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Cultural adaptation in the era of climate change: An ethnographic study on the resilience of indigenous people at Chittagong Hill Tracts area in Bangladesh

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ABSTRACT

Climate change has gained global recognition as one of the most urgent challenges in recent decades. Many indigenous people attempt to overcome great challenges in their lives by adhering to their cultural customs and traditional knowledge. This is especially true for those who live in isolated, hilly places and are dependent on natural resources. The aim of the paper is to critically investigate the cultural facets of indigenous people's adaptation to and resilience to climate change in the Chittagong Hill Tracts (CHT), namely in the Rangamati Sadar sub-districts of the Rangamati districts, in Bangladesh. This paper also examines how cultural components in indigenous community are changing and influencing the adaptation process in adverse situations. This study used a critical ethnography technique in conjunction with participant observation, in-depth interviews (N = 55), and focus group discussions (N = 5, 45 participants) during a one-year period (October 2019 to October 2020). According to the study's findings, climate change-related risks have significant adverse effects on indigenous people. However, they develop their strategies to adjust to the adverse environment, like building different kinds of houses, changing cultural customs, relying less on natural resources, and adhering to their indigenous knowledge. They also strengthen their prayers and ceremonial practices, which reinforce their communal ties and allow them to become more resilient against challenges in their community. The popular belief that Indigenous people are stupid, poor, and helpless while they wait for outside help is challenged by this study. It also refutes the discourse that indigenous strategies and knowledge are not undervalued and can be an effective instrument for the adaptation process and combating hazards.

1. Introduction

Global environmental and climatic change has become an important issue across the world with the rapid change in ecosystems, weather, temperature, precipitation, and so on (IPCC, 2007; IPCC, 2022; Willox et al., 2013). Climate change is considered a multiple threat that exacerbates ecological, social, economic, and environmental challenges across the globe. While climate change is global, its environmental effects are most likely felt by local people or communities (Galappaththi et al., 2020). In recent decades, existing academic and scientific reports have highlighted that climate change exacerbates unparalleled suffering for the poor and marginalized due to the increasing frequency of climatic events such as floods, cyclones, tidal surges, droughts, low rainfall, and so on (Tarhule and Lamb, 2003). It is also seen being concerned about the low capacity of these people to address the severe impacts of climatic hazards in their vicinity (Huda, 2013).

The recent climatic and environmental changes mostly affect indigenous communities because they directly depend on natural resources and agricultural livelihoods, which are diminishing gradually due to climate change (Culas, 2012; Whitfield, 2015). Nevertheless, though indigenous communities are widely known as the most vulnerable to the impact of climatic events, their unique knowledge, skills, and experiences remain largely unused and undervalued to minimize vulnerability and adjust to a new environment (Kodirekkala, 2018). Negligence to local adaptive capacity by Western society and insufficient research about local adaptation to indigenous communities make a disparity in knowledge distribution in coping strategies at the local level (Pasgaard et al., 2015) as developed countries only consider so-called technological and

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engineering preferences as adaptation processes (IPCC et al., 2015).

However, non-technological adaptation, especially local resource-based cultural adaptation by indigenous people, is important for minimizing risks and vulnerabilities (Kodirekkala, 2018; Garai et al., 2022). Indigenous people make great observers of environmental change and its effects because of their acquired and experienced knowledge, therefore they are unlikely to be passive victims of climate change extremities. As they build coping mechanisms to counteract the effects and vulnerabilities of climate hazards, their experiences and connections with this environmental variability, shifts, and trends become an essential part of their daily lives. For this, they utilize their existing local resources, extensive accumulated practical experiences, and cultural and traditional knowledge to develop resilience and adapt to adverse situations (Garai, et al., 2022). Considering this trait, this paper sheds light on cultural aspects of climate change adaptation among indigenous people in the Chittagong Hill Tracts area of Bangladesh. This paper also sheds light on how their traditional culture, indigenous knowledge, and practical experiences help them to develop resilience for adaptig in climatic events.

