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Climate change impact and adaptation on agriculture sector with special reference to north east region of India: A review

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Abstract

The review explores the climate change impact and adaptation on agriculture sector with special reference to north east region of India. In Northeast India, an area that is mostly dependent on traditional farming and natural resources, climate change poses complicated problems to the agricultural sector. In addition to soil degradation, deforestation and biodiversity loss, unpredictable weather patterns, rising temperatures and frequent extreme events like floods and droughts have affected agricultural output. Communities using traditional practices, such as shifting agriculture, must balance maintaining ecological and cultural integrity with adjusting to climate change. Despite these dangers, the area has a great deal of promise for resilience through a combination of institutional assistance, contemporary technology and indigenous wisdom. Precision agriculture and government programs such as PMFBY and NAFCC are complementing sustainable techniques including climate-resilient crops, rainwater harvesting and intercropping. However, obstacles including exclusionary legislative approaches, low awareness and high input costs making adaption difficult. To enhance climate resilience, it is essential to integrate traditional and scientific knowledge, strengthen community engagement and promote inclusive, locally informed policymaking. In the face of climate change, Northeast India can provide sustainable agriculture and protect the means of subsistence for its various communities by implementing comprehensive, climate-smart solutions.

Keywords: Climate change, adaptation, agriculture, north east, India

Introduction

Climate change refers to long-term changes in temperature, precipitation patterns, and other atmospheric conditions caused by natural factors and, predominantly, human activities such as fossil fuel combustion, deforestation, and industrial processes (IPCC, 2021) ^[13]. Since the pre-industrial era, the global average temperature has increased by 1.1°C, and it is projected to rise by 1.5°C by 2040 under current emission trends (NASA, 2023) ^[21]. This warming has intensified extreme weather events, including prolonged droughts, severe floods, and frequent cyclones, affecting ecosystems and human livelihoods (WMO, 2022) ^[41].

In addition to rising temperatures, the concentrations of greenhouse gases like CO₂, CH₄, and N₂O have reached unprecedented levels. Carbon dioxide levels, for instance, surpassed 420 parts per million (ppm) in 2023, marking a 50% increase from pre-industrial times (NOAA, 2023) ^[22]. This has accelerated glacial melting, contributing to a global sea-level rise of approximately 3.4 mm per year, which threatens coastal communities and low-lying islands (IPCC, 2021) ^[13]. Global water systems have also been disrupted, with some regions facing water scarcity while others experience excessive rainfall, posing challenges to agriculture, water management, and food security

(UNFCCC, 2022) ^[40].

Northeast India, a region characterized by its diverse topography, rich biodiversity, and unique cultural heritage, is highly dependent on natural resources for livelihood. Agriculture forms the backbone of its economy, engaging over 70% of the population in subsistence farming (Roy *et al.*, 2021) ^[29]. The region is predominantly rural, with communities practicing traditional farming systems such as jhum (shifting cultivation) and wet terrace rice cultivation, which are closely intertwined with the local environment and cultural practices (ICAR, 2019) ^[12]. Beyond agriculture, the livelihoods of people in the region are supported by activities such as fishing, livestock rearing, horticulture, and forest-based industries (Government of Assam, 2020) ^[11]. However, the region's dependence on climate-sensitive sectors makes it highly vulnerable to the impacts of climate change. Erratic rainfall, prolonged dry spells, and rising temperatures have disrupted agricultural cycles, reduced crop yields, and intensified water scarcity in several areas (Pradhan *et al.*, 2022) ^[26]. Livestock and fisheries, which supplement household incomes, are also affected due to changes in pasture quality and water temperatures. Additionally, the region faces challenges such as deforestation, soil erosion, and declining forest resources,

further aggravating the livelihoods of rural communities (Singh *et al.*, 2020) ^[33]. The compounded impact of these challenges necessitates urgent attention to climate-resilient strategies tailored to the socio-economic and ecological context of Northeast India.

