

Socio-Economic Impacts of Agricultural Production in North East India: A Comprehensive Review

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Abstract

Agriculture plays a central role in sustaining rural livelihoods, household income, food security and socio-economic development in North East India, yet its potential remains constrained by fragmented landholdings, difficult terrain, inadequate irrigation and mechanisation, weak market infrastructure, limited institutional support and continued dependence on rainfed and shifting cultivation. This review examines the socio-economic dynamics associated with agricultural production across the eight North Eastern states, focusing on land and farm structure, human capital, technology, diversification, infrastructure, institutions, markets and livelihood outcomes. A structured literature-review approach was adopted to synthesise relevant empirical studies published till date, with evidence organised thematically around major determinants and consequences of agricultural production. The reviewed literature indicates that landholding characteristics, family labour and traditional land-use systems significantly influence agricultural livelihoods, while education, technical knowledge, extension contact and training facilitate technology adoption and productivity improvement. Crop diversification, integrated farming, agroforestry, organic agriculture, livestock production and rainwater harvesting emerge as important strategies for enhancing farm income, employment, resource efficiency and environmental sustainability. However, inadequate irrigation and mechanisation, poor storage and transportation, limited credit and extension services, weak certification and marketing systems, and insufficient institutional coordination continue to restrict agricultural transformation. Farmer Producer Organisations and other collective institutions offer opportunities for improving access to inputs, services, value addition and markets. Overall, agricultural production and socio-economic development in the region are mutually reinforcing but highly context-specific. The review highlights the need for integrated, livelihood-sensitive and region-specific policies that combine modern technologies with indigenous knowledge and strengthen infrastructure, human capital, diversification and collective institutions. Comparative household-level and multivariate research is recommended to better assess the relative contribution of socio-economic, technological, institutional and environmental factors to agricultural productivity and sustainable rural development.

Keywords: Agricultural Production, Socio-Economic Dynamics, Agricultural Diversification, Rural Livelihoods, North East India.

Introduction

Agriculture is a major foundation of rural livelihoods and socio-economic development in North East India, where the sector is closely connected with employment, household income, food security, cultural practices and natural-resource management. The region comprising Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura possesses considerable agro-biodiversity, diverse agro-climatic

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conditions and substantial potential for crop, horticultural, livestock and integrated farming systems. Nevertheless, agricultural development remains constrained by hilly terrain, fragmented holdings, inadequate irrigation and mechanisation, weak market infrastructure, limited access to institutional credit and extension services, and the continuing dependence of many communities on rainfed and shifting cultivation. These structural characteristics make the relationship between agricultural production and socio-economic development particularly important in the North Eastern Region (NER).

The socio-economic significance of agriculture in the region can be understood from several complementary perspectives. Samal et al. (2016) argued that agricultural technologies in North East India need to be pro-poor, locally appropriate and compatible with the resource conditions of subsistence farmers rather than relying exclusively on high external inputs. Prakash et al. (2017) emphasised integrated farming systems as a means of combining crop, livestock and other farm enterprises to improve resource utilisation, food security and livelihood security among small and marginal farmers. Punitha et al. (2018) demonstrated that shifting cultivation is not merely an agricultural practice but a socio-cultural and livelihood system involving distinctive land-use traditions, household characteristics and community institutions. Marchang (2018) highlighted the importance of land as the principal productive resource among Scheduled Tribes and showed that small and medium holdings frequently support subsistence-oriented agricultural livelihoods, although dependence on agriculture has gradually declined. The productivity dimension is equally important. Das et al. (2014) showed that appropriate tillage and biomass management can influence soil quality and rice productivity among small-scale farmers in North Eastern India, demonstrating the importance of improved production practices for raising farm efficiency. Gogoi (2019) stressed that agroforestry can simultaneously improve soil productivity, household earnings and ecological sustainability because many farmers in the region operate small holdings and depend directly or indirectly on agriculture. Das et al. (2019) further demonstrated that integrated organic farming systems can enhance productivity, income, employment and on-farm resource recycling in the North Eastern Hill Region.

