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Shifting Landscapes: Influence of Climate Change on India's Rural Economies and Livelihoods

Harish Kumar S[1], S. Priyadharsini[2], R. Arjunan[3] & FX. Lovelina Little Flower[4]

[1,2]*Research Scholar, Department of Social Work, Bharathiar University.*

[3]*Associate Professor, Department of Social Work, Bharathiar University.*

[4]*Professor, Department of Social Work, Bharathiar University.*

Corresponding Author: Harish Kumar, **Email:** harishbu16@gmail.com

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ABSTRACT

This article is intended to analyse the effects of climate change on the rural economy. Climate change and variability affect everyone and every part of the world. It is a serious threat to individual livelihoods and ways of making a living. The study conducted a rapid literature review to provide a timely synthesis of the existing evidence. Changes in climate conditions have significantly impacted ecosystem degradation in recent decades, with dire effects for the rural population, which mostly depends on agriculture and fishing for a living. Undoubtedly, a changing climate has a direct and indirect impact on the economy. Countries like India, whose GDP largely depends on the rural economy, have faced enormous challenges in the last two decades. Many researchers have tried to find the changes in the rural economy and its crisis from an economic and political point of view, rather than Climate change and its impact, which seems to be a simplistic view. However, this article attempts to critically examine the changing rural economies in the context of climate change. This study offers a fresh perspective by analysing rural economic crises through the lens of climate change rather than purely economic or political factors, thereby revealing how environmental shifts fundamentally reshape livelihoods in India.

Keywords: Climate Change, Climate resilience, Rural Economy, Sustainable Agriculture, Sustainable Development.

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INTRODUCTION

India is primarily a rural nation, with two-thirds of its population living in rural areas and 70% of its workers working in rural areas. A total of 46% of the country's income comes from the rural economy. According to population predictions, India's population will remain primarily rural until 2050, at which point it is anticipated that the urban population will surpass that of the rural population (United Nations, 2012). Therefore, the country's growth and inclusive development over the next three decades depend heavily on the demographic and economic growth of rural areas (NITI AYOG, 2017). India's rural development is a key driver of the country's economic expansion. The primary objective of rural development is to effectively enhance the productivity of the sectors within rural economies that experience severe poverty (Ekka, 2020). The primary sectors of the rural economy and business community include agriculture, fishing, poultry, handicrafts, and dairy production (Rao, Srinivasa, 2019). According to the Economic Survey of India in the year 2019 to 2020, the significance of agriculture in the Indian economy is evident from the fact that a substantial portion of the Indian population relies directly or indirectly on agriculture for employment opportunities, more so than any other sector. Over half of India's population makes their living from agriculture, the main industry in rural areas, and for employment and economic growth, it has historically been agriculture. One major factor driving economic growth and change in the rural and overall economies is the shift in output and occupation from agriculture to higher-producing nonfarm sectors. Several scholars have observed that such a transition is taking place in the Indian economy (Maurya & Vaishampayan, 2012; Aggarwal & Kumar, 2012). Article 1 of the United Nations Framework Convention on Climate Change says that “A change in climate that is attributed directly or indirectly to human activity which alters the composition of the global atmosphere, and where, in addition to natural climate variability, observed over comparable periods of time”. Changes in the environment and their severe ramifications have emerged as a significant concern for societies, scientific communities, political entities, and the global economy. Climate change is a global problem, but its effects are most felt in rural areas. Climate change has become biggest challenge of the 21st century (Roy et al., 2023). Climate change is a global problem that governments must work together to solve. It affects many areas of the environment, society, politics, ecology and economy. During the pre-industrial revolution, natural sources, including forest fires, seismic activities, and volcanoes, were regarded as distinct sources of greenhouse gases (GHGs) such as CO2, CH4, N2O, and H2O into the atmosphere (Usman & Lorente, 2022). However, recently, industries and other human

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activities like deforestation, burning fossil fuels are thought to be big sources of pollution. Climate change generally unfolds over several decades or longer (Ninawe et al., 2018). Each additional rise in global temperature intensifies associated hazards, leading to more severe heat waves, heavier precipitation, and other extreme weather events that elevate risks to ecosystems and human health. As global warming increases, so will climate induced food and water insecurity. When these risks intersect with other crises such as pandemics or armed conflicts they become far more challenging for nations to address (United Nation, 2015)

