

Climate Change and Gendered Health Risks: Evidence from the Santal Women in Northern Bangladesh

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Abstract: Climate change has emerged as one of the most pressing global challenges, disproportionately affecting marginalized communities in vulnerable regions such as Bangladesh. This study examines the gendered health risks of climate change among Santal women, one of the largest indigenous groups in Bangladesh. Drawing on qualitative research conducted in Parbatipur Upazila under Dinajpur district, the study employed in-depth interviews, focus group discussions, and key informant interviews to capture women's lived experiences of climate-related health challenges. Findings reveal that climate change is reshaping the daily realities of Santal women by intensifying food insecurity, water scarcity, and disease prevalence. Rising temperatures, erratic rainfall, droughts, and floods have disrupted agricultural production, reduced dietary diversity, and heightened risks of malnutrition and anemia among women and adolescent girls. Water shortages have increased the prevalence of urinary tract infections and poor menstrual hygiene, while heat stress has exacerbated cardiovascular strain and maternal health complications. Participants also reported the emergence of "new diseases," including skin infections, respiratory problems, and heat-related illnesses, which traditional healing practices struggle to address. Mental health burdens such as anxiety, stress, and social isolation were widely observed, underscoring the psychosocial dimensions of climate vulnerability. The intersection of gender and indigeneity further exacerbates these risks. Women's responsibilities in caregiving, food preparation, and water collection position them at the frontline of environmental stresses, while limited healthcare access, cultural restrictions, and exclusion from decision-making reduce their adaptive capacity. The erosion of traditional ecological knowledge compounds their vulnerability, leaving many without reliable coping strategies. This study concludes that climate change is not only an ecological crisis but also a deeply gendered health issue. Addressing these challenges requires inclusive climate policies and culturally sensitive health interventions that prioritize Indigenous women's voices, resilience, and rights.

Keywords: Climate Change, Vulnerability, Indigenous Women, Santal Community, Health Risk, Bangladesh

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Introduction

Climate change has emerged as one of the most formidable global challenges of the 21st century, threatening ecological balance, food systems, public health, and social stability. The Intergovernmental Panel on Climate Change (IPCC, 2022) emphasizes that global surface temperatures have risen by approximately 1.1°C above pre-industrial levels, leading to widespread environmental transformations. These transformations manifest through intensified heat waves, rising sea levels, erratic rainfall, floods, droughts, and tropical cyclones. While these phenomena affect populations worldwide, developing countries especially those with fragile infrastructure, economic inequality, and geographic vulnerabilities bear the greatest burden (World Bank, 2020). Bangladesh is globally recognized as one of the most climate-vulnerable countries due to its deltaic topography, dense population, and heavy reliance on climate-sensitive sectors such as agriculture and fisheries (Rahaman et al., 2021). The country frequently experiences devastating floods, salinity intrusion, cyclones, and riverbank erosion. These environmental disruptions have far-reaching implications for human health and wellbeing, particularly among socioeconomically and geographically marginalized communities.

According to the IPCC (2014), from 2030 to 2050, climate change is expected to cause an additional 250,000 deaths per year globally due to malnutrition, malaria, diarrhea, and heat stress an estimate that disproportionately impacts poor nations like Bangladesh. Among the most severely affected groups are indigenous communities, who are not only ecologically dependent but also socially marginalized. The Santal people, one of the largest indigenous communities in northern Bangladesh, rely heavily on agriculture, forest resources, and traditional ecological knowledge for their survival (Bleie, 2005; Sahoo, 2016). Climate variability has disrupted these ecological foundations, threatening their food security, economic activities, and cultural resilience. However, within the Santal community, women experience a double layer of vulnerability as indigenous individuals and as women entrenched in patriarchal norms and health inequalities (Sarker, 2014). Santal women's health is especially sensitive to climate-induced stresses. Rising temperatures, prolonged droughts, and water shortages have intensified the physical burden on women, as they are often responsible for water collection, food preparation, and caregiving. Water scarcity leads to increased risk of urinary tract infections and poor menstrual hygiene, while heat stress heightens cardiovascular strain and worsens pregnancy complications (Ndlovu & Chungag, 2024). Furthermore, erratic rainfall and floods have severely affected crop yields, reducing dietary diversity and resulting in malnutrition and anemia, especially among women and adolescent girls (Anzum, 2019, as cited in Islam, Shafi & Uddin, 2021; Le et al., 2023). In addition to these direct effects, climate change also contributes to the spread of vector-borne and infectious diseases. The transmission of malaria, dengue

fever, and diarrhea is closely linked to climatic conditions such as temperature and rainfall. Higher humidity and stagnant water bodies formed after floods or heavy rainfall become breeding grounds for mosquitoes, increasing the incidence of vector-borne diseases (Bentham, 1992; Khasnis & Nettleman, 2005).