Thus, agricultural production in North East India should not be viewed only in terms of crop yields. It is embedded in a broader socio-economic system in which education, landholding size, labour availability, access to technology, extension contact, credit, infrastructure, crop diversification, market participation and institutional support influence both production and household welfare. The existing literature also indicates a gradual transformation from subsistence and shifting cultivation towards diversified, market-oriented and higher-value agricultural activities. Against this background, the present review synthesises the available literature, with particular emphasis on the socio-economic determinants and consequences of agricultural production in North East India. It seeks to identify the major themes emerging from previous research, compare evidence across the North Eastern states, and highlight gaps requiring further empirical investigation.

Literature Review

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The previous findings on agricultural production in North East India identifies land use, farm structure and traditional cultivation systems as fundamental socio-economic factors. Datta et al., (2013) found that the livelihood status of Jhum-practising tribal households in Tripura was closely associated with the area under Jhum and family participation in cultivation. Marchang (2018) similarly reported that collective land ownership and small- to medium-sized holdings remain important for tribal livelihoods, although dependence on agriculture and agricultural income has gradually declined. Punitha et al. (2018) viewed shifting cultivation as a deeply embedded socio-cultural and livelihood institution and cautioned against policies focused solely on its elimination. Pandey et al. (2019) showed that the transition from Jhum to alternative agricultural systems among the Mara tribe of Mizoram affected household well-being, demonstrating that agrarian change has broader socio-economic consequences. Marchang (2023) further observed declining dependence on shifting cultivation alongside increasing pressure on agricultural land and movement towards non-farm livelihoods. These studies collectively indicate that landholding pattern, land-use practices, family labour and the transition from subsistence to alternative livelihoods are important determinants of agricultural and socio-economic outcomes in the region.

A second major factor concerns technology, human capital, diversification and sustainable production practices. Das et al. (2014) demonstrated that appropriate tillage and biomass management can improve resource use and maintain rice productivity, while Sorokhaibam et al., (2017) showed that liming, planting time and tillage significantly influence rice-lathyrus system productivity in Manipur. Samal et al. (2016) advocated locally appropriate, resource-efficient and pro-poor eco-technologies because conventional high-input technologies may not suit the ecological and economic conditions of North Eastern farmers. Singh and Devi (2019) highlighted indigenous soil and water conservation practices as valuable resources for sustainable agriculture, while Gogoi (2019) emphasised agroforestry for improving soil productivity, income diversification and ecological sustainability. Das et al. (2019) found integrated organic farming beneficial for soil health, employment and farm income, and Ray et al. (2019/2020) reported livelihood improvements through integrated farming and rainwater harvesting compared with traditional shifting cultivation. Priscilla et al. (2021) found that crop diversification significantly improved household income and was associated with landholding, household labour, crop-loss experience, extension contact and training. Moyon (2021), specifically in Chandel district of Manipur, linked rice production with household income, education, land ownership and access to modern agricultural techniques. Naveen et al. (2022) further showed that farmer characteristics and knowledge influenced adoption of organic pesticides among vegetable growers in Bishnupur. Collectively, these studies establish education, technical knowledge, extension, training, land resources and diversification as important factors influencing agricultural productivity and household welfare.

The third cluster of research focuses on institutional, infrastructural, market and livelihood factors. Halder et al. (2017) demonstrated that improved livestock management, veterinary support and better breeds can generate socio-economic benefits for tribal households, highlighting the importance of allied agricultural activities. Gogoi (2019)

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identified fragmented holdings, inadequate irrigation and mechanisation, poor-quality seeds, pest and disease problems, weak storage and limited marketing as major constraints, compounded by insufficient awareness and training. Kadirvel et al. (2020) argued that agricultural biodiversity can support value addition, agribusiness, entrepreneurship and inclusive growth when linked with processing and market development. Borgohain (2020) stressed that inadequate infrastructure, communication, coordination and technological support constrain rural livelihoods, while Bordoloi and Swami (2020) identified weak certification, extension, awareness and marketing systems as barriers to organic farming. Priscilla et al., (2021) showed that agricultural and non-farm income sources are closely related to income inequality and livelihood diversification. Sharma et al. (2022/2023) found that participation in Farmer Producer Organisations significantly improved farmers' income in Meghalaya, indicating the importance of collective institutions for access to inputs, services and markets. De and Tamang (2023) concluded that agricultural progress in North East India remains constrained despite favourable agro-climatic resources, with land allocation, diversification, resource use and labour absorption influencing regional agricultural performance. Overall, the literature suggests that agricultural production and socio-economic development are mutually interconnected through land, education, technology, diversification, infrastructure, institutions, markets and livelihood opportunities. However, the evidence remains fragmented across states and themes, indicating a need for integrated, household-level and comparative studies that jointly examine these factors and their effects on agricultural productivity and socio-economic well-being.