Worldwide, climate change is projected to heighten the severity and disaster potential of environmental events. Although its effects are felt across all societies, the most damaging impacts are often concentrated in vulnerable regions, particularly rural areas, where indigenous and disadvantaged populations face amplified inequalities (Atkinson, 2019). Climate variability and change present substantial challenges for agricultural and fishing communities, whose livelihoods are closely tied to natural resources such as land, water, crops and fisheries. Consequently, rural livelihood activities are increasingly affected. This makes it essential to examine and understand how climate change and its associated consequences influence the lives, livelihoods and overall well-being of marginalized groups within rural economies.

METHODOLOGY

A rapid literature review was conducted for this study, sources were retrieved primarily from Scopus-indexed journals and Google Scholar, focusing on literature published between 2010 and 2024. To give a brief overview of the evidence that is available, enabling swift identification of emerging trends and gaps in current research while maintaining methodological transparency and rigor (Smela, 2023; Devane et al., 2024; Armitage, 2009). This approach was chosen as it facilitates the efficient analysis of newly published data within condensed timeframes, supporting the practical demands of the research context (Smela, 2023; Devane et al., 2024).

RESULTS

Pathway of the climate crisis impacting the rural economy

Rural communities tend to depend heavily on climate-sensitive resources such as agricultural land and local water supplies; they rely on climate-sensitive activities such as livestock husbandry, arable farming, and on natural resources such as fuel wood and wild herbs. Climate change has no limit or variation to affect rural or urban places; the effects are measured based

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on the vulnerability caused by climate. By keeping the major challenges for measurement without any doubt, the rural population and their economies are affected more compared to the urban population. The rural population is affected by social, economic, geographical, and health factors due to a changing climate. Women in rural developing countries tend to be more vulnerable to climate change than men because they constitute a large proportion of the poor and depend more heavily on local natural resources for their daily livelihoods (Armah et al., 2010). Many rural women find it difficult to get a livelihood because the type of work that can be offered is usually labour-intensive with marginal wages in rural areas (Duru, 2022). People in rural areas often do not view climate change as an issue that affects them personally, either because they feel insulated from its impacts or consider it unimportant. In many marginalized, land-dependent communities, dismissing climate change typically reflects a lack of engagement with available information, as individuals may place greater trust in family beliefs than in scientific findings.

Rural economies are also disrupted by the increasing unpredictability of weather patterns, leading to frequent crop failures, reduced livestock productivity, and fluctuating incomes that destabilize household economies (FAO, 2021). The degradation of ecosystems through desertification, soil erosion and declining water quality further restricts agricultural yields and limits alternative livelihood options. Migration has emerged as both an adaptation and a coping strategy, with many rural inhabitants, particularly young men, moving to urban centres in search of more secure employment, thereby reshaping traditional social and gender roles in rural communities. Inadequate access to climate information, extension services and financial risk protection mechanisms such as crop insurance leaves rural populations with limited adaptive capacity. The intersection of poverty, low levels of education and weak institutional support also amplifies climate vulnerability, perpetuating cycles of deprivation and ecological decline (IPCC, 2022). Figure 1 illustrates the key components of how climate influences rural economic pathways, synthesized from existing literature.