2. Indigenous communities worldwide: Adaptation to climate change and resilience

Indigenous people have endured many forms of adversity throughout history, and they have attempted to adapt to these hardships in their unique ways by making use of natural resources that are already available and by adhering to their cultural and traditional knowledge in social contexts. There are many studies regarding how mainstream people are adjusting to climate change, but there are surprisingly few about the struggles of indigenous people and how they are doing it. Additionally, indigenous knowledge and local adaption techniques are frequently ignored and underestimated in the dominant discourse. There is a research gap on how indigenous people in Bangladesh and elsewhere might build resilience and adapt to challenging circumstances by utilizing their cultural practices, traditions, and local resources. This study demonstrates how indigenous knowledge, cultural practices, and local initiatives can help an indigenous community build resilience and adapt to hardship. Thus, this study sheds light on the cultural components of indigenous people's response to climate change in CHT.

In this study, resilience is termed “as the capacity of social, economic, and ecosystems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure as well as biodiversity in case of ecosystems while also maintaining the capacity for adaptation, learning, and transformation. Resilience is a positive attribute when it maintains such a capacity for adaptation, learning, and/or transformation” (IPCC, 2022). Similarly, adaptation is demarcated in human systems “as the process of adjustment to actual or expected climate and its effects to moderate harm or take advantage of beneficial opportunities. In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate this” (IPCC, 2022).

In a study, Ford et al. (2020) underlined the fact that indigenous people are subject to environmental change all over the world, making them a group of people who are “at risk” even though many of them build resilience within their communities. This research explored certain factors that impact resilience by looking at the interconnected roles of locations, organizations, group activities, education, and indigenous knowledge that help Indigenous people cope with and adapt to environmental change. These connections are essential because they form the foundation for identities, livelihoods, belief systems, knowledge, resistance, and adaptations to environmental change and vulnerability. The loss of their traditional knowledge bases due to environmental change is another factor putting a lot of indigenous people in threat. These factors include landscape fragmentation, relocation, and land eviction.

Similar to this, Speranza et al. (2010) demonstrated how Kenyan agro-pastoralists use traditional knowledge to detect, minimize, and manage drought. As per the research conducted by Speranza et al. (2010) and Hiwasaki et al. (2014), agropastoralists acquire a fundamental knowledge base that enables them to comprehend metrological forecasts and utilize them for informing their decision-making within the community. Based on their belief that it can be applied successfully, agro-pastoralists employ indigenous knowledge to explain rainfall variability, according to this research. Hiwasaki et al. (2014) employed target interviews and group discussions as techniques for gathering data. Indigenous people learn about the variability of climate change through a lifelong process grounded in their comprehension of local knowledge and resource-use practices. Native Americans employed this traditional ecological knowledge, according to Leonard et al. (2013) and Speranza et al. (2010), to keep an eye on how their community's environment was changing and to cope with challenging situations. According to Leonard et al. (2013), as part of a mixed-methods ethnographic research project, indigenous people collect detailed information about their local environment to monitor their use and management of natural resources and to develop their cultural values, traditions, and worldviews (Leonard et al., 2013; Speranza et al., 2010).

Indigenous people attempt to adapt to climate change-related environmental hazards by continuing to practice their traditional cultural wisdom and techniques over time (Kodirekkala, 2018; Leonard et al., 2013). Kodirekkala (2018) in a study, concentrated on how indigenous people could reduce climatic disasters and adapt to challenging circumstances through cultural adaptation. This study claimed that because of their socio-cultural and economic reliance, Konda Reddis people move from Jeelugu (fishtail) to Tati (Palmyra pal) and rely on traditional knowledge to adapt to climatic extremities (Kodirekkala, 2018). In the past, they have grown a variety of crops to reduce the possibility that certain climatic occurrences will result in crop failure. For survival during crop failure and food crises triggered by climatic disasters like cyclones, droughts, etc., they modify their farming practices and rely on alternative foods like the forest foods known as Jeelugu, from which they extract starch and prepare porridge (Kodirekkala, 2018).