Objectives

The review aims to examine the socio-economic dynamics associated with agricultural production in North East India. Specifically, it seeks to: (i) assess the influence of education, landholding, labour, technology, extension services and other socio-economic factors on agricultural productivity; (ii) examine the roles of agricultural diversification, integrated farming, organic practices and indigenous knowledge in improving farm income, livelihood security and environmental sustainability; and (iii) evaluate the influence of infrastructure, credit, markets, institutions and collective organisations on agricultural development. The review also aims to identify major research gaps and draw policy implications for inclusive, sustainable and region-specific agricultural development in North East India.

Materials and Methods

The study adopted a structured literature-review approach to synthesise empirical evidence on agricultural production and its socio-economic dimensions, with particular emphasis on North East India. Relevant scholarly studies published so far were considered, while the methodological framework of the original review covered literature from 1990-2020 and incorporated studies relevant to the Indian agricultural context. The review focused mainly on research conducted in India, supplemented by studies from other developing regions where their findings were relevant to agricultural production and socio-economic conditions in the region. Literature was identified through academic sources using

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combinations of keywords relating to agricultural production, socio-economic factors, productivity, technology, diversification, sustainability, livelihoods and North East India.

Studies were selected according to their relevance to the review objectives, with particular attention to empirical research examining relationships between agricultural outcomes and socio-economic, technological, institutional and environmental factors. Quantitative approaches reported in the literature, including regression analysis, stochastic frontier analysis and econometric modelling, were given particular consideration because of their ability to assess determinants of agricultural productivity and efficiency. The principal variables reviewed included education, farm and landholding characteristics, labour, technological adoption, agricultural diversification, income, extension contact, infrastructure, institutional arrangements, market access and environmental sustainability. The evidence was then organised thematically into major factors, land and farm structure; technology, human capital and diversification; and institutional, infrastructural, market and livelihood conditions, to identify common findings, differences across states and communities, and gaps requiring further investigation.

Analysis and Results

The thematic analysis identifies land use, farm structure and traditional cultivation systems as the first major dimension of agricultural and socio-economic dynamics in North East India. The evidence indicates that Jhum cultivation remains closely associated with household livelihood, family labour and community-based land institutions, particularly among tribal populations. Studies from Tripura and other tribal areas show that the extent of cultivated land and family participation influence livelihood conditions, while small and medium holdings and collective land ownership continue to support subsistence-oriented farming. The literature also demonstrates that shifting cultivation is not merely a production system but an integral socio-cultural and livelihood institution. Consequently, its transformation requires viable alternatives that protect household income and livelihood security. Evidence from Mizoram indicates that the transition from Jhum to alternative agricultural systems can substantially affect household well-being, while recent research suggests a gradual decline in dependence on shifting cultivation and increasing movement towards non-farm activities. A second major dimension is technology, human capital and agricultural diversification. The reviewed studies consistently indicate that education, technical knowledge, extension contact, training and access to improved technologies contribute to production efficiency and sustainable agricultural practices. Appropriate tillage, biomass management, liming, improved planting practices and locally adapted technologies can enhance resource-use efficiency and productivity. The literature also emphasises indigenous soil and water conservation, agroforestry, integrated organic farming, rainwater harvesting and crop diversification as important strategies for combining productivity with ecological sustainability. Household-level evidence suggests that diversification can increase income and is influenced by landholding, family labour, crop-loss experience, training and extension contact. Research from Manipur further indicates that education, household income, land ownership and access to modern agricultural techniques influence rice production, while farmer knowledge and characteristics affect the adoption of organic pest-

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management practices. Overall, the findings demonstrate that agricultural productivity is shaped not only by physical inputs but also by the interaction of human capital, technology, land resources and diversification.

