

CLIMATE CHANGE AND LIVELIHOOD VULNERABILITY AMONG INDIGENOUS PEOPLES IN RURAL BANGLADESH

Faraha Nawaz^{1*}, Imrul Kabir²

¹Department of Public Administration, University of Rajshahi, Bangladesh

²Department of Social Work, Jamalpur Science and Technology University, Bangladesh

Abstract

Climate change continues to pose critical threats to vulnerable populations worldwide, particularly indigenous communities whose livelihoods and cultural practices are closely linked to their natural environments. This article investigates the impacts of climate change on the Garo indigenous community in Nalitabari Upazila of Sherpur District. Employing a mixed-methods approach with a sample of 50 respondents, the research integrates qualitative insights and quantitative data to examine socio-economic, cultural and environmental dimensions of climate vulnerability. The results indicate that climate-induced changes - such as erratic rainfall patterns, temperature increases and intensified extreme weather events - have adversely affected agricultural productivity, income stability and local biodiversity. The study underscores the necessity of incorporating indigenous knowledge into national and local climate adaptation frameworks to enhance community resilience and promote inclusive climate governance.

Keywords

Adaptation strategy, climate change, indigenous community, local community.

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1. Introduction

In Bangladesh, existing legal frameworks and policy guidelines do not formally recognize the tribal communities as “tribal peoples”; rather, they are identified as *indigenous peoples*. The term “indigenous peoples” refers to culturally and socially distinct groups that maintain unique linguistic, historical, economic and political identities, separate from the dominant national population. Within this context, the Garo community represents one of the major indigenous groups in northern Bangladesh. According to the Bangladesh Bureau of Statistics (BBS, 2024), the Garo constitute approximately 44.02% of the total indigenous population in Sherpur District, where about 20,840 ethnic minority individuals reside. The majority of the Garo population is concentrated in the Madhutilla Garo Hills of Sherpur, an area characterized by hilly terrain and limited access to modern infrastructure.

Most Garo households in this region are traditionally constructed with mud or earthen materials, reflecting both cultural practices and economic constraints. However, environmental stressors linked to climate change have intensified their vulnerabilities. Rising summer temperatures have increased evaporation rates, leading to a noticeable decline in the water levels of rivers, ponds and lakes and in some cases, complete drying of these water bodies. This has resulted in acute water scarcity, particularly in the Madhutilla area, where residents primarily depend on manually dug wells to meet their

*Corresponding Author: Faraha Nawaz, e-mail: faraha.nawaz@ru.ac.bd

daily water needs. Notably, the absence of tube wells underscores the region's infrastructural and hydrogeological challenges. Furthermore, recurrent climate-induced disasters, including erratic rainfall and prolonged dry spells, have significantly disrupted agricultural productivity, preventing the Garo people from cultivating seasonal crops and thereby exacerbating their socio-economic insecurity. The primary driver of the current environmental crisis is the rapid pace of climate change. Climate refers to the long-term average of weather conditions, encompassing both general atmospheric patterns and environmental variability. While short-term fluctuations and extreme weather events - such as severe storms, prolonged droughts or anomalously hot seasons - constitute natural climate variability (United Nations International Strategy for Disaster Reduction), the scale and intensity of recent changes extend beyond these normal variations. Climate change can be defined as a statistically significant alteration in the state of the climate system that persists for an extended period, typically decades or longer and is directly or indirectly attributed to human activities that modify the composition of the global atmosphere (Report, 2006). Empirical evidence increasingly demonstrates that the impacts of climate change are observable across both physical environments and biological ecosystems. Rising global temperatures, shifting precipitation patterns and more frequent extreme weather events have contributed to widespread ecological disruption and socioeconomic instability. Moreover, these impacts are not evenly distributed; marginalized and vulnerable communities - particularly those whose livelihoods depend on natural resources - experience the most severe consequences. Indigenous populations, in particular, face disproportionate risks due to their close relationship with local ecosystems and limited adaptive capacity (Garo). Understanding these dynamics is essential for developing equitable and sustainable responses to ongoing climatic transformations.