According to Nursey-Bray and Palmer (2018), since indigenous people are the ones most directly impacted by climate change, it is imperative that specialised solutions be developed that are place-based, culturally acceptable, and resilient. Even if it is still challenging to manage climate change in a way that is both culturally and institutionally appropriate, it is crucial to look into the coping strategies needed to assist indigenous-driven adaptation strategies while taking varied cultural barriers into account. According to the findings of Nursey-Bray and Palmer (2018); and Leonard et al. (2013), the process of adaptation for indigenous people depends on their close ties to their traditional lands, as well as their cultural values, historical experiences, group efforts, and a climate governance system that is sensitive to their cultural needs.

Our study provides insight into how the native Chakma people of Bangladesh have adapted culturally to the natural threats caused by climate change. This study also shows that indigenous wisdom and regional adaptation tactics are successful in indigenous communities.

3. Methodology

3.1. Critical ethnography

The current study has been conducted using a critical ethnographic approach. Grounded in critical social theory, critical ethnography aims to change social structure through critical analysis in order to ‘emancipate well-being from the dismal conditions that subjugated them’ (Horkheimer, 1982:244, cited in Savin-Baden and Major, 2012). It consistently highlights the moral duty to combat oppression, inequality, and social injustice for underprivileged populations or groups in society (Denzin, 2001; Thomas, 1993; cited in Madison, 2005). The epistemological approach of this study is grounded in critical social theory, which questions social, political, and other structures in order to produce knowledge that will uphold democratic society and liberate indigenous people from discrimination against mainstreaming Bengali people and

the oppression of natural disasters linked to climate change.

Critical ethnography enables us a reflexive lens to see our power connection with our respondents sensitively and a critical perspective through which to view the experience of indigenous people in their society. As outside academic scholars, we are aware of our uneven subject status relative to the indigenous inhabitants of the area. We always treat locals with modesty, listening to their opinions and honoring their views.

3.2. Study sites

Several field visits were made from October 2019 to March 2020 and June 2020 to October 2020 in the Kutuk Chhari and Sapchhari unions of Rangamati Sadar (sub-district) in Rangamati (district) in Bangladesh for this study (See Fig. 1). This location is among the most susceptible in Bangladesh to natural hazards brought on by climate change. Furthermore, this location is more easygoing and communicative than other hilly parts of CHT. This is why the sub-district of Rangamati Sadar was chosen for this study.

When outside researchers conduct ethnographic fieldwork in a dominant mainstream society and the informants perceive them as such, the task becomes increasingly difficult. As researchers who don't live in indigenous communities, we saw that the majority of Bengali people were excluding indigenous people. We had some difficulties starting our ethnographic fieldwork in the Chittagong Hill Tracts area as a result of this situation. We wanted to interview members of the Chakma community, but we had always wondered how they would take us. Would they believe that we intended to gather data to take advantage of them? Would they acknowledge us as a reliable member of their community and confide in us about their grievances with the Bengali community and climate-related events? Upon entering the indigenous community to carry out our ethnographic study, these were the questions that never left our minds. However, since my student Amlan Chakma, who is from the Chakma community, was with us and helped us build a relationship with the native people, we scarcely faced any challenges throughout the ethnographic fieldwork trip. We procured data from the indigenous population in this manner while doing our ethnographic study.

