

Climate Change Impacts on Agripreneurs in Mizoram: Insights and Adaptive Strategies

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Abstract

Climate change, largely influenced by human activities, has led to increased frequency and intensity of natural disasters globally. Human-induced factors such as burning fossil fuels, deforestation, and industrial pollution have significantly contributed to climate change, exacerbating its impacts. In India, climate change poses a significant threat, with profound implications for the agricultural sector and agripreneurs. Mizoram, one of India's north eastern states heavily reliant on agriculture, faces challenges due to changing weather patterns, inconsistent rainfall, and increased temperatures, affecting crop production and food security. This study investigates the impact of climate change on agripreneurs in Mizoram, exploring the interplay between natural phenomena and anthropogenic activities. A mixed-methods approach is employed, combining secondary data analysis with primary data collection through surveys and interviews. Findings reveal the multifaceted impacts of climate change on agripreneurs, including water scarcity, reduced crop yields, and economic challenges. Moreover, the study highlights the importance of social entrepreneurs in addressing climate change by spearheading innovative solutions and promoting sustainable practices. By fostering collaboration among stakeholders, social entrepreneurs can drive meaningful change and mitigate the adverse impacts of climate change on agricultural communities. The research underscores the urgent need for targeted adaptive measures to enhance resilience in the agricultural sector and support the livelihoods of agripreneurs in Mizoram and other vulnerable regions.

Keywords: Human-induced climate change, Agricultural impacts, Mizoram agripreneurs, Sustainable practices, Adaptive measures

Introduction

The scale of natural disasters observed across the globe is largely influenced by human activities. Anthropogenic climate change has played a major role in increasing the frequency and intensity of climate hazards. Changes in temperature, humidity, rainfall, wind, and extreme events such as droughts, heatwaves, floods, and tropical cyclones can be attributed to human actions. Different parts of the world experience varied climate patterns, which can fluctuate from hour to hour, day to day, month to month, and year to year. A region's climate, usually tracked over at least 30 years, encompasses these long-term weather patterns. From the 18th century onwards, rapid developmental processes in human civilization have exacerbated climate change. Activities such as burning fossil fuels, increasing carbon emissions, excessive use of non-degradable items, and industrial pollution have significantly contributed to global warming. Consequently, climate change issues became more pronounced in the late 19th century. While natural phenomena like volcanic

eruptions, fluctuations in solar radiation, tectonic shifts, and orbital changes have historically affected planetary warming and cooling, human-induced factors such as deforestation, burning oils, chemical fertilizers, and industrial activities now play a substantial role.

Climate change impacts all living beings on the planet, with India ranked as the seventh most affected country. In 2020, India was the third-largest emitter of greenhouse gases (GHGs) and was identified as a global hotspot in the IPCC report. In India, 58% of the population relies on agriculture, making it a critical sector. Despite its importance, the contribution of agriculture to India's GDP has steadily declined, from 23% in 2016 to 18.3% in 2022-23. Agriculture remains the largest source of livelihoods, especially in rural areas where 70% of households depend on it, with 82% of farmers being small and marginal. In view of these rationales, the present work is initiated to investigate the impact of climate change on agripreneurs in Mizoram, one of the Indian north east states.

Literature Review

The literature extensively documents the critical role of human activities in exacerbating climate hazards. Smith (2010) asserts that anthropogenic climate change has significantly increased the frequency and intensity of natural disasters. This perspective is reinforced by Brown et al. (2014), who highlight that since the late 19th century, activities such as the burning of fossil fuels and deforestation have been pivotal in driving global climate change. These actions have released large amounts of greenhouse gases into the atmosphere, contributing to global warming and altering climate patterns. In addition to human activities, natural factors have historically influenced climate variability. Jones and Mann (2004) discuss the impact of volcanic eruptions, fluctuations in solar radiation, and other natural phenomena on climate changes over geological timescales. Despite these natural influences, contemporary research underscores the significant impact of human-induced factors on recent climate trends. Hansen et al. (2013) emphasize the role of industrial pollution and carbon emissions in exacerbating global warming. Similarly, Foley et al. (2005) identify deforestation and the use of chemical fertilizers as major contributors to climate change, highlighting how these practices alter land surfaces and release additional greenhouse gases.