Irregular rainfall patterns, rising temperatures and extreme weather events increasingly threaten agriculture, livelihoods and biodiversity in Bangladesh. For indigenous peoples such as the Garo community, adaptation knowledge remains vital for sustaining their socio-ecological systems. However, adaptation efforts are often constrained by limited resources, inadequate institutional support and recurrent challenges such as elephant-induced crop destruction. These factors underscore the urgent need for inclusive policies that integrate indigenous and local knowledge into climate change adaptation planning (Rifat, 2025). As scholars suggest, climate change and disaster risks can be mitigated through coordinated adaptation efforts that align with community development priorities rather than intensifying vulnerabilities (Laukkonen, 2009). The research explores multi-facet impacts of climate change on the Garo and local communities of Sherpur District. The article also highlights the necessity of incorporating indigenous knowledge into national and local climate adaptation frameworks to enhance community resilience and promote inclusive climate governance.

Despite a growing body of research on the impacts of climate change in Bangladesh, limited attention has been given to the indigenous Garo and local communities in the Sherpur district. Existing studies often overlook the nuanced ways in which these communities perceive and respond to environmental changes. While national and regional studies have emphasized general adaptation measures, they rarely incorporate indigenous perspectives or examine how traditional ecological knowledge and cultural practices contribute to resilience. Consequently, climate-induced vulnerability rooted in indigenous worldviews remains underrepresented in policy frameworks at the national, regional and international levels. Furthermore, there is a

significant gap in comparative research exploring how indigenous groups, such as the Garo, adapt to climate variability in relation to neighboring non-indigenous communities. This lack of comparative understanding hinders the formulation of inclusive and context-sensitive climate policies. To address this gap, the present study investigates the implications of climate change on Garo and local communities in Sherpur district. It seeks to understand how these groups are being affected with the impacts of climate change.

The climate crisis is a global phenomenon whose impacts are unevenly distributed across regions and social groups. Vulnerable populations - particularly indigenous, marginalized and rural communities - experience the most severe consequences due to limited adaptive capacity and socioeconomic constraints (Social Dimensions of Climate Change, n.d.). In Bangladesh, unpredictable rainfall patterns, prolonged heat waves and increasingly extreme weather events have triggered profound socio-economic, cultural and ecological challenges for both the Garo indigenous people and the local communities of Sherpur District. These environmental changes threaten traditional livelihoods, disrupt cultural practices and destabilize ecological balance, necessitating the re-evaluation of existing mitigation and adaptation mechanisms (Venugopal *et al.*, 2018). This article adopts a cross-cultural framework to explore how indigenous knowledge, social practices and community-based resilience strategies shape adaptive responses to climate change. The findings are expected to contribute to a deeper understanding of climate adaptation from both indigenous and non-indigenous perspectives, offering insights for inclusive and sustainable climate policy formulation. This study critically examines the perceptions, responses and coping mechanisms of indigenous and local communities in relation to climate change, with particular attention to the Garo community in Sherpur, Bangladesh. It explores how indigenous knowledge systems and local practices are applied within cross-cultural contexts to address the adverse effects of climate variability.

Climate change poses severe threats to indigenous and local populations, disproportionately affecting their livelihoods, cultural traditions and environmental stability (Islam *et al.*, 2022). The Garo community, in particular, faces increasing challenges due to erratic rainfall, rising temperatures and extreme weather events, which collectively endanger agricultural productivity, biodiversity and socio-cultural resilience (Rifat, 2025). This article seeks to explore the impacts of climate change on livelihood vulnerability of indigenous communities of Bangladesh. This study is grounded in understanding how these communities interpret and respond to climatic changes by integrating traditional ecological knowledge with contemporary adaptation strategies. Ultimately, the research aims to generate insights that support inclusive, culturally responsive policies which recognize indigenous worldviews and strengthen resilience to climate risks (Kenney & Phibbs, 2021).

2. Materials and methods

This study adopts a mixed-methods approach to investigate and compare the climate change adaptation practices of indigenous and local communities in Sherpur, Bangladesh. Methodology, in this context, provides the theoretical rationale for the research design, articulates the research questions and justifies the significance of the study. It also outlines the starting point of the research, the directions taken and the potential implications upon completion, while situating the study within relevant literature, terminologies and theoretical frameworks. The mixed-methods approach employed here integrates both qualitative and quantitative strategies, positioning the study at the intersection of these paradigms. The qualitative component is grounded in

ethnographic fieldwork, offering rich, contextualized descriptions of cultural practices and local responses to climate change. The quantitative component allows for systematic measurement and comparison across the study population, enhancing the robustness of the findings. Sherpur district was selected as the study site due to its environmental vulnerability to climate change and its multicultural composition, which includes the Garo indigenous community and the local Bengali population. Given the district's heavy reliance on agriculture and natural resources, it provides an important context to explore grassroots-level adaptation strategies. Qualitative data were collected through surveys, participant observations, focus group discussions (FGDs), key informant interviews (KIIs) and in-depth case studies. These qualitative methods facilitated an in-depth understanding of the lived experiences of the Garo community and their interactions with local public services, including perceptions of service effectiveness and satisfaction.