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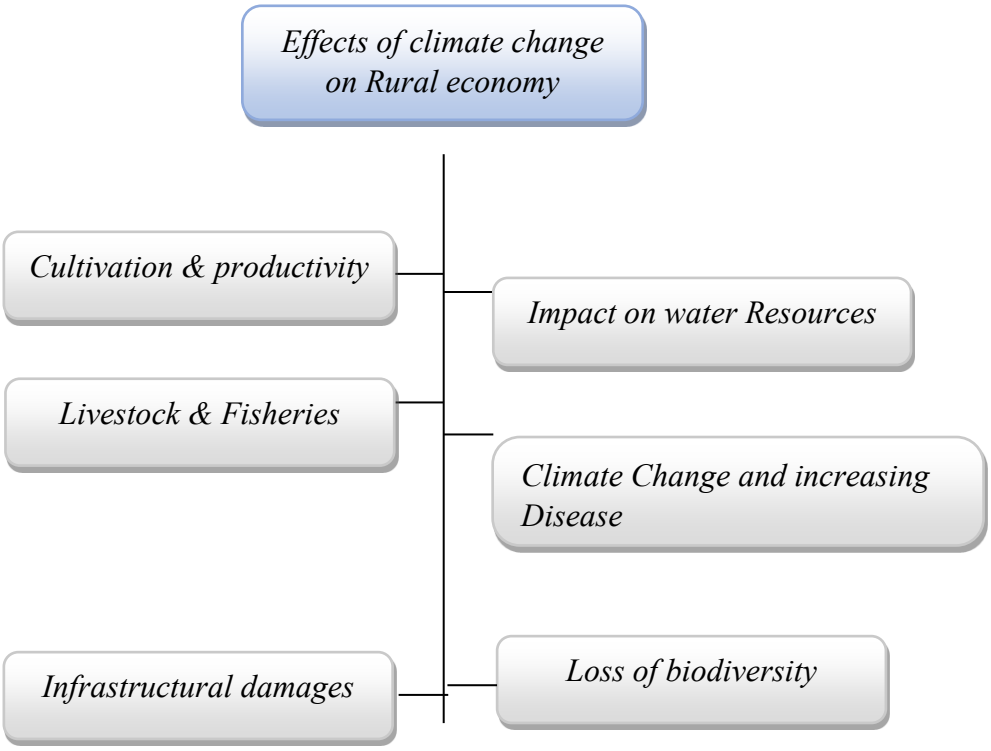

Figure 1: Climate change affecting the rural economy
Source: *Author's illustration based on original concept.*

Climate change impact on rural agricultural productivity

While the Green Revolution enabled India to achieve "self-sufficiency" in food grain production, it also led to various socioeconomic challenges including increasing costs of agricultural inputs and widening regional disparities as well as environmental concerns such as declining soil fertility, waterlogging, contamination of surface and groundwater and greeted pest and disease incidence. Beyond these existing problems, climate change has introduced an additional layer of threat, putting Indian agriculture and national food security at significant risk (Rao et al., 2016). Furthermore, India is considered one of the countries most vulnerable to climate change (INCCA, 2010). The nation faces serious concerns because nearly 85% of its farmers lack financial resilience (Singh et al., 2019). Climate change directly influences agriculture by altering temperature and rainfall patterns and increasing the frequency of extreme weather events. These shifts have major implications for food security and economic stability, particularly in developing economies like India. Rural communities relaying on agriculture for their economy are mostly affected because of this changing nature of climate. It is also negatively influencing the qualitative characteristics of wheat grains, particularly the percentages of sugar, starch, and protein. Rising temperatures and higher carbon dioxide level

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alter the growth characteristics of wheat grains and resulting crop losses create widespread economic repercussions including financial distress among farmers, inflation and related challenges. Losses from extreme weather events alone are estimated to equal about 0.25 percent of India's GDP each year. Environmental stress also intensifies farmers' debt burdens, contributing in some cases to farmer suicides (Carleton, 2017). Climate change has additionally driven shifts in livestock management, such as reducing herd sizes, adding cattle to improve income, or replacing larger animals with smaller ones to minimize water and feed consumption. These adjustments not only threaten food security but also undermine the economic resilience of rural communities that rely heavily on agriculture.

The Intergovernmental Panel on Climate Change (IPCC, 2021) reports that climate variability has already reduced global agricultural productivity by 5% to 10%, with the most acute impacts occurring in rural regions dependent on rain-fed farming. According to the World Bank (2020), rural households in developing nations experience disproportionate harm from climate-related disasters, resulting in prolonged economic and social instability. In India, where agriculture is a central part of the national economy, these challenges are particularly severe. Water scarcity, in particular, has profound consequences. Decreased water availability reduces agricultural output, elevates food prices and exacerbates existing vulnerabilities. Climate Change has affected not only the environment but it has also severely impacted the economies of farmers in rural areas due to low crop yields and damage to agricultural land. Many farmlands have been converted to other uses. In rural areas, farmers are largely affected, and their economic stability has collapsed due to the devastating climate crisis. Significant farmer deaths in rural areas are linked to the effects of the climate crisis. India has seen a large number of farmer suicides linked to climate change, particularly in regions experiencing recurring droughts and erratic rainfall. Climate change-induced weather extremes often lead to crop failures, drastically reducing farmers' incomes and pushing them into debt. Farmers need support to manage the climate crisis. More training and empowerment schemes related to climate-based agricultural policies are needed to reduce the burden on farmers and help to build sustainable economic growth.