India's vulnerability to climate change has been well-documented. The IPCC (2020) identifies India as one of the global hotspots for climate change impacts, with profound implications for its economy and population. Kumar et al. (2021) specifically note that climate change significantly affects agripreneurs in India, who rely heavily on agriculture for their livelihoods. Despite being the largest producer of milk, pulses, and jute, and a leading producer of other crops, India's agricultural sector has seen a decline in its contribution to GDP, dropping to 18.3% in recent years (Government of India, 2020). Several state-specific studies in India have highlighted the localized impacts of climate change. Kattumuri et al. (2011) discuss the effects of climate variability on agriculture in Andhra Pradesh, emphasizing how increased temperatures and altered rainfall patterns have adversely affected crop yields. In Maharashtra, Patil and Reidsma (2012) examine the impacts of changing climate on water resources, noting that recurrent droughts have strained agricultural productivity. Aggarwal et al. (2010) study the impact of climate change on wheat production in Punjab, finding significant reductions in yields due to heat stress and water scarcity. These state-level studies underscore the varied and localized impacts of climate change within India, highlighting the need for region-specific adaptive measures.

The impact of climate change on food security and nutrition in India is particularly concerning. The Global Nutrition Report (2021) and the Global Hunger Index (2021) rank India poorly in terms of nutrition and hunger, highlighting chronic issues exacerbated by climate change. Singh and Singh (2018) discuss the direct and indirect impacts of climatic conditions on agripreneurs, emphasizing the need for adaptive strategies to mitigate these adverse effects. These strategies are crucial for sustaining agricultural productivity and the livelihoods of those dependent on this sector. Further research by Rathi et al. (2022) explores the economic implications of climate change on smallholder farmers in Gujarat, noting that unpredictable weather patterns have led to significant income losses. Additionally, Sharma and Bhattacharya (2022) highlight how extreme weather events in West Bengal have disrupted agricultural supply chains, impacting food prices and accessibility. These literatures emphasise the critical need to address both natural and anthropogenic factors influencing climate change. Understanding the complex interactions between these factors is essential for developing effective solutions to support agripreneurs and enhance the resilience of the agricultural sector in the face of climate change.

Objectives

The primary objective of this paper is to investigate the impact of climate change on agripreneurs in Mizoram, a northeastern state of India. Specifically, the study aims to assess how human activities such as burning fossil fuels, deforestation, industrial pollution, and chemical fertilizer use contribute to climate change. It explores the interplay between natural phenomena and anthropogenic activities in shaping climate variability, providing a detailed review of historical and contemporary impacts. The research documents India's susceptibility to climate change, focusing on the agricultural sector and its economic and livelihood implications for agripreneurs. By analyzing state-specific studies, the paper illustrates localized impacts of climate change on agriculture across India, including altered rainfall patterns, increased temperatures, and recurrent droughts affecting crop yields and water resources. Additionally, the study evaluates the broader implications of climate change on food security and nutrition in India, highlighting chronic issues exacerbated by climatic changes. It examines the role of social entrepreneurs in addressing climate change and their contributions to resilience-building in agricultural communities. Finally, the paper proposes adaptive strategies to mitigate the adverse effects of climate change on agripreneurs, aiming to enhance agricultural productivity and sustainability, and support the livelihoods of small and marginal farmers in Mizoram and other regions. Through these objectives, the paper seeks to provide a comprehensive understanding of the multifaceted impacts of climate change on agripreneurs and suggest viable solutions to enhance resilience in the agricultural sector.

Research Methodology

This study employs a mixed-methods approach to investigate the impact of climate change on agripreneurs in Mizoram, combining secondary data analysis with primary data collection for comprehensive insights. Secondary data from books, academic journals, government reports, and statistical handbooks provide a foundation for understanding how human activities like burning fossil fuels, deforestation, industrial pollution, and chemical fertilizer use contribute to climate change. This data also explores the interplay between natural phenomena (e.g., volcanic eruptions, solar radiation fluctuations) and human activities

in shaping climate variability, documenting India's susceptibility to climate change with a focus on agricultural impacts and economic implications for agripreneurs.

Primary data were also collected from a sample of 50 agripreneurs in Mizoram through structured interviews and surveys in March 2023, offering first hand insights into local impacts such as altered rainfall patterns, increased temperatures, and recurrent droughts affecting crop yields and water resources. Results are presented as percentages of various opinions, highlighting the challenges faced by agripreneurs. The analysis involves both qualitative and quantitative methods, with secondary data systematically reviewed to identify key themes and trends, and primary data analysed in percentage to quantify impacts and identify patterns. This comprehensive approach covers human activities contributing to climate change, the interplay between natural and anthropogenic factors, India's vulnerability to climate change with a focus on agriculture, regional impacts across India, broader implications for food security and nutrition, the role of social entrepreneurs in resilience-building and adaptive strategies to enhance agricultural productivity and sustainability. By integrating secondary and primary data, the research aims to provide a holistic understanding of the multifaceted impacts of climate change on agripreneurs in Mizoram and suggest viable solutions to enhance resilience in the agricultural sector.