The impacts of climate change in Northeast India are profound, affecting both natural ecosystems and human livelihoods. Rising temperatures, erratic rainfall, and extreme weather events such as floods and landslides have disrupted agricultural productivity, particularly in rainfed areas that dominate the region's farming systems (Sharma *et al.*, 2020) ^[32]. Shifting rainfall patterns have reduced the reliability of water resources, threatening crop yields and challenging traditional farming practices like jhum cultivation (ICAR, 2019) ^[12]. Additionally, frequent floods, exacerbated by glacial melt in the Eastern Himalayas, have damaged infrastructure, displaced communities, and eroded fertile soils, further undermining agricultural resilience (WMO, 2022) ^[41].

In response to these challenges, the region has begun adopting various climate change adaptation measures. Farmers are diversifying crops to include climate-resilient varieties such as drought-tolerant rice and high-yielding maize (Pradhan *et al.*, 2022) ^[26]. Agroforestry practices, integrating tree species with traditional farming, are gaining popularity as they enhance soil fertility, reduce erosion, and provide an additional source of income (Mishra & Singh, 2019) ^[19]. Government initiatives, such as the National

Adaptation Fund for Climate Change (NAFCC) and the Pradhan Mantri Fasal Bima Yojana (PMFBY), aim to provide financial and technical support for sustainable agricultural practices and risk management (NAFCC, 2018; Ministry of Agriculture, 2020) ^[20, 1]. Despite these efforts, there is a pressing need to scale up these strategies, improve rural infrastructure, and strengthen local institutional capacities to effectively address climate-induced vulnerabilities.

Climatic trends in northeast India

The climatic trends in Northeast India reveal significant variations in temperature and precipitation patterns, influenced by both natural and anthropogenic factors. Recent studies indicate a warming trend, particularly in winter and post-monsoon seasons, alongside erratic rainfall patterns that have implications for water management and ecological stability. The following sections elaborate on these key aspects.

Temperature Trends

Rising Average Temperatures: Mean air temperatures have increased by 0.2 °C to 1.6 °C per decade across various locations in Northeast India, with significant rises noted during winter months (Chakraborty *et al.*, 2017) ^[9].

Future Projections: Climate models predict a temperature rise of approximately 3-8 °C by the end of the century under various emission scenarios (Kumar & Dimri, 2018) ^[6].