Secondary data were gathered from a variety of sources, including published research papers, government documents and reports from organizations such as the Bangladesh Meteorological Department, World Meteorological Organization (WMO), United Nations Environment Programme (UNEP) and the Intergovernmental Panel on Climate Change (IPCC). These sources provided insights into climate change impacts, particularly in relation to indigenous populations. The integration of secondary data supported the development of a conceptual framework and helped contextualize primary data findings. Primary data collection focused on climate change impacts and adaptation strategies among the Garo community. Respondents provided information on observed changes, including rising temperatures, reduced crop yields and the occurrence of droughts. The combination of quantitative and qualitative approaches allowed for triangulation of findings, providing a robust understanding of the effects of climate change on both indigenous and local populations in Sherpur, as well as the strategies adopted to cope with these challenges.

3. Results and discussion

In Bangladesh, the Garo are generally found in the north-eastern border area of the greater Mymensingh region, especially in Tangail, Mymensingh, Netrokona, Jamalpur, Sherpur and in Sunamganj and Moulavibazar of greater Sylhet (Muhammed *et al.*, 2011). However, the socio-economic and cultural situation of the Garo in Sherpur in this regard is virtually invisible. As for education, the problems are even worse. Financial obstacles like tuition fees, transportation and opportunity costs mean that even low-to middle-income indigenous families have limited access to education at all levels (Sabates *et al.*, 2013). Which is why many people interviewed over the course of this research either dropped out of or never even started formal learning: the conditions just weren't there. This reflects the now customary global pattern of early attrition due to poverty and unbalanced infrastructure (Global Education Monitoring Report Team, 2020). In terms of employment, the great majority of Garo informants are still farmers or earn low wages, which is becoming increasingly difficult to sustain due to the loss of land, climate change, reduced market access and other causes (Juice *et al.*, 2019). Unemployment and informal labour among indigenous young people also show them being kept out of job training opportunities, systematically disadvantaged again (Roy & Halder, 2020). In terms of diet, the survey finds that the primary habit is indeed based on a subsistence economy and is largely vegetarian. On the other hand, this form of feed won't be viable for very long due to environmental pressure and economic difficulties. As non-resistant substitutes become vulnerable in the market, so too does the very essence of Garo culture. Thus, traditional

sources of food are on the decline and cultural assimilation with Bengali society is ongoing for those who live there today. The net effect may well be that these people lose their language over time as well, since they will be unable to remember or transmit it anymore. The Garo also maintain neighbourly networks and collective well-being in village communities, thus serving functions which would normally be performed by formal institutions (Uddin *et al.*, 2011). All of these aspects combine. Consequently, unbalanced development strategies that are not suited to human needs, combined with a lack of understanding about the importance of education, are currently causing harm to the Garo ethnic culture. One of our respondents mentioned that:

“The house most of the people I know live in is still the old-fashioned one handed down by their parents, quite often lacking even proper comfort”.

While a primary occupation of the community, the major proportion of people engaged in agriculture also highlights its dependence and the fragility of the village should economic fluctuations affect its vital local industries. The significant proportion of respondents living in traditional housing, combined with the lack of land ownership for many, suggests that access to modern amenities and property is limited. This is bound to affect the community's overall standard of living. Education appears to be a key factor in breaking the cycle of poverty, but what is also needed are more opportunities for employment, as well as access to land, to ensure a more secure and prosperous future. One of our respondents mentioned that

Respondent 2 said *“At least in one major agricultural village, which is growing rapidly, there was even a shortage of employment for those with education”.*

Respondent 10 said *“Although we primarily rely on farming, things can go very wrong if a crop failure occurs”.*

To summarise, the Garo community in Sherpur faces challenges including limited access to resources, low income and reliance on traditional farming methods. However, these combined elements, along with education and housing conditions, have developed into a complex socioeconomic environment. Here, opportunities for advancement remain scarce without change. For the Garos, their socio-cultural isolation is such that access to education remains a problem. Although many students successfully complete their education at higher secondary level. Poor families and personal obligations often necessitate that students prioritise immediate financial returns over long-term benefits of education (Sabates *et al.*, 2013). This situation is common in South Asia, where the costs of missed opportunities may prevent moving forward beyond secondary school into university. These are the long-term consequences of this social inequality. To deal with the problem, policy changes are needed to help marginal families (Sabates *et al.*, 2013). According to various responses off the field:

Respondent 8 said *“Many farming families do not own the land on which they work and live and this makes them feel insecure”.*

Respondent 18 said *“Young men want to be moving forward, but there are few jobs other than in agriculture”.*

3.1. Climate change and its impact on agricultural vulnerability

3.1.1. Climate-induced crop and livestock problems

Climate-induced crop and livestock problems refer to the adverse effects of climate change - such as rising temperatures, erratic rainfall, droughts, floods and increased outbreaks of pests and diseases - on agriculture and animal husbandry (Davis *et al.*, 2018). These issues can decrease crop yields and quality, reduce livestock growth and reproductive rates and threaten food and economic security in vulnerable regions. Heat stress, water scarcity and shifting disease patterns commonly impact animal health and productivity. Ultimately, these problems underscore the urgent need for adaptation strategies in agriculture and livestock management. Perhaps the most important theme is the capriciousness of the weather, which can have a significant impact on both crop yields and livestock production. Due to ever-changing rainfall patterns, erosion of hill slopes and general soil degradation, crop viability is declining. Eight in ten interviewees were troubled by this situation. Respondent 1 observed, “The rain isn't falling where it used to. The weather isn't predictable anymore like our ancestors taught us”. And as a result, cow health is not as good as in the past because of a lack of grass and disease.

Climate change has changed the agricultural industry, but it is particularly strife for indigenous and local people that depend on natural resources. In Sherpur, which is comprised of a unique ethnically diverse and local farming community, climate change problems have become apparent. The community's most significant report is reduced agricultural productivity which jeopardizes food security, income earning potential and overlaid traditional livelihoods. The loss of productivity can be seen as a composition of interrelated main problems mostly derived by climate variability and environmental stressors.

Climate change has led to multiple challenges on agricultural production in the Sherpur area. The most serious issue due to climate change is irregular rainfall (32%) that usually causes delays in sowing or harvesting crops often resulting in crop failure due to timing; also, crop diseases and pests (25%) and wild elephant attacks (8%) threaten producers with sudden and serious crop loss; drought stress causing prolonged or widespread rainfall deficits (20%) largely reduces soil moisture deficits and irrigation challenges that contribute to poor yield; soil degradation (10%) reduces growth rate, harvestable yield and overall crop productivity and lack of embedded technology or inadequate infrastructure (10) adds to the sector's overarching vulnerabilities. It is possible that some issues remain to be discovered, suggesting further research may be needed.

3.1.2. Deforestation and loss of forest resources

According to the Asiatic Society of Bangladesh (2004), sal forests existed as a continuous belt from the Comilla district of Bangladesh to Darjeeling. The World Rainforest Movement (WRM) bulletin states that people living far away from forests usually perceive deforestation as an exclusively environmental problem. With the disappearance of forests, the Garo people have become ever more reliant on external sources. We find that it is much harder to gather medicinal plants (confirmed by 12.5 per cent) or firewood. One of our respondents mentioned that

Respondent 3 put it, “Formerly, when we needed medicine or wood, we would go anywhere in the forest. But now the forest is gone”.

This has profound implications for how they are able to live in their surroundings. In Sherpur, deforestation is one of the contributors to climate change and loss of ecosystems. Deforestation is an issue affecting the lives of indigenous and local people, due to further cutting of forests for agricultural expansion, logging and the large need for urban land cover. All of these factors have created a cascade of issues that have led to climate change and environmental degradation or disturbance. A cross-cultural analysis and field interview paradigm was used, which discovered that deforestation is barely an environmental problem but a socio-cultural problem related to the livelihood of marginalized peoples in Sherpur. In recent years, deforestation in Sherpur has had many negative effects on the environment and biodiversity. Global warming (35%) is rising as a result of the onset accumulation of carbon dioxide from forest cover loss causing rising temperatures in the region. The human-wildlife conflict (30%) has been exacerbated as more and more wild animals are entering villages, destructing crops and property. The loss of biodiversity (25%) and soil erosion (25%) is a rampant issue from the loss of forest cover resulting in agricultural harm and preventing ecosystem stability. The ecological imbalance (20%) is causing broadening drought and shifts in climate. The level of poverty (10%) is increasing and is impacting communities dependent on forests and their livelihoods are becoming increasingly impossible. However, there were further problems that this study couldn't completely identify and they need to be explored further in future studies.