The Santal community, with limited access to healthcare and sanitation infrastructure, faces elevated exposure and lower resilience to these illnesses (Kabir et al., 2016). Moreover, social structures further constrain Santal women's ability to adapt to climate challenges. Cultural restrictions, lower literacy rates, limited access to health services, and underrepresentation in decision-making processes reduce their capacity to respond effectively to climate-induced health risks (Chao, 2012; Soren, 2023). Traditional gender roles often confine them to unpaid care work, and during climate-related disasters, they are frequently the last to receive aid or evacuate to safety due to their household responsibilities and social expectations. The erosion of traditional ecological knowledge due to land dispossession, environmental degradation, and shifting climate patterns has also disrupted indigenous health practices. Santal women have historically relied on herbal medicine, community rituals, and forest resources for treatment, but these sources are now under severe threat (Sarker et al., 2014). The replacement of indigenous knowledge systems with inadequate modern health access has left many women in a precarious position, lacking both traditional and institutional care.

In sum, the intersection of gender, indignity, and climate vulnerability creates a complex matrix of health risks for Santal women in Bangladesh. While climate change is a global issue, its impacts are deeply local and uneven shaped by socio-cultural, economic, and environmental factors. Therefore, any attempt to mitigate or adapt to these impacts must consider the gendered dimensions of climate change, particularly among indigenous populations.

This study aims to contribute to the growing body of scholarship on climate justice by specifically focusing on the gendered health risks experienced by Santal women in the face of climate change. Through qualitative fieldwork and analysis of lived experiences, the research seeks to illuminate the specific ways in which environmental change intersects with indigenous identity, gender inequality, and public health, and to advocate for inclusive, equitable climate adaptation strategies that prioritize marginalized voices.

Methodology

This study was conducted in the Parbatipur Upazila of Dinajpur District, located in the northwestern region of Bangladesh, where a significant population of the indigenous Santal community resides. These indigenous women are uniquely vulnerable to the impacts of climate change due to their socio-economic marginalization, dependence on agriculture and natural resources, and inadequate access to healthcare services. Santal women, in

particular, bear the dual burden of gendered responsibilities and environmental degradation, which directly and indirectly affect their health and well-being. To understand the lived realities of these women, a qualitative research approach was adopted. This approach was chosen to capture the deeply embedded and complex experiences of Indigenous women in a rapidly changing climate. More specifically, a case study methodology was employed to allow for an in-depth and holistic investigation of how climate-related changes impact the health, behavior, and cultural lives of Santal women over time. As Merriam (1988) states, qualitative case studies are especially effective for uncovering meaning, interpreting lived experience, and generating new insights particularly when the phenomena are closely tied to local culture and context. Yin (2018) further supports the use of case studies when the boundaries between the phenomenon under study (climate change and health) and its real-life context (Santal culture and livelihood) are not clearly defined. Stake (1995) also argues that such studies help explore the uniqueness and complexity of bounded systems shaped by time, place, and identity.

Data collection was designed to provide a multidimensional understanding of how climate change is experienced and interpreted by Santal women in relation to their health. The study relied on three primary methods: In-depth semi-structured interviews, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs). A total of 35 Santal women participated in semi-structured interviews, selected to reflect diversity in age, marital status, education, and reproductive health experiences. The interview guide covered topics such as changes in climate patterns (e.g., rainfall, heat), their observed effects on women's health, reproductive issues, food security, disease outbreaks, and emotional stress. This open-ended format allowed women to narrate their lived experiences in their own voices, offering insight into both physical and mental health impacts linked to climate instability. Additionally, three Key Informant Interviews (KIIs) were conducted with senior women in the community who held deep cultural knowledge and were active in local social and spiritual affairs. These informants provided crucial context on the Indigenous health practices, gender norms, and belief systems that influence how climate-related health issues are perceived and managed. As Yin (2018) suggests, such informants offer more than just data they help interpret patterns and validate broader findings within the community. To further enrich the data and explore collective perspectives, four FGDs were carried out with 21 women participants. These discussions were conducted using Lederman's (1990) model, beginning with rapport-building and ethical clarification, followed by questions on resource scarcity, women's coping mechanisms, social roles during climate crises, and community health challenges. The FGDs served as an essential platform for collaborative reflection, enabling participants to identify shared experiences of gendered vulnerability and resilience in the face of environmental challenges.

