculture industry; her findings imply that the combination of growing consumer demand for "green" products and inconsistent regulatory oversight creates a fertile environment for greenwashing to thrive. She further reported that unseen effects (such as land degradation or carbon misreporting) in agriculture and food systems are hard to identify, even though many

nations have begun to address this issue through recommendations and labelling regulations. She suggested some of the policies for addressing this issue, like establishing international anti-greenwashing standards, third-party verification of sustainability claims, digital traceability of the agri-value chain, controlling the application of sustainability narratives and eco-labelling (like carbon-neutral, regenerative, and climate-smart), subsidies, branding opportunities, and policy incentives for sincere farmers and agribusinesses. Sharma et al. examine how farmers perceive and handle pesticides, and how they use them regularly. Findings revealed that about 50% of farmers had a basic level of awareness of pesticide risks and an optimistic attitude towards pesticide use, but less than 50% had received any form of safety training for proper handling. Study conducted by Puja and Garba explores whether linking crop residues to biofuel markets can simultaneously reduce burning and improve rural livelihoods in Haryana and demonstrates that the transition from residue burning to residue valorization in Haryana is not merely a technical switch but a complex socio-economic process and diverting straw into briquettes, compressed biogas, and ethanol can significantly reduce open-field burning and its associated GHG emissions while raising the annual earnings of landless workers. Laishram et al. reported significantly higher net returns per hectare, the best relative economic efficiency for each crop, and a reduced market dependency ratio after comparing the natural farming method with the conventional farming system in Himachal Pradesh.

Regarding NRM policy issues, a study on renewable energy in Punjab by Singh and Ranguwal found that converting agricultural waste into bioenergy offers an economically viable solution to surplus paddy residue while simultaneously addressing sustainability and environmental concerns. They observed that adopters primarily managed residues through removal using ballers for power generation in Punjab, demonstrating this as a profitable and sustainable option for soil and human health. Another study by Srivastava et al. on a graduated pricing structure for electricity, in which prices increase when consumption crosses established thresholds for the sustainability of groundwater resources in Uttar Pradesh. The evidence reveals that, at established thresholds of free electricity, all smallholders who need policy support can meet their peak-season irrigation demand; free electricity exceeding the peak-season requirement does not reflect the scarcity value of groundwater and may undermine the objective of changing farmers' behaviour towards its efficient use. They further reported that in shallow-water regions, it might fail to incentivise farmers to adopt water-saving technologies and practices, which may result in a cycle of increased groundwater extraction and disincentivise farmers from using solar energy for irrigation in the state. Raj et al. highlight the critical interplay between electricity subsidies, groundwater sustainability, and irrigation costs in India. The findings underscore the significant role of free or highly subsidised electricity in increasing the rate of groundwater over-extraction, as evidenced by the alarming rates of groundwater depletion in states like Punjab, Haryana, and Andhra Pradesh. They

reported that eliminating the electricity subsidy is likely to reduce irrigation hours but would raise irrigation costs. A relatively higher rate of increase in irrigation costs than the reduction in irrigation hours highlights a policy dilemma: optimising the trade-off between improving farmers' welfare and ensuring groundwater sustainability. They suggested alternatives to electricity subsidies include Direct Benefit Transfers to farmers' bank accounts or tiered electricity pricing that ensures farmers' affordability and promotes sustainable use. The findings of studies highlight the exploitation of natural resources and their consequences, and require policy measures, along with the adoption of conservation technologies in agriculture, for inclusive development. Therefore, research in agricultural economics should also focus on sustainable farming by combining three main sustainability principles: minimal soil disturbance, permanent soil cover, and crop diversification to manage natural resources efficiently.

IX

ISSUES FOR DISCUSSION

The preceding review of research papers brings out the following issues for discussion.

1. The central government's "Sabka Saath, Sabka Vikas" (inclusive development) mantra for rural development shows growing interest in ensuring that the benefits of development reach the poor and underprivileged. This provides a new horizon for agricultural economists on subjects that have heretofore occupied only development, inequalities, agrarian crises, issues of agricultural labourers, and the participation of women in the rural transformation process. No research paper has addressed asset formation, structural and occupational changes, and only a few have addressed off-farm and on-farm labour, except for a conceptual framework presented in the keynote research paper on asset formation, labour demand, the labour market, and labour productivity. Therefore, it would be academically beneficial for the group to discuss the pursuit of economies of scale in production and investment in larger, more efficient farm assets, as well as the factors affecting asset growth and efficiency. Similarly, labour-related issues in rural transformation, such as wage structures, skill and efficiency enhancement, alternative opportunities, and social vulnerability, need to be discussed.
2. There is evidence in some research papers that economic, ecological, and social factors create disparities and contribute positively or negatively to the process of rural transformation in different ecological and resource-endowment settings across the country. For rural transformation and inclusive development, there are several schemes providing housing (PMAY-G), all-weather roads (PMGSY), Deendayal Upadhyay – Grameen Kaushalya Yojana, Rural Self-Employment Training Institutes for skill development,

and rural women's empowerment through community institutions like Deendayal Antyodaya Yojana–National Rural Livelihoods Mission (DAY-NRLM), digital inclusion, financial inclusion and rural infrastructure development via projects funded by the Rural Infrastructure Development Fund and MGNREGA, However, the results of many development programmes are not commensurate with the expectations and investment made therein. In light of this, it will be pertinent for the group to discuss the contributions of various factors to the success and failure of rural transformation schemes/ projects, and to distil lessons for midterm corrections and future implications.