3.2. Climate change and its impact on economic vulnerability

Climate change has severely impacted the Garo livelihoods, particularly with the traditional farming systems (Karki *et al.*, 2020). Unpredictable weather patterns littered with rainfall beyond season have made planning agricultural activities ever more difficult for farmers. This has led to smaller harvests and increased insecurity over income and the future. Mr. Wang told our reporter, “We never wait for the rain now or even before it comes”. Garo communities are forced to turn to more flexible sources of income and employment for their livelihoods. To deal with the climate-related uncertainties, they often rely on seasonal labour rather than depend solely on agriculture. Such adaptation measures are widespread among indigenous and rural communities living in areas similarly affected by environmental stress. This emphasizes still further the urgent need for climate-resilient agricultural support in these vulnerable regions (Karki *et al.*, 2020).

One of our respondents mentioned that “*The forest is too different from its old self to allow us to go out gathering herbs and plants with which we lived or medicated for that very sickness that killed me*”. As a result, the decrease in biodiversity and natural resources, such as forests and water bodies, further undermines their ability to maintain traditional practices, which are essential sources of food and income generation. These changes, while eliminating traditional sources of livelihood, have not only impacted the economy but also cultural and religious life.

Our 1 respondent mentioned their problem:

Respondent 9 said, “*I can't just do farming any more. I must take my family to the nearest town and work as a day-labourer in order to survive, for work elsewhere because farming isn't reliable now*”.

3.2.1. Climate induced economic vulnerability

In rural communities, climate change has increased economic vulnerability. This has meant that some people who previously subsisted through farming are now migrating seasonally for short-term work; the alternative of continuing their traditional way of life has become completely unviable (Tuholske *et al.*, 2024). Such a change in lifestyle leads to financial dependency on others and it reduces independent economic activities. One of our respondents mentioned that: *“These days, at the market, we have to purchase more food to eat. Why? Simply because our crops are not growing as well as they used to at home. That makes life even more costly for us”*. Climate change is transforming the Garo community's lives - disrupting traditional farming methods and lowering people's incomes, while also undermining the cultural value of their environment. The community must find new ways to cope with changes as weather patterns become increasingly unpredictable, the loss of resources reduces the food provided by nature for people's livelihoods and pushes up pressure on households or families when there is no water. With these pressing needs in mind, it cannot be too soon for localised climate adaptation measures to be formulated that not only maintain traditional practices but also ensure economic security for Garo community residents.

Our 1 respondent mentioned their problem:

Respondent 7 said, *“Farming is no longer a reliable way to make a living. Many people from here have to leave their homes and go elsewhere simply because it's so difficult for them; even then, you can never earn what you'd like. To feed themselves and keep house on top of all this”*.

Economic harm refers to financial losses or negative impacts on individuals, businesses or economies since disruptions, such as policy changes and market volatility, lead to increased costliness and less economic stability in general (Smith, 2020). Increased production inputs due to climate change reduce agricultural profits. One of our respondents mentioned that respondent 5 said, *“Now we pay more for seeds, for fertilizer, for pesticides. We are spending so much on farming, our profits are down”*. In addition, increasing market dependency (eight in ten interviewees) means more expenditure at home and less self-sufficiency”.

The most immediate and visible impacts of climate change on conditions is the impact on housing situations. In Sherpur, particularly for indigenous and rural people, the types of housing that people live in are considered highly vulnerable to extreme weather events presented by climate change. In Sherpur, 70% of households are made from mud (prone to flooding damage, mould and pests). Mud houses are inexpensive to build, but seem to need repairs constantly. 20% of households live in tin houses, which can become quite hot and are very susceptible to storms or fires. Only 10% of houses are made of brick: these are stronger (though most families can only afford them by working abroad).

Climate change creates challenges to simple livestock rearing, especially indigenous people's connection between their livestock reliance for livelihood, food security and cultural continuity. Indicators of climate change have shifted environmental conditions for the people of Sherpur and created a disconnect with traditional ecological balance. Consequently, livestock management has felt the largest stress. Increasing animal heat stress (40%) has become one of the key challenges facing the livestock sector in Sherpur as a consequence of climate change. Reductions in feed intake, milk production and even mortality are major effects and leading to loss of income. During conditions of extreme heat and humidity, disease incidences (35%) have increased,

especially through vector-borne infections, while veterinary services remain limited in rural areas. Increasingly grazed land (25%) is affecting feed costs for livestock and many farmers are increasingly forced to reduce herd sizes. Damage to shelters and infrastructures (20%) as a result of natural disasters is also putting additional economic strain on poor households. There are likely additional factors this study could not explore or identify and further research might help to elucidate these issues.