Participant selection followed a purposive sampling technique, which is common in qualitative research for selecting individuals who are best positioned to provide rich, relevant, and diverse information (Patton, 2002). Criteria for selection included being female, over 18 years of age, Indigenous Santal by ethnicity, and having lived in the village for more than five years. This approach ensured inclusion of women with extensive environmental exposure and culturally embedded knowledge of health risks linked to climate variability. Secondary sources were used to complement primary data, including peer-reviewed journal articles, government policy reports, NGO documents, and Indigenous literature, particularly concerning climate vulnerability, gender, and Indigenous health. These materials helped position the study within the broader academic and policy framework. After completing the fieldwork, all audio-recorded interviews and FGDs were transcribed verbatim. The resulting qualitative data were analyzed through thematic analysis, following the six-step framework of Braun and Clarke (2006). This approach enabled the identification of recurring patterns and themes such as heat-related illness, food insecurity, menstrual health challenges, stress and anxiety, loss of traditional healing practices, and exclusion from health services which collectively illustrated the gendered dimensions of climate-related health risks among Santal women.

Theoretical Framework

The health impacts of climate change are deeply shaped by the interplay of environmental, political, and social forces. Understanding these impacts requires moving beyond a narrow biomedical model of health to frameworks that consider structural inequalities and community resilience. The Political Ecology of Health provides such a lens, emphasizing that health is not merely the absence of disease but a state of physical, mental, and social well-being that is shaped by access to resources, power relations, and environmental conditions (King, 2010; Mayer, 1996). This approach mentions that climate-related health disparities are not evenly distributed but are mediated by political-economic systems. Access to potable water, sanitation, nutrition, secure housing, and healthcare are essential determinants of health, yet these are often unequally available, particularly for marginalized groups such as Santal women in Northern Bangladesh. In these contexts, climate stressors such as flooding, droughts, and food insecurity compound pre-existing vulnerabilities rooted in land tenure inequalities, limited healthcare access, and gender-based discrimination (Baer, Singer, & Susser, 2013; Robbins, 2019). Figure 1 illustrates how health responses to climate change can be understood through community resilience, represented along a spectrum from low resilience to high resilience. At one end, Kleinman's Model underscores how individual beliefs, cultural perceptions, and healthcare choices shape health behaviors. However, when resilience is low, these individual-level choices are often constrained by structural barriers such as poverty or lack of healthcare access. Moving along the spectrum, the Political Ecology

perspective highlights how broader political and economic systems like land ownership, governance structures, and policy frameworks directly influence resource distribution and exposure to climate-related risks. Finally, at the high-resilience end, the concept of Social Capital emphasizes the importance of strong social networks, community solidarity, and collective action in enabling adaptive health responses (Adger, 2000; Putnam, 2001). Taken together, this framework suggests that climate change adaptation in health cannot be achieved solely at the individual level but must also account for political-economic contexts and the strength of social networks. The integration of these perspectives shows that resilience is multi-layered: it begins with individual health-seeking behaviors, is shaped by structural inequalities, and is ultimately strengthened through collective networks of trust and cooperation. By applying this integrated framework, the present study examines how climate change generates gendered health risks for Santal women in Northern Bangladesh. Their experiences focus the interconnectedness of environmental stressors, social inequality, and community resilience, demonstrating that health outcomes are inseparable from broader systems of power and resource allocation.

Understanding health responses to climate change through community resilience

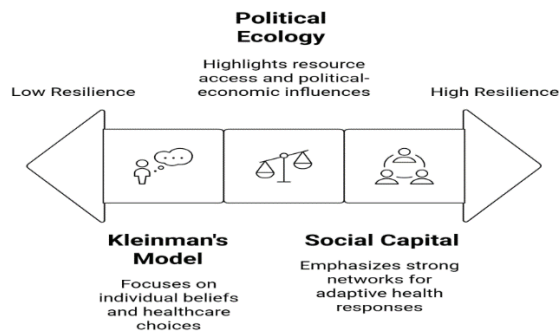


Figure 1: Theoretical framework of the study.

Result of the Study

Santal Women's Perception of Health

For the Santal Women's, health is not limited to the absence of disease but is understood as a state of physical strength, mental balance, social harmony, and spiritual well-being (WHO, 1978). Health also involves the capacity to acquire and manage both material and non-material resources that sustain life (Singer & Susser, 2003). This broader view suggests that health cannot be separated from the larger social, economic, and environmental conditions in which people live. This study reveals that Santal women's perceptions of health are deeply rooted in a mixture of environmental, spiritual, and social

interpretations. Traditionally, illness was attributed to ancestral displeasure, supernatural forces, black magic, or social disharmony. While these beliefs continue to shape their worldview, many Santals are beginning to associate certain health issues with visible environmental changes, particularly those brought on by climate variability. Vijay Murmu (40) shared his experience: *“Now, when there’s extreme heat, drought all around, no water for irrigation, and scorching wind, I feel weak and anxious. How can I stay healthy if my food spoils due to this unbearable heat?”* This statement illustrates how perceptions of health are increasingly linked to changing climate realities, especially as they impact food security and mental well-being. Another participant, Puthi Maddi (30), reflected on the changing environment and its effects on community health:

In my childhood, I used to visit the folk healer when I was sick. But now, things are different. Our land is dry, water is scarce, and we worry all the time. We are facing new illnesses like weakness, low blood pressure, tension, diarrhea, and black fever. When something goes wrong, we go to the local doctor, or sometimes to the health center if we can afford it.