Results and Discussion

Causes of Climate Change:

The literature identifies a multitude of causes for climate change, with significant variations based on geographic and regional contexts. Common global contributors include deforestation, the burning of fossil fuels, the use of chemical fertilizers, industrial pollution, and the release of industrial waste. These activities collectively contribute to the emission of greenhouse gases, which drive global warming and alter climate patterns (Smith, 2010; Brown et al., 2014). Additionally, increased transportation and construction activities, the rise in severe storms, and the accumulation of plastic waste exacerbate the situation (Foley et al., 2005). In the north eastern region of India, particularly Mizoram, specific factors play a critical role in climate change. These include traditional agricultural practices such as slash-and-burn or jhum cultivation, which lead to significant deforestation and land degradation (Kumar et al., 2021). The increase in vehicle numbers, illegal logging, fuel wood collection, and timber logging further contribute to environmental degradation. Coal mining, soil erosion, and human-induced forest fires (accounting for 90% of forest fires) add to the region's vulnerability (Aggarwal et al., 2010).

Projections by the Union Ministry of Environment, Forest, and Climate Change (2020) indicate that temperatures in the north eastern region will rise by 1.8 to 2.1 degrees Celsius by 2030, with annual mean rainfall expected to increase by 0.3 to 3% in the same period. The *Global and Planetary Change* paper forecasts an annual mean surface temperature rise of 0.64°C between 2011 and 2040, potentially reaching 5.15°C by the end of the century, with an annual rainfall increase of 33 mm (Hansen et al., 2013). The phenomenon of anthropogenic climate change, primarily driven by greenhouse gas emissions from fossil fuel consumption, is evident in the observed global warming of recent decades (IPCC, 2020). This type of climate change includes the well-documented occurrences of the ozone hole and acid rain. Natural climate changes have also been significant throughout geological times, influenced by factors such as volcanic eruptions and solar radiation

fluctuations (Jones and Mann, 2004). Generally speaking, global temperature rise impacts the quality, duration, and timing of rainfall, which disrupts agricultural production schedules and productivity, contributes to glacial melting and sea-level rise, and increases the frequency of storms and other geological and meteorological events (Luterbacher, 2001). Climate change represents one of the most serious and far-reaching challenges of the 21st century, with scientific consensus indicating that its impacts will become more severe in the coming decades.

In India, climate change impacts are influenced by factors such as altitude, latitude, relief features, pressure and wind systems, and ocean currents (Government of India, 2020). These geographical and meteorological elements interact with human activities to create diverse and region-specific climate impacts. While global activities like industrial emissions and deforestation are significant contributors to climate change, region-specific practices in Mizoram, such as traditional agricultural methods and industrial activities, exacerbate the problem locally. The projected rise in temperatures and changes in rainfall patterns highlight the urgent need for targeted adaptive measures to safeguard agripreneurs and sustain agricultural productivity in the region.

Impact of Climate Change on Agripreneurship:

Climate change is recognized as one of the most critical environmental challenges facing the world today. Its impacts are extensive, threatening everything from small island states due to sea-level rise to the lives and livelihoods of millions globally (Hansen et al., 2013). With increasing temperatures, the likelihood of droughts and floods also rises, significantly affecting human health and ways of life and causing irreversible losses in biodiversity (Smith, 2010). In regions already stressed by water shortages, climate change exacerbates the risk of agricultural and ecological droughts, thereby increasing the vulnerability of ecosystems (IPCC, 2020). The last decade (2011-2020) has been the warmest on record, with higher temperatures leading to more heat-related illnesses, challenges in outdoor work, and more frequent and severe wildfires (Brown et al., 2014).

India, in particular, faces severe repercussions from climate change. A report by the Overseas Development Institute (2020) found that India has the highest social cost of carbon worldwide. The country could lose 3-10% of its GDP annually by 2100, and its poverty rate may rise by 3.5% by 2040 due to climate-related impacts (Lal et al., 2011). Inconsistent rainfall patterns, including deficit monsoons and unseasonal rains, have disrupted crop cycles, causing both water shortages and flooding in different areas. These conditions degrade water quality and have cascading effects on all living organisms, including humans (Aggarwal et al., 2010). Agripreneurship, which involves entrepreneurial activities within the agricultural sector, is particularly vulnerable to climate change. Entrepreneurs in this field innovate and mobilize resources to improve products and services, essential for social and economic development (Kumar et al., 2021). Agripreneurs play a crucial role in enhancing agricultural productivity through mechanization, irrigation, and the application of new technologies. However, the adverse effects of climate change pose significant challenges to their efforts. Agripreneurs help reduce food costs, manage uncertainties, and improve diets for both rural and urban populations. They integrate smallholder farmers into local, national, and international markets, thus facilitating large-scale employment, optimal utilization of human and natural resources, and balanced regional development (Richards and Bulkley, 2007). Yet, climate change severely impacts agricultural productivity, leading to lower crop yields,