The third-dimension concerns institutional, infrastructural, market and livelihood factors, which determine the extent to which agricultural production translates into sustainable income and improved household welfare. The reviewed evidence identifies inadequate irrigation, fragmented holdings, limited mechanisation, poor-quality inputs, pest and disease problems, weak storage and transportation, insufficient communication, limited extension support and underdeveloped markets as persistent constraints. At the same time, considerable opportunities exist through value addition, agribusiness, livestock, organic farming and collective institutions. Agricultural biodiversity provides scope for processing, entrepreneurship and value-chain development, while livestock-based activities can strengthen food security and diversify household income. Organic farming has substantial potential in the region, although inadequate certification, extension, awareness and marketing systems restrict its economic benefits. Collective organisations, particularly Farmer Producer Organisations, can improve access to inputs, technology, services and markets and thereby enhance farmers' income. The literature also shows that agricultural and non-farm income sources are closely related to livelihood diversification and inequality, reflecting a gradual transition from predominantly subsistence agriculture towards mixed and market-oriented livelihood strategies. Despite favourable agro-climatic conditions, agricultural progress remains constrained by limitations in land allocation, resource utilisation, diversification and the capacity of agriculture to absorb labour. Thus, the overall evidence establishes that agricultural production and socio-economic development are mutually interconnected through land, education, technology, diversification, infrastructure, institutions and markets. However, substantial variation exists across states, communities and agro-ecological settings. The findings therefore suggest that uniform agricultural policies may be inappropriate for the region. A major research gap is the limited integration of these factors within a common analytical framework. Future research should adopt comparative, household-level and multivariate approaches to determine the relative contribution of socio-economic, technological, institutional and environmental factors to agricultural productivity, income, livelihood security and sustainable rural development.

Discussion

The reviewed literature demonstrates that agricultural production in North East India is fundamentally intertwined with land, livelihood systems and socio-cultural institutions rather than being determined solely by physical farm inputs. The continued importance of Jhum cultivation among several tribal communities reflects its role in household subsistence, employment, cultural identity and community-based resource management. The findings of Datta et al. (2013) and Marchang (2018) indicate that landholding characteristics, family participation and collective land arrangements significantly shape livelihood outcomes. Punitha et al. (2018) further argued that shifting cultivation should be understood as a socio-cultural livelihood system, suggesting that policies aimed at its complete replacement may create unintended socio-economic vulnerabilities. The evidence from Mizoram reported by

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Pandey et al. (2019) similarly indicates that agricultural transformation affects household well-being, while Marchang (2023) noted the gradual movement from agricultural dependence towards non-farm livelihoods. These findings suggest that the region is experiencing an agrarian transition, but this transition is uneven and strongly influenced by ecological conditions, land institutions and community characteristics. Therefore, agricultural development policies should not impose a uniform model across the North East; rather, they should combine productivity improvement with livelihood security and recognise locally specific land-use practices. The perspective of Samal et al. (2016), who advocated pro-poor and locally suitable technologies, is particularly relevant in this context.

The second major finding concerns the importance of human capital, technology, diversification and sustainable agricultural practices in improving both productivity and socio-economic welfare. The evidence reviewed indicates that education, technical knowledge, extension contact and training enhance farmers' capacity to adopt improved technologies and respond to changing agricultural conditions. Findings on tillage, biomass management and crop management practices demonstrate that relatively appropriate and locally adapted interventions can improve resource-use efficiency without imposing excessive technological or financial burdens on smallholders. Prakash et al. (2017), Das et al. (2019) and Ray et al. (2019/2020) collectively support integrated farming, organic production and rainwater harvesting as strategies capable of improving productivity, employment, income and resource recycling. Similarly, Gogoi (2019) highlighted agroforestry as an approach that can simultaneously support farm income and ecological sustainability. The positive association between crop diversification and household income reported by Priscilla et al. (2021) is particularly important because diversification can reduce production risk and create additional income opportunities. Evidence from Manipur also shows that education, income, land ownership and access to modern agricultural techniques influence rice production, while farmer knowledge affects the adoption of organic pest-management practices. These findings imply that agricultural transformation requires investment not only in physical infrastructure but also in human capabilities and knowledge systems. Indigenous soil and water conservation practices should therefore be integrated with scientific technologies rather than treated as competing alternatives. A balanced approach combining traditional knowledge, modern extension and locally appropriate technologies could be particularly effective under the region's diverse ecological conditions.