3.3. Data collection methods

Participant observation was used for data collection in this study. Participant observation helped us gain contextual knowledge about the Chakma indigenous people's experience, their culture, and climate change. We conducted several field visits in CHT during our study periods. Between October 2019 and March 2020, in our first field visit, we conducted 24 weeks of in-field participant observation. During this time, we were involved in reconnaissance, preliminary data collection, and exchanging views with community members to get preliminary data and their feedback on the Chakma community. During the second and last field visit from June 2020 to October 2020, we collected data about the response and adaptation systems of indigenous people to the changing environment in CHT. During this time, we participated in different events of indigenous communities and were involved in different community-based activities to get comprehensive ideas about their response and resilience system to climate change. We also updated our daily field notes during this time to get verified data from participant observation. Field work was divided into two phases, because during the fieldwork COVID-19 was outbroken in Bangladesh like other parts of the world and there was restriction on movement at that time. Moreover, Amphan, a deadly climatic event (cyclone) was taken place in the early of 2020 in Bangladesh that also influenced us to choose this timeframe for fieldwork.

Fifty-five in-depth face-to-face interviews were conducted for this study. Among them, 45 were with indigenous Chakma people, and the rest of the ten interviews were with stakeholders such as NGO workers, volunteers, Headmen, Upazila chairman, and so on in CHT. A criterion-

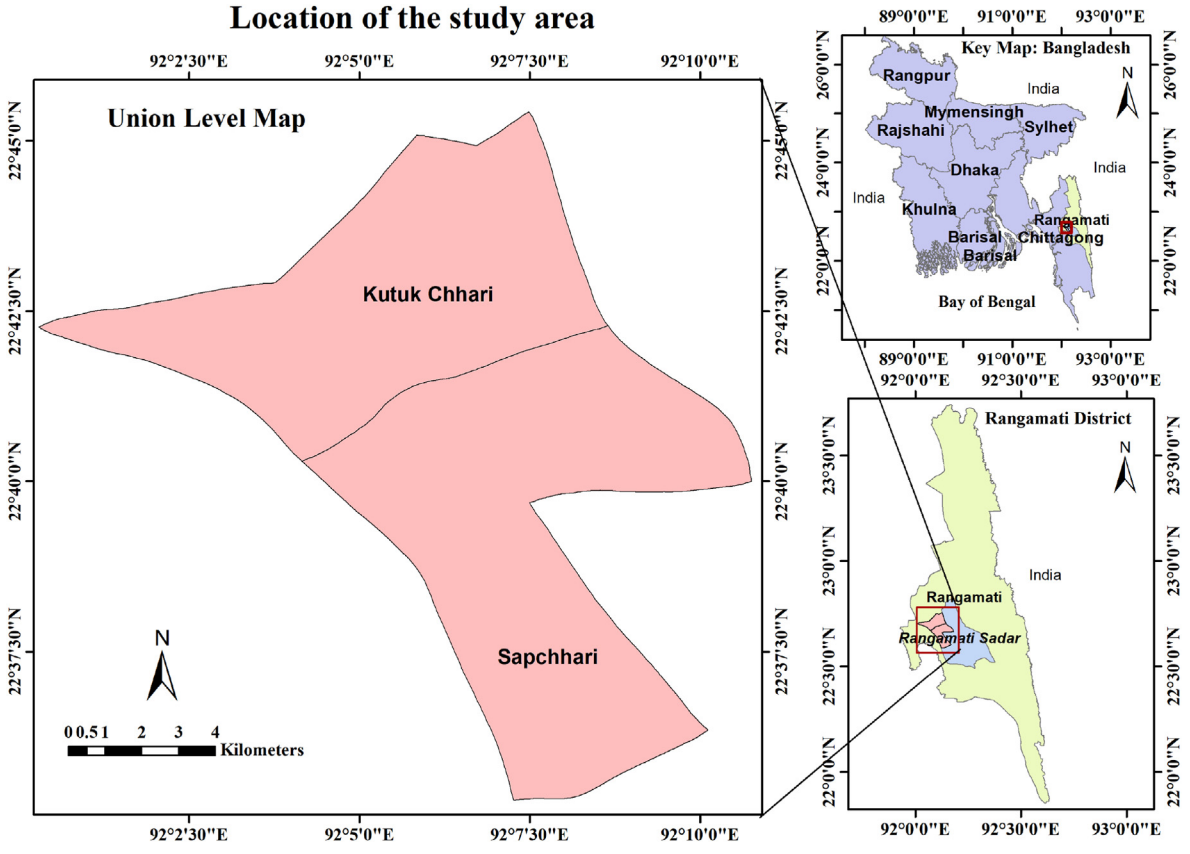

Fig. 1. The study locations in Kutuk Chhari and Sapchhari unions of Rangamati Sadar (sub-district) of Rangamati (district) in Bangladesh.