These narratives show that while cultural interpretations of illness persist, Santal women are increasingly integrating climate-induced vulnerabilities into their concept of health. This aligns with Kleinman’s model of changing explanatory frameworks and confirms the political ecology view that health is inseparable from environmental and structural inequalities. According to Kleinman (1980), individuals and communities interpret health and illness through “explanatory models” shaped by culture and experience. The Santals’ transition from attributing illness solely to spiritual causes toward acknowledging environmental stressors reflects a shifting explanatory model, where climate variability is being incorporated into their understanding of illness. From a political ecology perspective, these perceptions also reflect the structural realities of vulnerability. Limited access to land, irrigation water, and healthcare services situates Santal women at the margins, where climate variability directly translates into health risks (King, 2010; Robbins, 2019). Thus, their health perceptions are not just cultural but also deeply tied to socioeconomic inequalities and environmental degradation.

Common Health Problems

Climate change has significantly altered the health landscape of the Santal community, creating a complex interplay between environmental degradation, traditional livelihoods, and emerging disease patterns. Deforestation and the depletion of natural resources have not only weakened the community’s traditional practices of hunting and gathering but also heightened exposure to illnesses previously uncommon in their community. Prolonged heatwaves and recurring droughts are now central to women’s health concerns. Rakhi Hemram (50) explained: the health challenges, saying,

Sometimes the temperature goes so high, and sometimes there's no rain for a long time. Drought is increasing excessively. We suffer from diseases like dehydration and stroke during and after drought. When the temperature becomes extreme and then drops suddenly, we start seeing unknown insect-borne diseases in our locality. Our children become ill, and sometimes we even have to admit them to the hospital.

Excessive heat, drought, and abrupt weather changes not only strain agricultural production but also create favorable conditions for disease vectors, such as mosquitoes and other insects, to thrive. This leads to increased cases of fever, diarrhea, and other health issues linked to water scarcity and poor sanitation. Rakhi also noted the community's growing frustration that traditional herbal remedies and local healers (Kabiraj), once effective, often fail to treat these newer illnesses, forcing families to seek modern medical care often at significant cost. Similarly, Sohagi Maddi (40) observed,

Climate change has led to warmer summers and colder winters, and we see insect-borne diseases around us. A new thing is that many people suffer strokes from the heat. With the shortage of water and food, we along with children also suffer from malnutrition.

The community increasingly has been facing a double burden: higher temperature and irregular rainfall reduce water availability and agricultural yields, while also creating conditions that spread diseases such as fever, cholera, jaundice, diarrhea, and cold-related ailments like coughs and pneumonia during the winter. The prevalence of mosquitoes and other disease-carrying insects further complicates daily life and health, especially for women and children who are more vulnerable due to nutritional deficiencies and greater exposure. From a Political Ecology of Health perspective (King, 2010; Robbins, 2019), these disease patterns are not accidental but reflect the intersection of environmental change and social inequality. Poor access to healthcare, landlessness, and poverty magnify vulnerability to climate-related illnesses. Using Kleinman's Model (1980), we can see a shift in explanatory frameworks: while traditional beliefs remain important, community members are now acknowledging environmental causes and moving toward biomedical care when traditional systems fail. Overall, this result showed that, the rise of vector-borne and climate-induced diseases demonstrates how closely human health, environment, and cultural resilience are interlinked. For marginalized groups like the Santals, disruptions in one sphere such as environmental change cascade into multiple health crises, creating new illnesses, economic burdens, and emotional stress.

Food Crisis and Malnutrition

Food crisis has emerged as one of the most pressing health challenges for the Santal community, directly linked to climate variability and environmental degradation. Traditionally, Santals relied on a mixed system of hunting,

gathering, and small-scale farming to secure their nutrition. However, these practices have been severely undermined by prolonged droughts, irregular rainfall, and deforestation. As a result, agricultural productivity has declined, while access to traditional wild foods has diminished. Nira Hemram (60) shared,

In some years, we are not getting rain for about six months. Due to no rain during the farming period, the groundwater level drops, and scorching heat, severe drought, and lack of trees stop rainfall. We cannot cultivate enough crops. For these reasons, we live in food insecurity all year round. The local vegetables, leaves, and other animals we once got near the village have disappeared.