3.3. Climate change and its impact on health vulnerability

Owing to poor sanitation and global warming, skin infections, malnutrition, mental illnesses and other health problems have appeared in the Garo people's lives. For instance, traditional beliefs may prevent them from seeking medical advice or even consulting a doctor when they shiver incessantly in winter because their houses lack walls or ceilings (Hultgren *et al.*, 2025). This interconnected set of health problems illustrates how environmental and infrastructural issues can exacerbate vulnerabilities. It is particularly harmful to tribal and rural communities, which face complex public health risks. In the context of climate change, health-related issues represent an important area of consideration most specifically for indigenous and local communities in Sherpur. Due to multiple different factors resulting from climate change (changing weather patterns, rising temperatures, water scarcity and increased flooding), direct and indirect health problems are on the rise. Climate change has affected the health of people in the area in several ways. Waterborne illnesses (40%), especially diarrhea and typhoid, increase during flood times with the greatest burden on children and the elderly. Skin ailments (25%) develop as a consequence of increased humidity, contaminated water or poor sanitation. Many don't know it, but mental health problems (15%) such as stress and depression are caused by the loss of habitat and instability. Respiratory illness (10%), including asthma worsen with pollution and dust. Other health problems (10%) include heat stroke, dehydration and vector-borne diseases due to poor nutrition.

Waterborne diseases and sanitation issues:

In the Sherpur region, Climate Change and problems related to natural resource use have led to increased water shortages. People, especially poor farmers and families, are experiencing difficulties in their daily lives due to a lack of safe drinking water and under-supply of water for agriculture and livestock, which collectively creates a challenging crisis impacting public health, food security and the environment at the same time.

Water problems significantly hamper livelihoods in Sherpur. If no irrigation water (30%) was used, yields would be lower during crop production, leading to an increase in food prices and lower income for farmers. Health risks from waterborne diseases (13%) increase with the floods as the majority of victims belong to marginalized groups (Mills *et al.*, 2007). Deterioration of dried ponds and waterbodies (7%) continues the water issue and affects biodiversity. There are also potentially, many other waters related problems that could have arisen that are not mentioned and are currently unknown, which may require further investigation.

Waterborne diseases and sanitation issues arise in the Garo community due to drinking water contamination, especially from rainwater runoff, leading to widespread illnesses like diarrhoea and cholera. Poor sanitation infrastructure exacerbates the transmission of these diseases, posing a persistent public health threat to rural and indigenous populations in Bangladesh (Nguyen *et al.*, 2024). One of our respondents mentioned that “*We often drink unsanitary water and then our family often gets sick*”.

Such pollution has led to the spread of infectious diseases in the community, causing significant harm to people's health.

3.3.1. Skin infections

Poor sanitation and standing water are rich breeding grounds for all sorts of bacteria and fungi that lead to skin rashes/fungal diseases. 40% of those interviewed said they had these skin infections. Respondent 2 said, *“When the rains come, we often get skin rashes arising from standing water. This is a perpetual problem”*.

This theme brings out the constant public health problem of how difficult it is for a community that depends upon natural sources to make use of clean water and maintain hygiene.

3.3.2. Malnutrition and food insecurity

The advent of climate change has led to the failure of crops, resulting in a lack of reliable food supply; nearly 41% of those interviewed suffer from malnutrition.

Respondent 3 said, *“Our crops go bad again and again -- it's difficult to provide for my family”*.

This highlights the underlying issues of nutritional deficiency, as well as farmers' inability to cultivate sufficient food due to erratic weather conditions.

3.3.3. Mental health issues

Mental health issues are compounded by climate change in communities on the move, like the Garo Community in Sherpur. Here, environmental strains such as insecure food supplies and inadequate sanitation not only make people physically ill, but they also cause them psychological hurt. Now is the time to combine public health reforms with mental health measures. Policy should embrace integrated mental health service provision, improve the sanitation situation and ensure that as much clean water as possible is available (Hayes *et al.*, 2018). Currently, the community needs immediate action to improve sanitation, access to clean drinking water and psychological support. Respondent 4 said, *“Our future stability has vanished -- I'll go crazy”*.