purposive sampling technique was used for recruiting respondents. A household leader was given priority to do an in-depth interview to avoid redundancy in this study. We made appointments with participants over the phone or by walking in. We continued our interview until saturation when interviewees provided no new relevant data regarding the study (Bowen, 2008). Before beginning our interview, we sought permission from the participants for audio recording, and it took around 30–90 minutes to complete each interview. The interview audio records were later transcribed and given a written form for analysis. The interview questions were open-ended, and they mainly focused on the cultural aspects of climate change adaptation among indigenous Chakma people in CHT. It also highlighted how mainstream culture, apart from climate-induced hazards, influence indigenous people to adjust to a new environment and respond accordingly. The major questions were: What cultural component help indigenous people to adapt and response in climatic events? How mainstream culture influences/dominates indigenous culture and to what extent it affects in the community? How ritualistic practices help indigenous people to develop resilience in the extremity? What type of local strategies people employ to overcome the hazards and develop resilience during climatic events and to what extent local Government/NGOs help people to adapt to the hazardous situation? And what are the indigenous people's suggestions to combat the hazards in the locality etc. The interview questions were pertinent to the topics because it critically evaluated the findings that emerged from the interviews.

Data for this study were gathered through five focus groups (FG). Of them, two FGs included male indigenous people, two more included female indigenous people, and the remaining ones included NGO employees, members, the local chairman, and volunteers. Participants were selected purposively especially those who were knowledgeable and met the criteria of the study. Before the FGs were organized, respondents were formally invited and informed, and they were aware of the objectives, purposes, and conclusions of the study project. Eight to ten individuals from a variety of origins, ages, gender, education and occupations made up each FG. The group discussion was facilitated by a researcher, who was assisted in recording the facts discussed by a research assistant. FGs helped us get verified and authentic data about the response and resilience systems of indigenous people during and after hazards at the Chakma community in CHT.

Among the FG, 38% participants were primary educated and 27% were illiterate in the community. Moreover, around 58% participants were between the age of 31–50 and around 38% were women participants. In FG, participants come from different occupational background such as farmer/jhum cultivators 36%, laborer 18%, small-scale business 9% and so on (see Table 1).

Table 1
Socio-demographic profile of the participants of FG.

Socio-demographic profile of the respondents	N = 45	%
Educational status		
Illiterate	12	26.67
Primary	17	37.78
Secondary	10	22.22
Higher Secondary	4	8.89
Graduate	2	4.44
Age of the respondents		
20–30	5	11.11
31–40	14	31.11
41–50	12	26.67
51–60	8	17.78
61–70	6	13.33
Sex of the respondents		
Men	28	62.22
Women	17	37.78
Occupational status		
Farmer/*Jhum* cultivator	16	35.56
Vegetable/fruit cultivators	6	13.33
Laborer	8	17.78
Forest resource collectors	5	11.11
Small scale business	4	8.89
Housewife/Knitting clothes	4	8.89
Traditional healer	2	4.44

Source: Fieldwork

3.4. Data analysis

A thematic analysis was conducted following the translation and transcription of qualitative data into English. Data were described, analyzed using themes, and interpreted to conduct a thematic analysis (Creswell, 2005). The study's data analysis process began as soon as fieldwork began and lasted all the way through and even after. The primary focus of this research was to identify themes to analyze the data regarding how indigenous people responded to and adjusted to climate change. The created themes and the data interpretation were probably in the early stages. LeCompte and Schensul (2010) noted that this was a circular process in which topics, data interpretations, and data collection were likely to change. As a result, impressions and interpretations were made throughout the investigation. By the time the majority of the data collection is complete, the interpretation may provide a comprehensive picture of the adaptation process of indigenous people (LeCompte and Schensul, 2010). The results were further reinforced by in-depth interviews based on theme analysis and direct quotations.