This narrative shows that prolonged droughts and declining rainfall cycles directly undermine agricultural productivity, leaving families food insecure throughout the year. Deforestation and environmental degradation have also worsened the situation by diminishing available wildlife and forest products. Lokmi Saran (40) noted, *“Hunting is no longer possible in our society due to the lack of prey. There is no need to teach hunting rituals and techniques to children because animals no longer exist in the nearby areas due to drought and deforestation.”* Historically, food was more abundant in traditional farming and gathering, but now these sources have sharply declined. In response to food scarcity, many Santals have adopted more technology-dependent agricultural practices, despite their high cost and uncertain outcomes. Sifanil Murmu (45) explained,

Although we work hard on the drought-affected land to grow food, without rain it becomes expensive to irrigate. Since there’s no rainwater, we have to buy irrigation water, borrowing money or selling cattle. When I am in debt, I cannot buy enough food for my family, and after harvesting, I must sell crops at a lower price to repay the loan.

The unpredictable weather such as untimely rain, unusually short or long winters, and prolonged droughts has disrupted planting and harvesting cycles. Philip Hemrom (30) described,

Due to weather change, we face long droughts and sometimes untimely rains every year. The temperature has increased due to uneven weather. Because of this, the production of wheat, chickpea, lentil, mung dal, and other crops has decreased. We also spend more on machinery and chemical fertilizers. We cannot get enough food from our fields and must buy from the market. Our food variety is almost lost.

Climate change has also disrupted the Santals’ traditional hunting lifestyle, forcing them into uncertain modern agriculture. As many are sharecroppers without their own land, their ability to produce enough food remains limited, resulting in continued food insecurity. But food insecurity is not merely the result of natural variability but is shaped by structural inequalities such as

limited land rights, dependence on costly irrigation, and market pressures that force families into debt (Robbins, 2019). On another viewpoint like Social Capital theory communal systems reduce resilience. Where collective food-sharing or cooperative farming once provided security, declining social cohesion leaves families more vulnerable (Adger, 2000; Putnam, 2001). The findings reveal that climate change not only reduces agricultural productivity but also erodes traditional food systems and dietary practices. This double burden declining yields and declining food quality directly contributes to malnutrition, especially among women and children who already face nutritional deficiencies. Food insecurity here is not simply an ecological issue but a political and cultural problem, where structural inequalities, weakened social safety nets, and climate stress converge to create persistent health vulnerabilities.

Water Scarcity and Health Hazards

Water is an essential resource for human survival, yet across many regions of Bangladesh, including Santal-inhabited areas, access to safe and sufficient water has become increasingly threatened by climate change, over-extraction of groundwater, and inadequate infrastructure. Nearly two billion people globally still lack access to safe drinking water, with this crisis hitting vulnerable populations especially hard (WHO, 2023). The Bangladesh Water Development Board (2022) reports an alarming annual drop in groundwater levels by about 1–2 meters in the northwestern regions which worsens local water shortages. Supporting this, a UNICEF (2021) study found that around 40% of deep tube wells in some regions become non-functional during the dry season, leaving communities to rely on less reliable and unsafe water sources. As a result, the International Centre for Diarrhoeal Disease Research, Bangladesh (2023) documented a 30% higher incidence of waterborne diseases in these water-scarce areas compared to the national average. For the Santal community, water scarcity is not a recent phenomenon but its severity has grown, deeply affecting daily life and health. Jhumu Murmu (45) described,

Our tube-wells have run dry. Since our land is higher than the neighboring villages, we've always had water shortages—but now it's unbearable. We have to travel from one village to another just to collect drinking water. Even for irrigation, we dig 8–10 feet deep pits to install shallow pumps.

A similar experience was shared by Asha Mardi (42), who explained,

Water scarcity in our Santal community is nothing new, but no real solutions ever come. We often use our own money to dig wells for irrigation, but even then, our household tube wells stop working. We have no choice but to fetch water from faraway places. The challenges extend beyond inconvenience, directly threatening health and economic stability.

Another respondent Onita Kisku (28) added,

Drought is becoming increasingly common as the weather changes. Local ponds dry up completely during severe droughts, leaving us without enough water for bathing, sanitation, or even drinking. The old tube-wells don't provide water anymore because the water layer has fallen so low.