4. Discussion

Bangladesh remains one of the world's least developed and most densely populated countries, where forest land accounts for only 16.85% of the total area and per capita forest cover stands at merely 0.022 hectares - reportedly the lowest globally. The annual deforestation rate of 3.3% further exacerbates ecological degradation and disproportionately affects forest-dependent Indigenous groups such as the Garos (Mia, 2003). Findings from our study reveal that approximately 85% of Garo respondents reported reduced access to natural remedies and forest-based organic resources vital for food, medicine and household energy due to declining forest biodiversity. Climate change is intensifying these vulnerabilities: a World Bank projection warns that by 2050, as many as 216 million people may be displaced across six global regions, including up to 19.9 million in South Asia, with Bangladesh expected to bear a significant share (World Bank Group, 2021). Consistent with these trends, our research indicates that climate-induced habitat loss has forced 36% of the Garo community in Sherpur to migrate, while 30% have relocated due to diminishing livelihood opportunities.

Water insecurity further compounds these risks. Globally, over two billion people lack access to safe drinking water and more than half of the world's population experiences severe water scarcity annually - figures projected to rise under worsening climatic conditions. In Sherpur, the Garo population faces acute potable water shortages, often traveling up to two miles to collect water, while declining groundwater levels hinder irrigation, reduce crop productivity and jeopardize food security. Our findings show that 50% of the community relies on contaminated water sources, contributing to both agricultural instability and adverse health outcomes. Recent World Bank assessments similarly indicate that climate change is accelerating the spread of infectious diseases in Bangladesh and exacerbating mental health challenges, underscoring the multidimensional risks confronting marginalized Indigenous populations. The Climate Afflictions Report highlights a strong association between shifting climatic conditions and rising incidences of respiratory, waterborne and vector-borne diseases, alongside escalating mental health disorders. These trends are projected to intensify, with children, the elderly and populations in densely populated urban centres such as Dhaka and Chattogram identified as the most vulnerable groups (Bangladesh, n.d.). Consistent with these national patterns, our research demonstrates that the Garo community in Sherpur is experiencing a substantial disease burden: 40% of reported illnesses are waterborne, complemented by high prevalence rates of skin diseases, stress-related conditions and respiratory illnesses. Children are particularly affected, with many suffering from ailments directly or indirectly linked to climate-induced changes in water quality and sanitation. The broader impacts of climate change on agricultural productivity in Bangladesh are extensive and potentially catastrophic for national economic stability. Extreme temperatures, recurrent droughts and increasing salinity intrusion are progressively undermining crop yields across multiple agroecological zones. Variability in temperature and rainfall patterns has already altered planting seasons, with delays in monsoon onset and the occurrence of early or erratic precipitation disrupting traditional cultivation cycles (Habiba *et al.*, 2012).

Within the Garo community, approximately 75% of respondents reported that the misalignment between cropping calendars and seasonal patterns has led to frequent crop failures, compelling many to abandon agricultural production in favour of market-purchased foods. This shift perpetuates a cycle of dependency, further reducing agricultural self-sufficiency and heightening vulnerability to market fluctuations. Climate change similarly threatens Bangladesh's fisheries sector, which contributes roughly 3.5% of national GDP and serves as a crucial source of dietary protein. With nearly 260 fish species - most highly sensitive to shifts in salinity and freshwater conditions - altered climatic and hydrological patterns jeopardize both biodiversity and food security. The impacts extend to the education sector, where climate disruptions disproportionately harm children. According to the UNICEF Children's Climate Risk Index, Bangladeshi children are among the most climate-vulnerable globally, with climate-related disasters frequently intensifying the country's already severe "learning poverty". One in two children cannot read at grade level and two-thirds struggle with basic arithmetic after completing primary school. Climate crises also exacerbate structural inequalities such as early marriage, with Bangladesh ranking among the top ten countries globally for underage marriage rates. As a result, schooling discontinuity remains widespread, with the 2024 climate crises disrupting the education of 35 million children nationwide (UNICEF, 2025).

These systemic challenges have profound implications for the Garo community. Limited access to educational facilities, low literacy rates and economic pressures

contribute to reduced enrolment and high dropout rates among Garo youth. Fewer than one-third of respondents have attained education levels that would enable them to learn climate-friendly techniques or adaptation strategies. As many young people leave school prematurely to pursue employment in various sectors, the community's long-term capacity to understand, evaluate and respond to climate risks becomes increasingly constrained. This educational marginalization, coupled with environmental and economic vulnerabilities, places the Garo people at heightened risk in the face of accelerating climate change.