Climate Change Impact on Water Resources and Agriculture

Water scarcity is described as a condition where water demand exceeds available water. Lack of water lead to insufficient water to simultaneously support both human and ecosystem water needs. Water scarcity affects large populations across broad geographic areas and unfolds over

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longer periods, months, or even years rather than impacting a single individual at a specific moment. It can arise from naturally limited water availability or from human activities that degrade existing water resources. Agriculture accounts for nearly 70% of global water withdrawals, making it the world's largest water-using sector (JFAO, 2011). As one of the most serious consequences of climate change, water scarcity now poses challenges that can no longer be ignored. When water becomes limited, food insecurity follows, since both crops and livestock rely on adequate water supplies to grow and survive. Research on Indian districts shows that 60% already suffer from groundwater depletion and contamination, which worsen due to global warming. This creates significant hardships for farmers, most of whom rely heavily on groundwater for irrigation. Dr. Veena Srinivasan, Director of the Center for Social and Environmental Research (ATREE), has emphasized the urgent need to draw attention to the escalating groundwater crisis. Groundwater is essential to the daily lives of almost 700 million Indians living in villages, with 85% of rural households relying on it, compared to 45% in urban areas. India, an agrarian nation that relies heavily on agriculture, allocates a large share of its resources to this sector. The 2021 Economic and Political Weekly article "Water and Agricultural Transformation in India "by Mihir Shah, P.S. Vijayashankar and Francesca Harris discusses these facts as "traces the roots of India's water and farm crises to the onset of the green revolution in agriculture," implying that "India's water problem" might be resolved "if the right lessons are drawn from the experience of the green revolution.". Indian agricultural society faces lot of problems due to water scarcity, lack of rainfall, changes in seasons and unpredicted rainfall which damages crop field. Almost 600 million people in India are currently facing severe to extremely severe water shortages, making it the most acute water crisis in the country ever before, as per the "Composite Water Management Index" report given by NITI Aayog in the year 2019. When water supplies become limited, yields may decrease, which lowers revenue. Water scarcity can raise input costs since farmers must purchase or rent water to make up the difference. Revenue could drop even further as a result. A large part of India's population is experiencing high to extreme water stress. Long-term consequences may result from dehydration. Due to factors like an excessive reliance on groundwater for irrigation, ineffective water management techniques, and a growing population despite possessing a small portion of the world's freshwater resources, India is currently experiencing a severe water scarcity crisis because of global warming and changes in climatic conditions that is especially affecting its agricultural sector and rural economy.

Impact of climate change on the livestock and fisheries effecting rural economy

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India's fisheries and animal husbandry are suffering greatly as a result of climate change. Rising temperature are exposing animals to heat stress, altering fish migration patterns and reducing the availability of feed due to shifts in rainfall. These factors together are lowering productivity and may result in economic losses for the country. An analysis of sea surface temperature (SST) and related indicators from multiple global datasets revealed a consistent warming trend along the entire Indian coastline. From 1960 to 2005, SST increased by 0.2 degree Celsius along the northwest, southwest and northeast coasts and by 0.3 degree Celsius along the southeast coast. Projections also indicate that the annual average SST are expected to significantly affect coral reefs, fisheries and overall coastal ecosystems. Under climate change, the major challenge for fisheries and aquaculture will be to secure food availability, strengthen nutritional security, improve livelihoods and economic benefits and protect ecosystems (FAO, 2014). Climate related hazards may also negatively impact livestock. Reduced feed quantity and quality, heat stress, heightened disease risk due to weakened immunity and increased mortality from extreme weather events such as storms, floods and temperature extremes are anticipated to compromise animal production, welfare and longevity (Godde et al 202). Livestock remains essential to India's agricultural system, especially for marginal and small farmers, with more than 62% of marginal households relying directly on this sector. In many villages in India cattle are seen as their assets rising temperature and changing climatic conditions causes may disease and spread of disease among cattle's easily, villagers depend on livestock will have devastating effects on economy there is a need for policy makers to focus on the effect of environmental changes on rural economy.