Participants' anomality and confidentiality were strictly maintained in every step of the study. The Human Subject Ethics Subcommittee (HSESC) of XXX University (or its deputies) has authorized the project (HSESC Reference Number: HSEARS20190826003). To uphold ethical concerns, a system of individual informed consent has been implemented.

4. Results of the study

Over the last few decades, climate change-induced hazards have increased a lot, severely affecting indigenous and marginal people across the globe. It not only affects the subsistence systems (accessing natural resources from the forest) of indigenous people, but also influences the way of life, culture, tradition, and religion of the Chakma people in their community. The frequency and intensity of hazards influence indigenous people to adjust their cultural practices and implement their local knowledge to adapt to adverse situations at CHT. Different types of natural hazards, such as cyclones, floods, landslides, etc., damage houses, crops, and other valuable resources of indigenous people and contribute to creating a vulnerable situation in indigenous communities. However, they try to combat this susceptibility and adapt to the extreme situation through their cultural adaptation process.

4.1. Climate change events and the change of religious practices

The Chakma people worship nature and practice Buddhism. Due to hearing about, understanding, and witnessing different religious rites in the past few decades, as well as the influence of mainstream culture, their religious practices have evolved. The Chakma people celebrate one of their biggest festivals, the *"Biju"* ceremony, annually. '*Full Biju*', or the Springtime festivities, is the first day of the '*Biju*' celebration. *'Biju,'* or *'Mul Biju,'* is the second day, and '*NuyaBojor*', or '*Gojja-Pojja Din*', is the third day. For the indigenous people, these three days are both highly joyful and meaningful. About the Biju festival, one of the participants in interview-5 quoted-

> "Every year we wait for this day, as we can get together on this day, eat delicious foods, wear new dresses and visit relatives' houses" (Participant, Interview-5, Farmer, 25, Kutuk Chhari Union).

Indigenous people prepare various traditional cakes (*Pides*), candies, vegetables, etc. based on their ability and distribute these goods to members of their community as part of this ritual. Curry, or "*Pajon*

Tonne," is one of the dishes prepared on this day. "*Pajon Tonne*" cuisine consists of mixed vegetables and dried fish. The Chakma people believe that they will have fewer illnesses in their lifetimes if they consume the "*Pajon Tonne"* of seven families or households. Their belief gives them the mental fortitude to conquer any issues about their community's physical and mental well-being. On this particular day, they also provide their wine to the guests. Regardless of class, caste, wealth, poverty, age, gender, or youngness, they congregate with each other these days and forget what class they belong to. They will feel extremely fortunate and joyful on this day if they can serve food to others. They invite mainstream individuals as well, sharing their culture and serving them traditional feasts at religious festivals. They can share their culture with them and become close to the mainstream people because of this invitation.

The mainstream Bengali culture has had a significant impact on Chakma cuisine, leading to frequent dietary changes. Bengali dishes like *jilapi, rosogolla, cakes, singara, samucha,* and other products are purchased from the market and served on special occasions. Climate-related natural disasters are the primary cause of this shift in eating habits since they progressively diminish the amount of crops available in the field, which makes it harder for the community to produce its traditional foods. The Chakma community has seen a substantial rise in ceremonial activities as a result of climate menaces. To avoid the threat of hazards, people expand their religious rituals. The Chakma community's religious leader counsels his followers that making use of prayer and religion can shield them from risk and their evil powers.