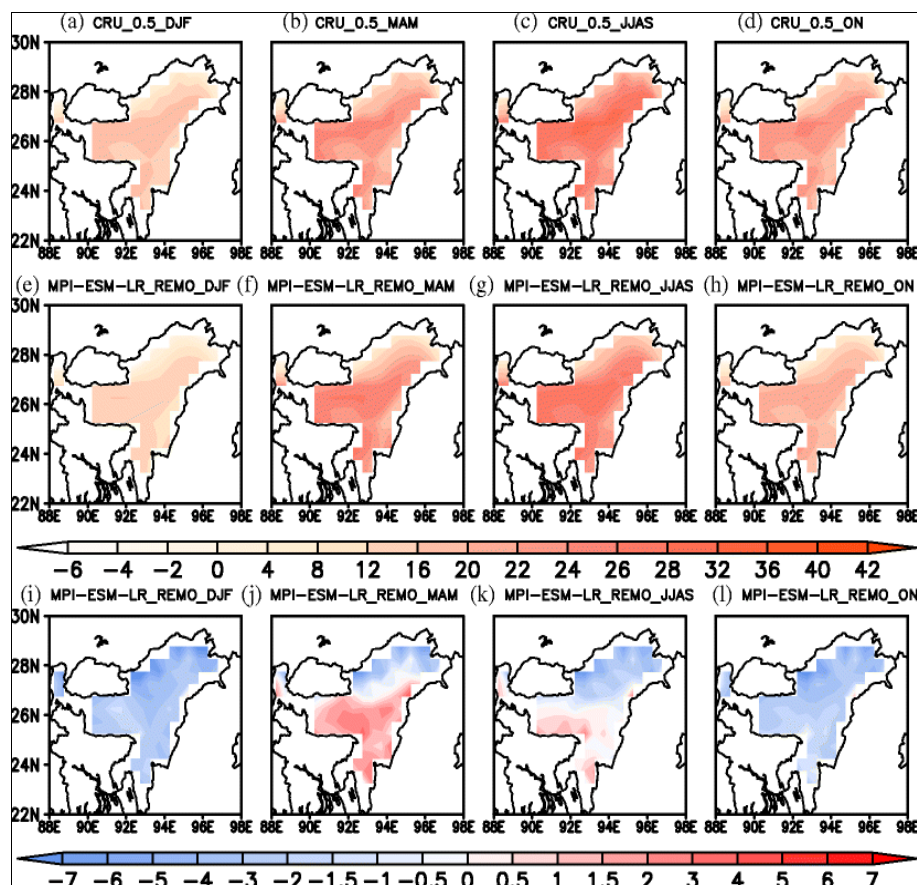


Fig: Near-surface air temperature climatology (°C) during 1970-2005 over the Northeast India region from Climatic Research Unit (CRU) dataset (a-d) and for REMO driven by MPI-ESM-LR global model (e-h) and their corresponding bias (°C) (i-l) under CORDEX South Asia experiment for DJF (December, January, February), MAM (March, April, May), JJAS (June, July, August, September), and ON (October and November) seasons. Source-Regional climate projections for Northeast India: an appraisal from CORDEX South Asia experiment

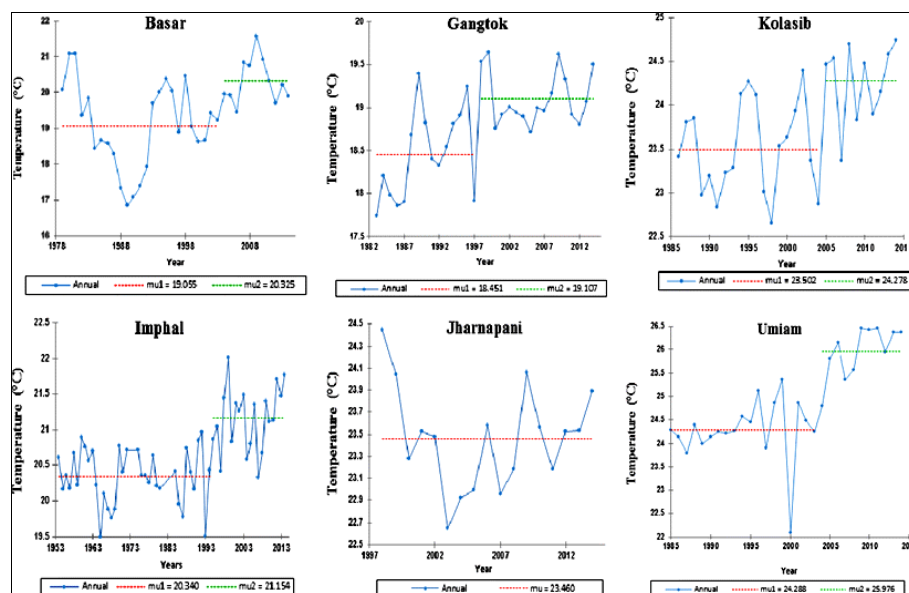


Fig: Change points in time series of mean annual temperature (Tavg) at different places of North East India. Source Trend Analysis and Change Point Detection of Mean Air Temperature: A Spatio-Temporal Perspective of North-Eastern India

Rainfall Variability

Erratic Rainfall Patterns: Long-term analyses show significant deviations in rainfall, with notable trends of increasing and decreasing rainfall during specific decades.