Changing Climate and Increasing Disease that impacts on rural economy

Climate change is significantly contributing to the rising incidence and spread of diseases across India, especially vector-borne illnesses such as malaria, dengue, and chikungunya, by fostering conditions more suitable for disease-carrying insects. World Health Organisation, in its report Climate Change and Public Health: Sanitation Risks in Rural Areas 2023, mentioned that floods overwhelm sanitation facilities, increasing the risk of waterborne diseases such as cholera and typhoid. This is due to increasing temperatures, irregular rainfall patterns, and longer transmission seasons. India has approximately 2 million confirmed cases of malaria per year (Kumar et al., 2007). The rise in diseases in rural India carries major economic consequences, affecting both household incomes and the wider rural economy. Illness often results in job loss, and as the FAO notes, many rural residents depend on agricultural labour; therefore, the spread of disease reduces employment opportunities and leads to wage losses.

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On average, hospitalized individuals in India spend about 58% of their total annual expenditure on medical care. More than 40% of those hospitalized rely on borrowing or selling assets to meet healthcare costs, and over 25% are pushed below the poverty line due to hospitalization expenses (Pandve & Parulekar, 2013). Health insurance coverage remains low in India, with significant gaps between rural and urban populations. Awareness of health insurance is particularly limited in rural areas; for instance, a study in rural Karnataka found that only 11% of respondents knew about health insurance, and only 6% were insured. Regions with weak infrastructure, common in developing countries like India, are least equipped to manage health threats without external support (WHO, 2023). Furthermore, a report by the Federation of Indian Chambers of Commerce and Industry (FICCI) and Ernst & Young (E&Y) indicates that healthcare expenditure in India is expected to double over the next decade. The impacts of climate change in rural areas thus have severe implications for economic stability and the overall well-being of rural populations.

Infrastructure Damages and Rural Economy

Extreme weather events adversely affect transportation infrastructure in rural areas, degrading its condition and increasing operational and maintenance costs. A reliable transportation network is essential for moving food, energy and other goods efficiently and for ensuring that workers and consumers can research employment and markets throughout the economy. Due to climate change, heavy floods affect rural areas. These floods are caused by extreme weather, which weakens bridge structures, raises sedimentation levels in water systems, and heightens the risk of landslides or avalanches. Additionally, flooding damages critical freight routes, harms energy infrastructure, and disrupts electricity supply, which drastically affects the rural economy (Pudyastuti & Nugraha, 2018). Increased precipitation and flooding lead to the erosion and degradation of rural roads, disrupting connectivity (World Bank, 2023). The Indian Ministry of Agriculture, in its 2024 report, found that Sedimentation and flooding damage canals and irrigation networks, reducing water efficiency for crops in rural areas. High winds and flooding damage communication towers, leading to prolonged service outages in rural areas. Extreme heat waves and cyclones weaken the structural integrity of warehouses, leading to crop spoilage and financial setbacks (UNEP, 2022). Additionally, droughts lower water levels, reducing the efficiency of hydroelectric power plants, while cyclones inflict damage on wind turbines and solar panels in rural areas. Homes constructed with non-durable materials in rural communities are especially prone to destruction from cyclones, storms, and heavy rains,

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resulting in widespread displacement, property loss, and severe financial strain for affected residents.