One of the participants in interview-3 demonsted-

> "I go to the temple every day and pray to God for a peaceful and happy life. I also solicit God to spare our community from dangers. I want God to grant that all living things on Earth are in good health." (Participant, Interview-3, Jhum cultivator, 45, Sapchhari Union).

Indigenous people have a deeper religious belief and build temples in every community for prayer against natural disasters like floods, cyclones, droughts, etc. They visit the temple daily and offer prayers to God for the improvement of their family and community to relieve the burden of dangers and risks. They pray to God and abide by the five tenets of their respective religions, thinking that if they do so, dangers will not hurt them and the evil force that brings about dangers will vanish from their neighborhood. To eradicate superstition from the minds of indigenous people, the religious leader of the Chakma group spreads awareness among the populace.

As natural calamities have increased, the Chakma community's religious practices have not diminished but rather evolved to adapt to the hazardous situation. Human sufferings and mortality rates have been impacted by the growing frequency and intensity of disasters in recent decades. Thus, there has been an increase in the practice of ceremonial activities in those days. People begin to believe that the only way to solve serious hazards and human mortality is through practicing religion and appeasing God and that the rise in sin on a global scale is the root of these issues. Regarding the prayer that there be no threat, one of the participants in FG-3 commented-

> "In the temple, we pray to Buddha for protection from hazards and evil forces, as well as for the prevention of landslides in our community. We also pray for protection from excessive rain, which might cause landslides and flooding. We are powerless to stop dangers from occurring in our neighborhood because they are dictated by the god Buddha. The only thing we can do is ask God to cease the dangers and keep us safe", (Participant, FG-3, Faith healer,39, Kutuk Chhari Union).

4.2. Indigenous knowledge, local wisdom, and the prevention of upcoming hazards

Indigenous people have gathered knowledge throughout history as a result of recognizing various symbols and messages in nature. They notice many natural indications that point to specific environmental phenomena. Indigenous people can predict what will happen to their environment shortly by analyzing these indications. They prepare for the impending climatic calamities based on these indications.

In a fieldwork interview, one of the elderly Chakma in interview-15 told us how to predict impending natural disasters-

> "When it first starts to rain, it is hard to predict how much rain will fall, but once you see the clouds in the sky, you can understand how much rain will fall. If the cloud is moving quickly, a cyclone might form although it might not be very powerful. However, if the cloud moves slowly, there is a high likelihood of cyclone formation, and the cyclone may be powerful"(Participant, Interview-15, Forest resource collectors,65, Sapchhari Union).

A deep understanding of nature is possessed by elderly Chakma people. That way, they can sense that something negative is about to happen to their society if they notice any anomalies in nature. For example, they may believe that hazards could arise in their neighborhood if they notice that birds are chirping and that wild creatures in the forest are acting strangely. Additionally, they believe that a cyclone or landslide may occur in their area if they observe that the wind is coming from the east side of the sky and that there have been days of precipitation. According to elderly people, dense black clouds in the western corner of the sky symbolize the imminent nor' wester (typhoon) of their locality. These indications are extremely beneficial to them because they allow them to minimize potential losses in their community and prepare themselves to encounter or combat risks. Indigenous people have used their ancestors' methods to forecast recurrent hazards throughout history, accounting for local biological and meteorological conditions. By using this strategy, they can counter threats and foster community members' resilience.

To prevent harm and the risk of life during an emergency, people try to stay aware of the reoccurring dangers. Signals/warnings are announced about reoccurring threats from the root-level institutions, such as wards or union councils, and instructions are given regarding what people need to do and where they need to go. People watch and listen to radio and television to be informed about potential dangers. Despite their anxiety and fear at this time, people make preparations to deal with them and find shelter in a secure location.

4.3. Mainstream consumption alters local practices in climatic events and serves as cultural adaptation in the community

Indigenous peoples' traditional ways of existence have changed dramatically over time as a result of both the impact of mainstream culture and the ongoing environmental degradation brought on by human factors like climate change. Western and Bangla cultures are considered to be mainstream in this context. Bangladesh's national culture is known as Bangla culture. Through satellite television, the internet, radio, and other forms of social media, Western culture has an impact on the Chakma people.