Extreme Rainfall Events: The summer of 2020 was marked

by extreme rainfall, attributed to specific atmospheric conditions, with projections indicating an increase in such events due to climate change (Gandolfi & Sh.M. Sodiqova, 2022)^[35].

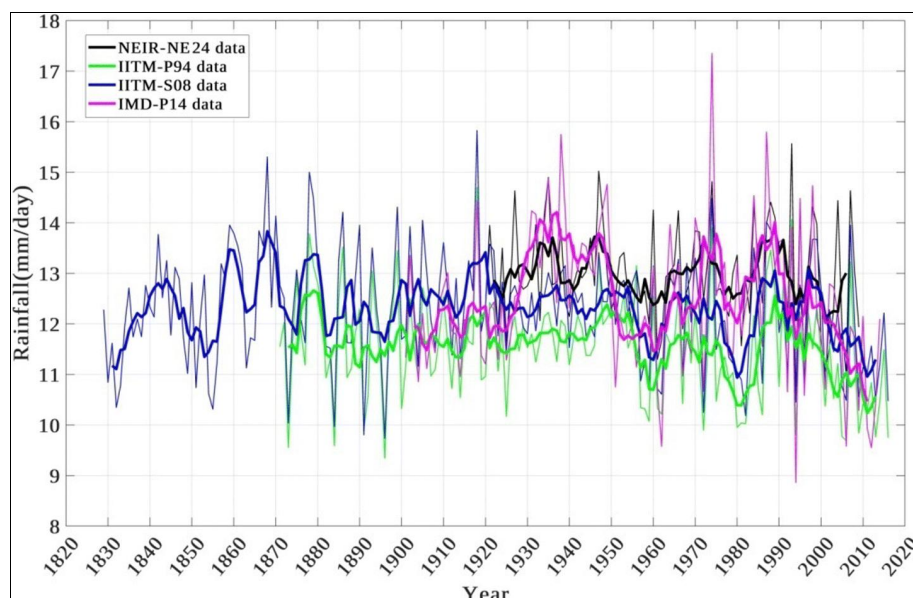


Fig: Seasonal mean rainfall (JJAS) over the NEI from four different data sets from a NE24 station data set (black) during 1920-2009 (Mahanta *et al.* 2019), b IITM dataset (Parthasarathy *et al.* 1994) during 1871-2016 (green), c IITM (Sontakke *et al.* 2008) during 1829-2006 (blue), d IMD gridded data set of 0.25×0.25 deg. resolution (Pai *et al.* 2014) during 1901-2014 (magenta). Source- Impact of climate change on North-East India (NEI) summer monsoon rainfall

Implications for Ecosystems

Impact on Biodiversity and Agriculture: The changing climatic conditions pose risks to local ecosystems and agricultural practices, necessitating adaptive strategies for resilience ("Trend analysis and Change point Detection of Monthly, Seasonal and Annual Climatic Parameters in The Garo Hills of Northeast India", 2022).

Impacts on Food Supply and Market Mechanisms: The combination of erratic rainfall, droughts, and extreme

weather events affects the overall food supply chain, leading to market instability and challenges for farmers in accessing markets and selling their produce

Livelihood of northeast in India

The livelihood of Northeast India is intricately linked to its unique ecological and socio-economic landscape, characterized by traditional agricultural practices, natural disasters, and emerging diversification trends. The region's

tribal communities primarily rely on natural resource-based livelihoods, with shifting cultivation (jhum) being a significant practice, especially in hilly areas. However, challenges such as flooding and limited agricultural land have prompted shifts in livelihood strategies. The following sections elaborate on these key aspects.

Traditional Agricultural Practices

Shifting cultivation remains vital for food security and biodiversity among tribal communities in the hills (Sharma, 2024)^[31].

In Barak Valley, traditional practices are being transformed, with many younger farmers diversifying into commercial farming to supplement income.

Impact of Natural Disasters

Flooding from the Brahmaputra and Barak rivers severely disrupts agricultural activities, leading to economic losses for small farmers (Das & Das, 2023)^[8].