3. Some research papers highlighted the role of community institutional innovations in rural transformation. Still, most studies focused on FPOs, SHGs, and cooperatives to leverage collective bargaining, microfinance, and primary processing of farm produce. But still, marginalised groups, including smallholders, women, and lower caste farmers, demonstrate lessened engagement in these institutions, underscoring persistent structural barriers that endure despite policy aims. Thus, the group needs to focus on the basic factors responsible for these inequalities, the strong backwards and forward linkages, and the development of a rural agro-processing hub to create more employment and benefits for the marginalised population. No research papers exist on the role of NGOs in rural transformation; thus, the group may like to discuss the success stories of some NGOs working in tribal and economically backward areas.
4. Many research papers from the northeastern state of the country mainly focus on the introduction of new crops into the cropping pattern, SHGs and NRLM for women's empowerment, challenges of microfinance, IFS, Custom hiring centres, agri-diversification, etc. Still, for this region, comprehensive multi-sectoral programs are needed to address under-employment by promoting skill development, technology adoption, and investments in the rural economy, with a focus on empowering rural women and young farmers. It will be desirable for the group to discuss the relevance and progress of new initiative taken by central government for rural transformation of this region like Prime Minister's Development Initiative for North East Region (PM-DevINE, Uttar Poorva Transformative Industrialization Scheme (UNNATI-2024), North East Rural Livelihoods Project (NERLP), National Rural Economic Transformation Project (NRETP), Mission Organic Value Chain Development for North Eastern Region (MOVCDNER), and North Eastern Regional Agricultural Marketing Corporation (NERAMAC).
5. Diversification is an essential strategy for resilience and a balanced, sustainable livelihood of rural households, as evident from research papers on livelihood and income diversification, crop and cropping system diversification, farm and non-farm diversification, and the introduction of

new crops for crop diversification. Most studies also observed regional disparities. The role of different contract farming models (centralised, nucleus estate, multipartite, informal, and intermediary), IFS modules, agro-enterprises, livestock, and value-addition activities is missing from the research papers accepted for discussion. Thus, it will be worthwhile for the group to discuss these activities and modules, which provide a broader range of products and services for enhancing food and nutritional security, reduces farm income volatility by spreading risk, improving on and off farm rural employment, creating associated rural infrastructure and market access for value added products and improves environmental sustainability by addressing issues like soil erosion and declining water tables.

6. Some research papers highlighted the importance of public policies in rural transformation; most researchers focused on market-driven policies such as price support, market infrastructure development, E-NAM, direct cash transfers, and alternative marketing channels. Researchers also analysed credit-linked policies such as PMFBY, KCC, PM-KISAN and subsidies. Studies on policies related to rural extension services primarily focus on the roles of NRLM, KVKs, and CHCs in rural transformation. Studies on policies related to infrastructure and technology development focus on digital inclusion, PM-KUSUM, PMKSY, MGNREGA, and public investment in irrigation. All these studies mainly focus on the impact of these policies and policies related to agri-product processing, such as Pradhan Mantri Kisan SAMPADA Yojana (PMKSY), PM Formalisation of Micro Food Processing Enterprises (PMFME), Production Linked Incentive Scheme for Food Processing Industry (PLISFPI), Agriculture Infrastructure Fund (AIF), PM MUDRA Yojana, and FDI, etc, are missing. Therefore, within the group, it is expected to discuss the policies related to food processing —progress, impact, and implementation challenges. Similarly, the group is expected to discuss policies for energy development, such as the National Bioenergy Mission, the National Green Hydrogen Mission, and technologies for second-generation ethanol, to diversify agriculture towards energy and power generation.
7. In a few research papers, the authors have demonstrated patterns of food consumption and the role of prices for rural welfare. Changes in nutritional security after the enactment of the National Food Security Act (NFSA) of 2013, which provides a legal right to subsidised food grains for the poorest of the poor, and priority households at affordable rates, have not been addressed. It will be desirable for the group to discuss operational inefficiencies, exclusion and inclusion errors in beneficiary identification and infrastructure development, in relation to their execution costs and benefits.
8. Climate change and rural development are linked because it affects poor and marginalised populations through impacts such as decreased agricultural

productivity, environmental degradation, biodiversity loss, and declining ecosystem services, which can lead to increased conflict over land and natural resources. Most researchers studied the effects of climate-smart technologies; a few examined adaptive capacity and climate risk; and very few worked on GHG emissions and productivity. But mitigation strategies for climate change, such as climate-resilient agriculture, sustainable resource management, livestock management, and technological advancement, are inadequately covered in the contributed research papers. To fill this gap, the group may like to discuss a few success stories of mitigation strategies for climate change across India, related to the adoption of drought- and heat-tolerant varieties, crop/system diversification, sustainable practices (rainwater harvesting, efficient irrigation methods, agroforestry), etc.

9. Natural resource degradation due to natural calamities and technologies, and policies for NRM are highlighted in the research papers submitted for discussion. Research gap in valuation of NRM practices for assessing their economic, social and environmental benefits, quantification of the economic and social costs of degradation of natural resources, impact of environmentally harmful subsidies and relationship between shifting cultivation and degradation of natural resources, especially in the northeastern region, for long-term inclusive development needs to be addressed by this group.
10. Lastly the some of the issues narrated in synopsis for this theme and also highlighted in lead paper by Singh are not addressed by the researchers such as tenancy related problems, interlinking agrarian markets, agrarian distress, depeseantisation and de-agrarianization, part time farming and changing scenario of agricultural finance (rise in private and digital lending), corporate interface (contract farming, private mandi/digital agri-markets) etc., thus group may like to discuss these issues.

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