The World Risk Index 2023 places Bangladesh ninth globally in terms of susceptibility to climate-related disasters, underscoring the nation's acute exposure to environmental hazards. Projections indicate that by 2050, Bangladesh may lose up to 17% of its landmass due to rising sea levels, resulting in the disappearance of nearly 30% of its agricultural land. Such losses will drive large-scale internal migration from coastal belts to already congested urban centres, further intensifying pressure on national resources and social infrastructure. Bangladesh's disaster risk score of 27.29 reflects the country's high vulnerability to recurrent floods, cyclones, storm surges and coastal erosion. These risks are magnified by the nation's physiographic characteristics: much of its terrain is flat, low-lying and situated less than five metres above sea level, rendering it exceptionally sensitive to hydrometeorological changes. Coastal zones - home to millions - are experiencing rapid erosion and escalating salinity intrusion, diminishing agricultural productivity and making traditionally arable land unsuitable for cultivation. Karim et al. (2024) warn that the anticipated reduction in land area will displace millions of people, many of whom depend heavily on agriculture and fisheries for their livelihoods.

Within this broader national context, our study reveals a deeply concerning situation regarding climate adaptation services among the Garo community in Sherpur. Only 25% of respondents reported receiving any form of adaptation support, whereas the remaining 75% remain entirely unserved. Moreover, 65% of the community is unaware that climate adaptation assistance exists at all. Key barriers to accessing available services include bureaucratic hurdles, limited awareness, financial constraints, geographic remoteness and entrenched socio-cultural obstacles. The cumulative findings indicate that climate change is exerting far-reaching effects on environmental stability, livelihoods, health, housing and social security. Strengthening access to inclusive, community-centered adaptation services is therefore both urgent and essential to protect vulnerable Indigenous populations such as the Garo and to enhance national resilience in the face of escalating climate risks.

5. Conclusions

The findings of this study have significant implications, as they illuminate the adaptation and response strategies of the Garo and local communities of Sherpur, a region where climate change poses an escalating threat. The results indicate that both groups face multiple, intersecting vulnerabilities driven by climate-induced environmental changes. However, the Garo - whose cultural identity, livelihoods and social wellbeing are deeply tied to ecosystem services - are disproportionately affected, facing heightened risks to their subsistence practices, cultural continuity and overall resilience. Across Sherpur, residents encounter a suite of climate-related challenges, including rising temperatures, increased variability in rainfall, scarcity of potable and irrigation water, declining agricultural yields, biodiversity loss and a growing burden of climate-sensitive health impacts.

Employing a socio-ecological systems framework and a mixed-methods research design, the study documents how both Garo and local communities draw upon a combination of traditional ecological knowledge and newly adopted coping mechanisms to manage climate stressors. Adaptation strategies identified - such as drought-resistant agriculture, improved cultivation and water management techniques, sustainable forest resource use, climate-resilient housing and strengthened institutional engagement - demonstrate how locally grounded knowledge systems contribute to community resilience. Mitigation efforts in Sherpur, including community outreach and environmental education, afforestation initiatives, ecological restoration projects and the development of green infrastructure, further reflect the proactive measures undertaken by community stakeholders to counteract environmental degradation and reduce future risks.

Nonetheless, the study also highlights persistent structural challenges that undermine long-term adaptive capacity. These include insufficient support from government and non-governmental organizations, limited access to financial and technical resources, inadequate infrastructure and reliance on formal policy frameworks that often fail to acknowledge or integrate Indigenous knowledge systems. Such constraints hinder the sustainability and scalability of adaptation and mitigation initiatives. The research therefore underscores the urgent need for inclusive, culturally informed and community-based climate policies that recognize Indigenous knowledge, promote inter-institutional collaboration and ensure equitable distribution of the environmental and social benefits arising from climate adaptation interventions. Investing in locally driven capacity-building and participatory planning processes will be essential for guiding Indigenous peoples and local communities in Sherpur - and comparable regions - towards climate-resilient and sustainable futures.

Declarations

Ethics Approval: Ethical approval has been obtained before receiving the participant's information.

Consent for publication: Participant's consent to publish this paper has been ensured during conducting research work.

Available of data and materials: The data are not publicly available due to the privacy of the participants.

Competing Interests: There are no ways to conflicts of interest in this Research.

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