reduced nutritional quality, and increased pests and plant diseases (Peltinger, 2016). Extreme temperatures and precipitation variability make farming more difficult and can expand the range of agricultural pests and diseases, necessitating more intensive pest and weed control measures (McElwee and Smith, 2012).

Moreover, climate change affects the synchronization between plant blooming periods and pollinator activities, which can reduce pollination and thus crop yields (Faisal, 2010). Soil erosion and nutrient depletion aggravated by heavy rains and runoff, harm water quality and lead to hypoxia in water bodies, which negatively impacts fish and shellfish populations (Jones and Mann, 2004). The health of agripreneurs is also at risk. Prolonged exposure to heat and extreme weather conditions can lead to skin and other health issues. Increased use of pesticides, necessitated by changing climate conditions, poses additional health risks, including respiratory diseases (Aggarwal et al., 2010). Heat and humidity can affect the productivity and health of livestock, further challenging agripreneurial activities (IPCC, 2020). Economic impacts are profound as well. Climate change is expected to cause significant shifts in the availability and prices of agricultural products, threatening rural livelihoods. Small agripreneurs, in particular, face challenges in altering production systems, adopting new technologies, and managing overall production (Kumar et al., 2021). High startup costs, difficulties in obtaining credit, and socio-political instability further exacerbate these challenges (Richards and Bulkley, 2007; Faisal, 2010; McElwee and Smith, 2012).

Thus, while agripreneurs play a vital role in agricultural and economic development, they face significant challenges due to climate change. Addressing these challenges requires targeted support to help them adapt to changing conditions, access necessary resources and technologies, and navigate the socio-political landscape to sustain their contributions to food security and economic stability.

Impact of Climate Change on Agripreneurship in Mizoram:

Mizoram, located in the north eastern part of India, shares its borders with Assam and Manipur to the north, Myanmar to the east and south, and Bangladesh and Tripura to the west. This state is characterized by a significant international border stretching about 722 km, nearly three times longer than its border with mainland India. The temperature in Mizoram ranges from approximately 12°C in winter to about 30°C in summer, and the climate becomes humid in the lower hilly areas during the rainy season. Agriculture is the backbone of Mizoram's economy, with around 60% of the population engaged in agricultural and related activities. Traditionally, the economic life of the Mizos has revolved around Jhum or shifting cultivation. In addition to Jhum cultivation, many farmers have established permanent farms on fixed lands where they cultivate a variety of mixed crops. Despite these efforts, Mizoram remains largely self-insufficient in most agricultural products, and there has been a noticeable decline in production over recent years due to various factors, including climate change. Climate change has had both direct and indirect impacts on the agripreneurs in Mizoram. These impacts significantly affect crop production and food security, disproportionately burdening those who already face challenges in accessing resources, expertise, and technology. Experts predict that around 130 million people could be pushed into poverty by 2050 due to the risks associated with climate change, natural disasters, and food inflation. The following are the findings from opinion survey shown in Table-1.

- i) **Changing Weather Patterns:** The survey reveals that 100% of the respondents acknowledged a change in weather patterns. This unanimous observation indicates a significant shift in the local climate, affecting agricultural activities.
- ii) **Rainfall Patterns:** All respondents (100%) reported that rainfall has not increased, suggesting a concerning trend of reduced or inconsistent rainfall, which is crucial for farming.
- iii) **Willingness to Reduce Climate Change Causes:** Despite recognizing the issues, 100% of the respondents expressed their readiness to mitigate the causes of climate change. However, there is a notable gap in awareness, with 88% admitting they are not aware of environmental policies aimed at reducing climate change.
- iv) **Use of Fertilizers:** The use of artificial fertilizers remains prevalent, with 60% of farmers relying on them, while only 40% use organic fertilizers. This continued reliance on artificial fertilizers contributes to climate change.
- v) **Human Activities and Climate Change:** A significant 96% of respondents agreed that climate change is partially caused by human activities, highlighting a general awareness of anthropogenic impacts on the environment.
- vi) **Water Scarcity:** The survey indicates severe water shortages, with 86% of agripreneurs reporting reduced availability of water from rivers, streams, springs, and even public health engineering department (PHED) supplies.
- vii) **Increasing Heat:** Almost all respondents (96%) observed an increase in the number of hot days, indicating rising temperatures that disrupt the agricultural production cycle and reduce yields.
- viii) **Direct Impact on Farming:** A striking 94% of the respondents stated that climate change directly affects their farming systems. Additionally, 92% confirmed that climate change poses a significant problem for their agricultural activities.