The recurrent floods result in prolonged submersion of cultivable land, causing out-migration to urban areas in search of better opportunities (Das & Das, 2023)^[36].

Livelihood Diversification

Many farmers are transitioning from traditional practices to diversified income sources, such as agroforestry and commercial crops, to combat economic instability.

Opportunities for small farmers include high soil fertility and market demand for rice, despite facing constraints like limited land and irrigation issues.

Diversification offers new avenues for income, it may also lead to ecological degradation if not managed sustainably, highlighting the need for balanced development strategies in the region.

The impact of climate change on agriculture in northeast India

The impact of climate change on agriculture in Northeast India is profound, affecting both traditional practices and food security. The region's reliance on monsoon precipitation makes it particularly vulnerable to erratic rainfall patterns, increased droughts, and extreme weather events, which threaten crop yields and agricultural sustainability. The following sections outline the key aspects of this issue.

Climate Variability and Crop Yields

Erratic rainfall and delayed monsoons have been reported, significantly impacting rice cultivation, which occupies over 60% of the cropping area in states like Nagaland and Mizoram (Tosato, 2023)^[38].

Climate change is projected to reduce farm earnings by 14-19% in irrigated areas and 19-24% in unirrigated areas (Kumar & Rana, 2024)^[30].

Soil Erosion and Land Degradation

Increased agricultural intensification combined with climate change is expected to exacerbate soil erosion, particularly in shifting cultivation systems, with erosion rates potentially increasing by up to 3.1 times by the end of the century.

Indigenous Knowledge and Adaptation Strategies

Indigenous communities possess valuable traditional

ecological knowledge that aids in adapting to climate change impacts. Integrating this knowledge with scientific approaches is crucial for enhancing resilience.

Despite these challenges, there are ongoing efforts to develop climate-smart agricultural practices and policies aimed at mitigating the adverse effects of climate change, highlighting the potential for adaptation and resilience in the region (Desai *et al.*, 2023)^[37].

Climate change adaptation strategies on agriculture in northeast India

Climate change adaptation strategies in agriculture in Northeast India are crucial due to the region's vulnerability to extreme weather events and shifting climatic conditions. Indigenous knowledge plays a significant role in these strategies, alongside modern agricultural practices. The following sections outline key adaptation strategies employed in the region.

Traditional Knowledge and Practices

Indigenous communities utilize traditional ecological knowledge (TEK) to adapt to climate variability, including crop rotation and intercropping systems that enhance biodiversity and resilience.

Practices such as rainwater harvesting and the use of local crop varieties that are drought-resistant are common (Sarma *et al.*, 2023)^[23].

Technological Innovations

The adoption of precision agriculture and climate-smart technologies helps farmers optimize resource use and improve yields under changing conditions (Rajesh *et al.*, 2024)^[3] (Saikanth *et al.*, 2023)^[7].

ICT tools are increasingly used in agricultural extension services to provide timely information and support to farmers, enhancing their adaptive capacity (Rajesh *et al.*, 2024)^[3].

Policy and Institutional Support

Effective policy frameworks and community engagement are essential for scaling adaptation strategies, ensuring they are context-specific and sustainable (Rajesh *et al.*, 2024)^[3] (Saikanth *et al.*, 2023)^[7].

Initiatives like participatory on-farm trials have demonstrated the effectiveness of adaptive strategies, such as real-time contingency planning for managing rainfall anomalies (Sarma *et al.*, 2023)^[23].

Adaptation decisions were strongly linked to sowing and post-sowing activities, highlighting the need to incorporate local perceptions into climate policies (Paul *et al.* 2023)^[25].

Government policies and institutional support for climate change adaptation in northeast India

Climate change poses significant challenges to agriculture and livelihoods in Northeast India, a region characterized by its unique socio-economic and ecological settings. Effective adaptation requires comprehensive policies and institutional support to address these challenges.