These narratives illustrate how climate change and environmental degradation magnify long-standing water challenges. The combined effect of prolonged droughts, declining groundwater, and unequal distribution of water resources forces Santal women and their families to invest more labor, time, and financial resources to access basic water needs. Beyond the physical hardship, this constant struggle leads to heightened stress and anxiety, especially among women who bear much of the responsibility for fetching and managing water. At the same time, reduced access to safe water worsens hygiene conditions, increases exposure to waterborne illnesses, and contributes to broader health vulnerabilities across the community. Altogether, the worsening water crisis does not only disrupt livelihoods it also endangers the health and dignity of Santal women and their families, highlighting the urgent need for sustainable and equitable water management solutions in climate-affected regions.

Reproductive and Maternal Health Challenges

In the Santal community, climate change has also intensified reproductive and maternal health challenges issues that already raised significant social and cultural attention. Santal Women, who shoulder the dual responsibilities of family care and agricultural work, find their health especially strained by environmental change, economic hardship, and limited access to healthcare services. Prolonged droughts, extreme heat, and irregular rainfall have led to food and water shortages, directly affecting pregnant and lactating Santal women. Insufficient nutrition during pregnancy contributes to weakness, anemia, and higher risks of complications during childbirth. Equally, the physical burden of carrying water from distant sources, often under the scorching sun, adds stress and fatigue during critical stages of pregnancy. In this regard, Shila Murmu (32), a mother of three children, shared,

During my last pregnancy, there was a severe drought. I had to walk far to bring water every day, and I felt dizzy and tired. Even after giving birth, I couldn't eat properly because food was scarce, and I had to start working in the field sooner than I should have.

Her experience illustrates how environmental change directly affects maternal health and postpartum recovery. The Santal women also report an increase in heat-related discomfort and illness during pregnancy. For instance, Purnima Mardi (28) described, *"It becomes so hot that sometimes I feel breathless when working outside. In the past, there were trees for shade, but now they're gone. Pregnant women now often complain of headaches, swelling, and weakness because of the heat."* Beyond physical strain, limited

access to maternal healthcare further worsens these challenges. As many Santal families live in remote areas, reaching healthcare centers especially during floods or heavy rains becomes difficult. Women may delay or miss antenatal check-ups, leading to preventable complications. Climate change has also disrupted traditional support networks. Older women who would traditionally assist during childbirth or offer herbal remedies now face the same health and livelihood challenges, reducing their ability to provide care. Combined with economic hardship, this means families may not afford nutritious foods, rest, or medical treatment during and after pregnancy. Overall, the interplay of environmental stress, poverty, and limited healthcare access magnifies reproductive and maternal health vulnerabilities in the Santal community. Women's narratives reveal how climate change affects not only land and forests but also their own bodies and futures often in silent, overlooked ways. Addressing these challenges requires acknowledging that reproductive and maternal health is inseparably linked to environmental conditions, cultural practices, and socioeconomic stability.

Menstrual Cycle Irregularity

Climate change has indirect yet significant impacts on Santal women's reproductive health, particularly affecting the regularity and comfort of their menstrual cycles. Rising temperatures, water scarcity, increased workload, and chronic stress from food and livelihood insecurity all contribute to disruptions in women's hormonal balance and menstrual health (UN Women, 2014). For Incenses, Lakshmi Rani (35) shared her experience: *"I am having irregular menstruation—sometimes it is delayed, and sometimes I have excessive bleeding. This gets worse especially during the hottest months. Now I have to take birth control pills regularly to keep my menstrual cycle under control."* Her narrative illustrates how climate-induced physical and emotional stress directly affects menstrual health, pushing women to rely on medication they may not have needed before. Similarly, Asha Rani Kisku (32) described, *"...earlier, my menstruation always started at the beginning of the month. Now, sometimes it comes a week late, and other times earlier. During hot weather, doing heavy work makes it worse."* Adding to these voices, Binita Mardi (29) noted, *"When the weather becomes very hot and we have to walk far to bring water or work in the fields, my bleeding becomes heavier. Sometimes, I also feel dizzy and weak during those days."* This illustrates how physical exhaustion and heat exposure can worsen menstrual discomfort and lead to weakness or fainting. Likewise, Jharna Soren (27) shared, *"In our place, water shortage means we cannot wash properly during periods. Sometimes I feel itching and irritation because I cannot change cloth frequently."* Her account highlights how water scarcity, linked to climate change, creates menstrual hygiene challenges, increasing the risk of infections (Sommer et al., 2016). These narratives reveal that extreme heat, increased labor burden, and lack of clean water together make menstrual health harder to manage. Cultural taboos around menstruation often silence discussion,

leaving women to cope alone. Yet for Santal women, menstrual irregularities and hygiene challenges are a deeply personal sign that climate change is affecting not only fields and forests but also their own bodies and dignity.