Impact of biodiversity harm on the rural economy

Climate change has emerged as a significant driver of biodiversity loss, posing an increasingly widespread threat to ecosystems and species worldwide (Diaz et al., 2019). It is altering species distribution, population levels and community composition while reshaping both terrestrial and aquatic ecosystems (Lenoir & Svenning, 2015). Extreme climatic events such as floods, droughts and storms are causing extensive habitat degradation, thereby reducing access to essential resources like water, timber and arable land. Consequently, rural communities, particularly those dependent on agriculture and natural resources, are being forced to relocate (Shivanna, 2022). The CORE report, Impact of Climate Change on Biodiversity of India (2014), explores how climate variations are influencing biodiversity nationwide, with a particular focus on rural regions. The report notes that shifts in rainfall patterns and rising temperatures are driving changes in vegetation, which, in turn, affect local fauna. This is particularly concerning for rural communities that depend on farming and animal husbandry for survival. The report notes that these climatic disruptions are driving increases in species extinction rates, diminishing biodiversity, reducing agricultural output, threatening food security, and lowering rural incomes.

DISCUSSION

The results of this study suggest that climate change has emerged as a defining force reshaping rural economies in India. The analysis suggests that rising temperatures, unpredictable monsoon cycles and frequent extreme weather events have disrupted agricultural productivity, altered crop patterns and weakened traditional livelihood systems. These climatic variations exacerbate the vulnerabilities of communities whose economic activities are closely linked to natural resources. Changes in climate worsen existing socio-economic inequalities in rural India, with small farmers, landless labourers and fishing communities facing the greatest hardship due to limited resources and weak adaptive support. Traditional development approaches that focus only on economic or political factors overlook the ecological reasons behind rural distress. To build sustainable rural futures, there is a need for climate-resilient farming, better water and ecosystem management, diversified livelihoods and the use of renewable energy. The study also notes that climate change is reshaping rural society through increased distress migration, shifting labour patterns and the weakening of community resource

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systems, which affects both economic stability and social cohesion. Overall, it underscores the importance of integrated, community-driven policies that combine environmental protection with economic development to strengthen long-term rural resilience.

LIMITATIONS

The limitations of the study are that it relies mainly on secondary data, which may not fully reflect rapidly changing climate patterns or the diverse realities of rural communities across India. Since no primary fieldwork was conducted, the study has limitations on first-hand narratives from farmers, labourers and fishing communities, which could have provided deeper insight into lived experiences. The generalised approach may also oversimplify the wide regional differences in geography, cropping systems and resource access. Additionally, the study does not specifically examine gendered impacts, even though rural women often face greater vulnerabilities. The analysis of policies and government schemes is limited, leaving gaps in understanding institutional challenges and long-term outcomes. Finally, because climate change is dynamic and continually evolving, the findings may require revision as new data and adaptation strategies emerge.

CONCLUSION

The shifting landscapes of rural India vividly reflect the profound and far-reaching consequences of climate change. Its effects are not confined to environmental degradation alone but extend deeply into the social and economic fabric of rural life. As agriculture remains the backbone of India’s rural economy, even slight fluctuations in temperature, irregular rainfall and the increasing occurrence of extreme climatic events disrupt traditional livelihood systems and threaten food and income security. The dependence of rural communities on land, water and forest resources makes them especially vulnerable to such transformations, leading to declining agricultural yields, soil degradation and biodiversity loss, further destabilizing local ecosystems and economies.

Climate-induced stresses also accelerate rural distress migration, intensifying demographic shifts and eroding community resilience. With declining productivity and shrinking resource bases, many households are forced to diversify their livelihoods through low-paying informal or urban labour, deepening cycles of poverty and social inequality. This dynamic underscores the interconnected nature of climate vulnerability and socio-economic marginalization in rural India.

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Addressing these challenges requires more than isolated environmental interventions; it calls for an integrated framework that embeds climate adaptation and mitigation within rural development planning. Strengthening climate-resilient agriculture, improving access to sustainable technologies, promoting renewable energy and enhancing rural credit and insurance mechanisms can collectively reduce vulnerability. Equally vital is the participation of local communities, civil society and government institutions in designing adaptive strategies that reflect local knowledge and priorities.

Ultimately, addressing the effects of climate change on rural economies is an ecological imperative and a developmental necessity. Building climate-resilient rural systems will not only safeguard livelihoods but also ensure that India's vast rural heartland continues to sustain national growth, social stability and environmental balance. The path forward lies in transforming climate adversity into an opportunity for sustainable and inclusive rural renewal, where resilience becomes the foundation for prosperity.

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