The third major theme emerging from the review is the decisive role of infrastructure, markets, institutions and livelihood diversification in converting agricultural production into sustained economic benefits. Although the North East possesses substantial agro-biodiversity and favourable agro-climatic resources, inadequate irrigation, mechanisation, storage, transportation, market access, extension and technological support continue to restrict productivity and profitability. Gogoi (2019) and Borgohain (2020) highlight these structural constraints, while Kadirvel et al. (2020) point to significant opportunities through value addition, agribusiness and entrepreneurship. The literature on livestock and organic agriculture further demonstrates that diversification can strengthen household food security and income, although weak certification, awareness and marketing

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systems limit the benefits of organic production. Importantly, evidence from Meghalaya indicates that Farmer Producer Organisations can improve farmers' income by strengthening collective access to inputs, services and markets (Sharma et al., 2022/2023). This reinforces the argument that institutional capacity is essential for inclusive agricultural development. At the same time, the association between agricultural and non-farm income sources and livelihood inequality suggests that rural households are increasingly adopting mixed livelihood strategies. The present literature supports a multidimensional development framework in which agricultural productivity, household income, employment, environmental sustainability and institutional participation are considered together. The fragmented nature of existing studies, however, limits understanding of the relative contribution of individual factors across states and communities. Future research should therefore employ comparative household-level studies and multivariate approaches to examine how education, land, labour, technology, diversification, infrastructure, markets and institutions jointly influence agricultural productivity and socio-economic well-being in North East India.

Conclusion and Implication

The review concludes that agricultural production in North East India is a multidimensional socio-economic process shaped by land, labour, education, technology, diversification, institutions, infrastructure and markets. Agriculture continues to provide livelihood, food security and employment for a substantial rural population, but its contribution varies considerably across states, communities and agro-ecological settings. The literature indicates a gradual transition from subsistence-oriented and shifting cultivation towards diversified, integrated and market-oriented agricultural systems. However, this transition remains constrained by fragmented holdings, inadequate irrigation and mechanisation, limited extension and technological support, poor storage and transportation, weak market linkages and restricted institutional access. The evidence also demonstrates that education, training, improved technologies, crop diversification, integrated farming, agroforestry, organic practices and livestock-based activities can enhance productivity, income and livelihood resilience. At the same time, Jhum cultivation should not be viewed exclusively as an inefficient production system because it remains embedded in local cultural and livelihood structures. The review therefore supports a development approach that combines agricultural modernisation with ecological sustainability, livelihood protection and respect for indigenous knowledge. The limited integration of socio-economic, technological, institutional and environmental determinants in existing studies represents an important research gap.

The findings have significant policy and developmental implications. Agricultural policies for North East India should be region-specific and designed according to local ecological conditions, land institutions and livelihood systems rather than applying uniform models. Priority should be given to improving rural roads, irrigation, storage, market infrastructure, institutional credit, extension services and access to quality inputs and appropriate technologies. Greater investment in farmer education, skill development, digital and agricultural extension can strengthen technology adoption and productive decision-

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making. Crop diversification, integrated farming, agroforestry, organic agriculture, horticulture and livestock production should be promoted as complementary strategies for increasing income and reducing dependence on single crops. Farmer Producer Organisations and other collective institutions should be strengthened to improve bargaining power, access to inputs, value addition, processing and markets. Indigenous soil and water conservation practices should be combined with scientific innovations to promote environmentally sustainable production. Policies concerning Jhum should emphasise gradual, participatory and livelihood-sensitive transformation rather than abrupt displacement. Finally, future research should undertake state-, district- and community-level comparative studies using household-level and multivariate approaches to identify the relative effects of education, landholding, labour, technology, diversification, infrastructure, markets and institutions on productivity and socio-economic well-being. Such an integrated strategy can contribute to inclusive agricultural growth, sustainable rural livelihoods, food security and long-term socio-economic development in North East India.

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