The present findings emphasise the multifaceted impact of climate change on agripreneurs in Mizoram. The shift in weather patterns, inconsistent rainfall, and increased temperatures directly challenge agricultural productivity. The lack of awareness about environmental policies and continued use of artificial fertilizers further complicate efforts to combat climate change. Thus agripreneurs in Mizoram face the dual challenge of adapting to these changing conditions while striving to maintain productivity and sustainability. Addressing these issues requires a concerted effort to raise awareness about environmental policies, promote sustainable agricultural practices, and enhance access to resources and technology. By doing so, the resilience of the agricultural sector in Mizoram can be strengthened, ensuring food security and economic stability for its agripreneurs.

Importance of Social Entrepreneurs in Climate Change:

Climate change is a pervasive issue affecting all aspects of life, impacting plants, animals, and humans worldwide. It arises from a complex interplay of natural phenomena and human activities, highlighting humanity's significant responsibility for its occurrence. Findings from a study conducted by the International Labour Organization in 2019 reveal

alarming projections: by 2030, high temperatures could lead to a 2.2% loss of global working hours, equivalent to the productivity loss of 80 million full-time jobs. Additionally, the research suggests that climate change may exacerbate global migration issues, potentially displacing 1.2 billion individuals as climate refugees by 2050. Addressing the multifaceted social and environmental challenges posed by climate change necessitates innovative solutions from social entrepreneurs. These individuals are at the forefront of developing novel approaches to address society's most persistent issues and catalyse wide scale change. By pioneering innovations that benefit humanity and society as a whole, social entrepreneurs play a crucial role in mitigating the impacts of climate change.

Effectively combating climate change requires a comprehensive examination of human activities, encompassing agriculture, food production, construction, and industrialization. Incorporating climate-resilient agriculture (CRA) practices into farming methods is essential. CRA emphasizes sustainable farming techniques aimed at achieving long-term productivity while conserving natural resources. Agripreneurs can contribute significantly by adopting climate-smart agriculture technologies, which focus on increasing productivity and incomes, improving livelihoods and ecosystem resilience, and reducing greenhouse gas emissions.

Despite the prevailing notion that agriculture aligns with natural harmony, modern agricultural practices often contribute to ecological degradation. The extensive use of inorganic fertilizers and pesticides has adverse effects on the environment, contaminating air, water, soil, and other environmental systems. Agricultural development relies heavily on industry, which produces harmful inputs detrimental to environmental health. Unlike industrial pollutants, agricultural pesticides pose unique challenges as they are not easily treatable, posing risks to both animals and humans. Henceforth, agriculture and its allied activities are deeply interconnected with climate change and its environmental repercussions. Social entrepreneurs play a critical role in addressing these challenges by spearheading innovative solutions and promoting sustainable practices. By fostering collaboration among industries, governments, and communities, social entrepreneurs can drive meaningful change and mitigate the adverse impacts of climate change on the planet we inhabit.

Table - 1: Opinion about climate change from agripreneurs in Mizoram

Opinion	Yes		No	
	N	N (in %)	N	N (in %)
Climate change is a problem to you	46	92	4	8
Climate change is directly affected to your farming system	47	94	3	6
Climate change is affected in production volume	45	90	5	10
It affects in product life cycle	42	82	8	16
Rainy water is sufficient for cropping	5	10	45	90
Temperature in different seasons are changing	43	86	7	14
Days of heat are increasing	48	96	2	4
You have sufficient water supply for agricultural activity	3	6	47	94
Do you feel the pattern of weather is generally	50	100	-	-

changing				
Rainfall volume is increase	-	-	50	100
Have you observed in amount of water in streams, rivers and springs are reduce	43	86	7	14
Do you feel any changes in water supply in the piped (PHED)	48	96	2	4
Are you aware about the environmental policies to reduce climate change	6	12	44	88
Climate change is partially caused by human activities	48	96	2	4
You are ready to reduce climate change causes	50	100	-	-
You use organic fertiliser	20	40	30	60

Source: Field data

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