Mental Health and Psychosocial Stress

Beyond the visible impacts on agriculture, food security, and disease, climate change has deeply affected the mental health and emotional well-being of the Santal women. Among community members, there is a shared belief that declining vegetation, worsening air quality, and unpredictable weather do not just harm physical health, they also bring emotional distress and psychological strain. Sonu Mandi (60) explained how adverse climate affects her daily life, saying, *“When the weather is bad, I become sick and mentally feel unrest. If I go to work with mental disturbance, I get injuries. I have seen many of us suffer from breathing problems, heart issues, and allergies.”* Her words highlight how mental unrest and physical vulnerability often go hand in hand, increasing the likelihood of accidents and further health complications. Similarly, Puthi Maddy (30) shared her observations, *“Adverse weather impacts the health of our men, women, and children, causing diarrhea and allergies because the number of trees has declined, and ponds and water reservoirs have become waterless.”* The shrinking presence of natural spaces—once central to the Santals’ social and cultural life has contributed not only to physical ailments but also to a sense of loss, anxiety, and helplessness. Adding to this, Basanti Soren (35) described, *“When there is no rain for many months and the land cracks, I cannot sleep at night. I keep worrying about how to feed my children and whether they will fall sick. Sometimes, I feel like my heart is heavy all day, and I don’t even feel like cooking or going to the field.”* Her experience illustrates how prolonged drought and fear of harvest failure translate into chronic stress and exhaustion, affecting daily motivation and family life. Likewise, Birsha Murmu (38) shared, *“Earlier, we would sit together under the big trees and talk in the evenings. Now there is no tree, and everyone is busy worrying about water and money. We talk less, and I feel lonely even among my relatives. I feel restless, and small things make me angry or sad.”* This narrative indicates how environmental degradation not only alters physical shelter but also erodes shared cultural spaces that offer emotional support and belonging. Community members, particularly women, speak of living in a constant state of worry—about finding enough food and water, protecting their children from illness, and coping with rising debts caused by repeated crop failures. The stress of having to adapt to these unpredictable challenges, often without external support, contributes to feelings of fear, sadness, and emotional exhaustion. Moreover, the loss of communal gathering places near ponds, fields, or large trees once spaces for storytelling, rest, and laughter has limited opportunities for emotional relief and collective coping, deepening the sense of isolation and psychological strain. In this way, climate change has introduced not only visible disruptions in livelihoods and health but also

hidden emotional and psychosocial burdens. For Santal women, those who carry the responsibility of caring for family members and managing household needs, the strain is especially intense. Their perceptions reveal that mental health challenges often overlooked are an inseparable part of the broader health vulnerabilities resulted from environmental change. These narratives remind us that the impacts of climate change cannot be measured only in economic or physical terms; they must also include the invisible but equally important for mental and emotional well-being.

Emergence of New Diseases

Women members of the Santal community increasingly speak of what they call “new diseases” that have appeared or become more common in recent years, closely linked to changing climate patterns and environmental degradation. While the community was historically familiar with certain seasonal diseases, they now report health problems that were previously rare or unknown, especially affecting women and children (Watts et al., 2018). Women describe how prolonged drought, rising temperatures, and deforestation have made their environment dustier and hotter, leading to a rise in skin infections, heat rash, and allergies. Purnima Saren (31) observed, “...in hot months, many women get itchy rashes, and children have red spots on their skin which we didn’t see before.” Her words reflect both surprise and concern, revealing how climate stressors manifest visibly on the body. Additionally, water scarcity combined with higher temperatures and heavy physical work contributes to more frequent urinary tract infections (UTIs) and related fevers. Koli Murmu (30) shared, “Due to water scarcity, some women complain of burning while urinating and frequent fever...” This highlights how reduced access to clean water directly impacts intimate hygiene, leading to discomfort and additional health risks (UN Women, 2014). They also note an increase in breathing difficulties and coughing, often linked to dusty air when ponds, fields, and village paths dry up under extreme heat. These health issues are compounded by limited access to healthcare facilities and the cost of treatment, which forces many women to endure symptoms or delay care. Research shows that climate change can intensify familiar disease and trigger the emergence of new vector-borne, waterborne, and heat-related illnesses, especially among vulnerable populations lacking healthcare infrastructure (Watts et al., 2018). For marginalized communities like the Santals, these impacts add hidden and unequal burdens, especially on women who balance care work, field labor, and their own health needs. These narratives remind us that the health effects of climate change extend beyond statistics to real, daily struggles in women’s lives illustrating how environmental change silently shapes new and emerging health risks.