Current Policies and Institutional Frameworks

National Adaptation Fund on Climate Change (NAFCC): The NAFCC provides financial, technical, and

capacity support to state governments, fostering competitive federalism and encouraging enhanced climate action. However, sustained handholding is necessary until climate change issues are fully embedded in the policy landscape (Prasad & Sud2018) ^[27].

Climate-Smart Agriculture (CSA): CSA approaches aim to reduce greenhouse gas emissions and address food security and climate change challenges. In Nagaland, institutional and policy assessments reveal that while some aspects are well-positioned, there is room for improvement in others (Patra & Babu 2022) ^[24].

Barriers to Effective Adaptation

High Costs and Lack of Awareness: Farmers in Northeast India face high costs of agricultural inputs and a lack of awareness about effective adaptation technologies, which are significant barriers to adaptation (Bhalerao *et al.* 2021) ^[1].

Top-Down Policy Approaches: Many policies are top-down and do not adequately incorporate traditional knowledge (TK) or the perspectives of marginalized actors, leading to less effective adaptation strategies. (Singh *et al.* 2021) ^[34]

Successful Adaptation Strategies

Knowledge Co-Production: Integrating traditional knowledge with scientific research through knowledge co-production can enhance adaptive capacity. Successful examples include the management of soil and water resources, where stakeholder participation has been effective (Singh *et al.* 2021) ^[34].

Self-Organized Adaptation: Long-term pathways of transformation through self-organized adaptation, supported by institutional interventions such as agricultural knowledge dissemination and market linkages, have led to diversified agricultural systems in the Indian Himalayas (Fischer *et al.* 2021) ^[10].

Recommendations for Policy Improvement

Holistic Support Programs: To overcome adaptation barriers, holistic support programs that raise awareness, reduce input costs, and facilitate access to financial credits are needed (Bhalerao *et al.* 2021) ^[1].

Inclusive Policymaking: Policies should be more inclusive, incorporating the perspectives of marginalized populations and traditional knowledge to ensure equitable adaptation strategies.

Public-Private Partnerships: Strong public-private partnerships and innovative institutional mechanisms are essential for formulating and implementing effective climate change adaptation strategies (Chaturvedi *et al.* 2018) ^[5].

Conclusion

Climate change poses significant and multifaceted challenges to the agriculture sector of Northeast India, a region heavily dependent on traditional farming systems and natural resources. Erratic rainfall patterns, rising

temperatures, and increasing frequency of extreme weather events such as floods, landslides, and droughts have disrupted agricultural cycles, reduced crop yields, and threatened food security. These impacts are further compounded by issues such as soil erosion, deforestation, and loss of biodiversity, which undermine the resilience of both ecosystems and rural livelihoods. Communities practicing shifting cultivation and other traditional systems face the dual burden of adapting to changing climatic conditions while maintaining ecological balance and cultural heritage.

Despite these challenges, Northeast India demonstrates considerable potential for resilience and adaptation through a combination of indigenous knowledge, emerging technological advancements, and institutional support. Traditional practices like rainwater harvesting, intercropping, and the use of drought-resistant local crop varieties offer valuable lessons in sustainability. At the same time, modern interventions such as precision agriculture, agroforestry, and climate-resilient crop varieties are being adopted to address climatic variability. Government initiatives like the National Adaptation Fund on Climate Change (NAFCC) and Pradhan Mantri Fasal Bima Yojana (PMFBY) provide financial and technical support for climate adaptation. However, these measures need to be scaled up and made more accessible, particularly for marginalized and smallholder farmers.

The region's successful adaptation also hinges on addressing key barriers, including high input costs, lack of awareness about climate-smart technologies, and the predominance of top-down policy frameworks that often exclude local perspectives. Integrating traditional knowledge with scientific research through knowledge co-production, strengthening public-private partnerships, and fostering community engagement are essential for enhancing adaptive capacity. Additionally, inclusive policymaking that considers the unique socio-economic and ecological characteristics of the region can ensure equitable and sustainable solutions.