Discussion

The impacts of climate change are not felt equally across populations, and gender remains a critical axis of vulnerability. Globally, women are more

susceptible to climate-related risks due to entrenched structural inequalities, socially constructed roles, and unequal access to resources and decision-making power (Lambrou & Nelson, 2010; Nellemann et al., 2011). In many developing regions, including Bangladesh, women are often responsible for managing water, food, and household health tasks that are directly affected by environmental disruption. These gender-specific roles, coupled with limited control over land, property, and finances (Ribeiro & Chaúque, 2010), constrain women's capacity to adapt to climate variability and increase their overall exposure to its health-related consequences. This study explored how climate change is shaping the health of the Santal community, with particular attention to women's experiences. The findings revealed a wide array of interconnected health challenges, including food insecurity, rising water scarcity, increased incidence of infectious diseases, and poor mental health. Santal women reported experiencing menstrual irregularities, fatigue, anxiety, and new or worsening illnesses that they associated with changing weather patterns. These symptoms reflect broader global trends in gendered health vulnerabilities, where women, particularly those from low-income and indigenous communities, experience greater health burdens due to overlapping social and environmental risks (Rudolph et al., 2016; WHO, 2014).

This study reveals that climate change, such as unpredictable rainfall, extended droughts, and hot weather, have disrupted their livelihoods. Because women are heavily involved in both subsistence farming and caregiving responsibilities, they bear a dual burden when climate shocks occur. Their roles in food preparation, water collection, and household health place them on the frontlines of managing environmental risks. These daily pressures not only impact physical health but also increase emotional distress and mental fatigue, especially when coping resources are limited or ineffective. Moreover, existing global research shows that climate-related disasters tend to result in higher mortality rates for women, especially in regions where socio-economic inequality is pronounced (Klyman et al., 2007; Neumayer & Plümper, 2007). In rural communities like those of the Santals, where access to healthcare is already constrained by poverty and geographic isolation, climate change acts as a force multiplier intensifying existing health disparities. The cumulative effects of chronic malnutrition, inadequate sanitation, and limited maternal care increase the vulnerability of women, particularly during pregnancy. Studies indicate that climate-related stress can contribute to adverse birth outcomes such as low birth weight and preterm delivery, leading to long-term consequences for both mothers and children (Sorensen et al., 2018). Additionally, many Santal families still rely on traditional knowledge systems to manage illness and maintain well-being. However, the worsening effects of climate change are beginning to exceed the capacity of these informal strategies. As one participant noted, *"The plants we used to boil for fevers don't work the same anymore... the weather*

changes too much, and we get sick in new ways." This illustrates the growing disconnect between ancestral healing practices and contemporary climate-related health challenges. The findings of this study are consistent with broader evidence that shows how women, particularly in resource-dependent and marginalized settings, are more likely to face long-term health challenges due to the cumulative effects of climate change (Lambrou & Nelson, 2010; Rodenberg, 2009). In rural Bangladesh, where formal healthcare services are often inaccessible or culturally mismatched, the Santal women remain underserved. Overall, this study underscores that climate change is not a distant or abstract issue for Santal women. It is a deeply personal, embodied reality that shapes their health, livelihoods, and daily lives. The intersection of climate stress, gender inequality, and limited healthcare access creates a critical vulnerability that must be addressed through targeted, culturally informed interventions. Recognizing the specific challenges faced by indigenous women, and supporting their adaptive capacities, should be central to any public health or climate resilience strategy in contexts like northern Bangladesh.

Conclusion

This study examined the gendered health risks of climate change among Santal women in northern Bangladesh, revealing how environmental stressors—such as prolonged droughts, extreme heat, irregular rainfall, and floods—intensify food insecurity, malnutrition, reproductive health complications, waterborne and vector-borne diseases, as well as psychosocial distress. The findings underscore that climate change is not merely an ecological challenge but a lived, embodied crisis that disproportionately affects Indigenous women. Traditional coping mechanisms rooted in ecological knowledge are proving increasingly inadequate, while limited healthcare access and social marginalization further exacerbate their vulnerability. Addressing these challenges requires integrating Indigenous perspectives into climate adaptation policies, expanding healthcare services, and ensuring culturally sensitive interventions that prioritize women's needs and voices. This study is qualitative and focused on a specific Santal community in Parbatipur Upazila, which may limit the generalizability of findings to other Indigenous groups or regions. The reliance on self-reported experiences may also be influenced by cultural perceptions of health and illness. Furthermore, the study did not quantitatively measure health outcomes, which could have provided broader statistical insights. Future studies should adopt mixed-method approaches to combine in-depth narratives with quantitative health and climate data. Comparative research across different Indigenous communities in Bangladesh would provide a more holistic picture of climate-related gendered health vulnerabilities. Longitudinal studies are also needed to trace how climate impacts evolve over time and how women's adaptive strategies shift in response. Finally, research that engages directly with policymakers and healthcare providers could help

translate Indigenous women's voices into actionable climate and health policies.

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