By prioritizing holistic strategies that combine technological innovations, institutional reforms, and the preservation of traditional practices, Northeast India can build resilience against climate change impacts. Strengthened infrastructure, improved access to resources, and enhanced institutional capacities will play a pivotal role in achieving climate-smart and sustainable agricultural practices. With these efforts, the region can not only safeguard its agricultural productivity but also ensure the well-being and livelihoods of its diverse and culturally rich communities in the face of an uncertain climatic future.

References

1. Bhalerao A, Rasche L, Scheffran J, Schneider U. Sustainable agriculture in Northeastern India: how do tribal farmers perceive and respond to climate change. *Int J Sustain Dev World Ecol.* 2021;29:291-302.
2. Bamniya B, Singh K, Kaundal M. A comprehensive review of potential adaptation and mitigation strategies in agriculture in the current climate change scenarios. *Int J Environ Climate Change.* 2024.
3. Rajesh CM, Jadhav A, Manohar K, Bhat P, Prasad R, Anil KS, *et al.* A review on adaptive strategies for

- climate resilience in agricultural extension services in India. *Arch Curr Res Int*. 2024.
4. Chakravorty A, Kundu SS, Aggarwal SP. Investigating the changing heavy rainfall climatology of North East India. In: EGU General Assembly Conference Abstracts. 2023. p. EGU-505.
 5. Chaturvedi A, Chandran K, Surendran U. Revisiting climate change adaptation through proactive policy designing and institutional mechanism. *Town Plan Rev*. 2018;5:14-18.
 6. Kumar D, Dimri AP. Regional climate projections for Northeast India: an appraisal from CORDEX South Asia experiment. *Theor Appl Climatol*. 2018.
 7. Saikanth DRK, Kumar S, Rani M, Sharma A, Srivastava S, Vyas D, *et al*. A comprehensive review on climate change adaptation strategies and challenges in agriculture. *Int J Environ Climate Change*. 2023.
 8. Das S, Das T. Flood, livelihood, and community resilience: a study from Barak Valley region of Assam in Northeast India. In: *International Handbook of Disaster Research*. Singapore: Springer; 2022. p. 1-14.
 9. Chakraborty D, Saha S, Singh RKP, Sethy BK, Kumar A, Saikia US, *et al*. Trend analysis and change point detection of mean air temperature: a spatio-temporal perspective of northeastern India. *Environ Process*. 2017.
 10. Fischer H, Chhatre A, Devalkar S, Sohoni M. Rural institutions, social networks, and self-organized adaptation to climate change. *Environ Res Lett*. 2021;16.
 11. Government of Assam. State Action Plan on Climate Change for Assam. Department of Agriculture; 2020.
 12. ICAR. Annual Report: Climate Resilient Agricultural Technologies in Northeast India. Indian Council of Agricultural Research; 2019.
 13. IPCC. Climate Change 2021: The Physical Science Basis. Intergovernmental Panel on Climate Change; 2021.
 14. Kumar SP, Lahiri B, Nageswararao MM, Alvarado R, Sangma SN. Trend analysis and changepoint detection of monthly, seasonal and annual climatic parameters in the Garo Hills of Northeast India. *Ecol Inform*. 2023;75:102104.
 15. Laishram K, De A, Chakraborty K, Paul S. Characterization of shifting cultivation, trends, and livelihood diversification: a case study from forest villages in Barak Valley, Assam, Northeast India. *Trees For People*. 2023.
 16. Lea S, Schröder L, Rasche K, Jantke K, Mishra S, de Lange SJ, *et al*. Combined effects of climate change and agricultural intensification on soil erosion in uphill shifting cultivation in Northeast India. *Land Degrad Dev*. 2023. doi:10.1002/ldr.4944
 17. Abdelaziz M, Ahmed M, Sarma P. Exploring the opportunities and constraints of rural livelihood: a case study of small farmers engaged in rice cultivation in India. 2021.
 18. Ministry of Agriculture and Farmers Welfare (India). Pradhan Mantri Fasal Bima Yojana (PMFBY). 2020.
 19. Mishra R, Singh R. Agroforestry for climate resilience in Northeast India: opportunities and challenges. *Environ Sci Policy*. 2019;90:114-122.
 20. NAFCC. Annual Report. Ministry of Environment, Forest and Climate Change; 2018.
 21. NASA. Global temperature data and analysis. National Aeronautics and Space Administration; 2023.
 22. NOAA. Trends in atmospheric carbon dioxide. National Oceanic and Atmospheric Administration; 2023.
 23. Sarma PK, Borah R, Borah R, Chary GR, Neog P, Sonowal A, *et al*. Climate risk management at farmers' field through adaptation strategies for resource-poor farmers of Assam, Northeast India. *Int J Environ Climate Change*. 2023.
 24. Patra N, Babu S. Institutional and policy process for climate-smart agriculture: evidence from Nagaland State, India. *J Water Climate Change*. 2022.
 25. Paul S, Chakraborty D, Padaria R, Tripathi AK. Climate change perceptions of shifting cultivators vis-à-vis meteorological observations influencing their adaptation decisions in Northeast India. 2023.
 26. Pradhan A, *et al*. Impact of climate change on crop yields in Northeast India: a systematic review. *Clim Change Agric J*. 2022;15(2):45-60.
 27. Prasad R, Sud R. Implementing climate change adaptation: lessons from India's national adaptation fund on climate change (NAFCC). *Clim Policy*. 2018;19:354-366.
 28. Rajendrakumar D, Deshpande A, Berning CE, McKinley W, Bennett W. An innovative approach to discern variation in long-term regional monsoonal rainfall trend in Northeast India. 2023.
 29. Roy A, *et al*. Sustainable farming practices for climate resilience in hilly regions. *Int J Climate Change Agric*. 2021.
 30. Kumar S, Rana N. Impact of geoinformatics and climate change on the Indian agriculture system: problems and solutions. 2024.
 31. Sharma CK. Contemporary development discourse in Northeast India and its impact on tribal communities. *Sociol Bull*. 2024.
 32. Sharma R, *et al*. Climate change and agricultural vulnerabilities in the Northeast region of India. *Indian J Agric Sci*. 2020.
 33. Singh P, *et al*. Role of agroforestry in mitigating climate change impacts in Northeast India. *Agrofor Syst*. 2020;94(3):815-823.
 34. Singh R, Singh A, Zander K, Mathew S, Kumar A. Measuring successful processes of knowledge co-production for managing climate change and environmental stressors: adaptation policies and practices to support Indian farmers. *J Environ Manag*. 2021;111679.
 35. Gandolfi S, Sodiqova SM. Increasing 2020-like boreal summer rainfall extremes over Northeast Indian subcontinent under greenhouse warming. *Geophys Res Lett*. 2022.
 36. Das S, Das T. Flood, livelihood, and community resilience: a study from Barak Valley region of Assam in Northeast India. In: *International Handbook of Disaster Research*. 2023.
 37. Desai S, Tirunagaru KC, Rao KV, Rathnakaran U, Prasad JVNS, Nithin K, *et al*. Agricultural impacts of climate change in India and potential adaptations. 2023.
 38. Tosato T. Climate change and agroecosystems in the

- hill and mountain regions of Northeast India. 2023.
39. Tsenbeni N, Lotha V, Ritse N, Ketiyala K, Imkongyanger I, Rudithongru L, *et al.* Climate change impact and traditional adaptation practices in Northeast India: a review. *Curr World Environ.* 2024.
 40. UNFCCC. United Nations Framework Convention on Climate Change Annual Report. 2022.
 41. WMO. State of the Global Climate 2022. World Meteorological Organization; 2022.