Indigenous people traditionally hunt and gather in hills and jungles/forests to survive. This is how they have subsisted for centuries. However, the scope for gathering these resources has shrunk and the supply of these wild foods significantly decreased as a result of climatic events and the progressive destruction of forest resources. Indigenous people have switched from eating traditional cuisine to food from the market to adapt to the changing environment. They used to simply purchase salt and oil from the market, and they could take care of the rest of their daily requirements themselves by either gathering from the forest or making goods in their community. Due to extreme weather brought on by climate change, the tendency has now reversed for lack of raw materials and natural resources. Indigenous people must therefore purchase the majority of their daily household supplies from the market. As a result, the foods of mainstream culture have a big impact on their eating habits. One

of the women participants in FG-2 provided the following evidence regarding their customary eating behavior in changing environment-

> "We consume a variety of meats, including beef, pork, chicken, duck, mutton, and snake. In the jungles, we gather snakes of all kinds, including venomous ones, and we bash their heads. Subsequently, we extract the snake's meat for consumption, burn the snake's skin, and remove its poisons. We typically do not butcher animals for food since it is considered a grave sin in our religion", (Women participant, FG-2, Housewife,36, Sapchhari Union).

Indigenous people prepare a variety of customary cakes, such *Nappi, Sidol*, etc., at their homes during customary events like *Biju*. They prepare various cakes and delicious delicacies, which the community members partake in by visiting various homes. In such instances, indigenous people visit different people's homes on their initiative and take part in the celebrations and feasts without having to extend an invitation. Chakma folks frequently purchase these delectable Bengali delicacies instead of their traditional foods because they are readily available in the market. Having scarcity of the raw materials for making traditional foods due to climatic events is the main cause of taking mainstream foods in the community. Thus, mainstream foods diminish their curiosity about their culture. Many indigenous associations in the area work to prevent the extinction of their customs.

Different restaurants have been constructed for tourists in CHT as a result of the increasing popularity of Chakma cuisine in Chittagong tourist destinations in recent decades. The several traditional cakes, flapjacks, and piede made by indigenous people include *Binipitha (Bini Pide), Sannapitha (Sannya Pide), Bang Pitha, Kola Pitha, and Binikhoga.* These flapjacks are all created from sugar cane molasses, bananas, coconut, and Binni rice, among other ingredients. In recent years, these cakes have been purchased in stores at several Rangamati and Chittagong tourist destinations. When young indigenous people visit the hill tract area, they become less interested in the traditional cakes and more interested in the mainstream cakes and cuisines available. However, some mainstream visitors do find these flapjacks interesting. Additionally, indigenous people prefer Bengali food and become less interested in their traditional foods because it is inexpensive, tasty, and readily available. Making traditional flapjacks in CHT has lost its appeal due to environmental degradation, hazard-related shortages of raw materials and forest resources, and both.

4.4. Adaptation and resilience of indigenous people in climate-induced natural hazards

Indigenous people experienced different climate risks such as cyclones, floods, landslides, thunder storms, drought etc. in their lives and they response to these events and develop resilience in their ways following their cultural practices and knowledge.

In CHT, indigenous people face cyclones every year in addition to other hazards that typically destroy their homes because their structures aren't sturdy enough to withstand the powerful wind of the storms. Therefore, fixing these people's homes after powerful cyclone and flood has become the norm; nevertheless, brick-built homes may not require repairs for many years because they are resistant to harm (see Table 2). About the damage of houses in cyclonic hazards, one of the participants in interview-36 uttered-

> "The folks in our neighborhood are supportive. The headman, my brother, and the neighbors came to my house after the storm wrecked it and fixed it. Wealthy people contributed money to us so we could build the houses. A few individuals gave us bamboo shoots from their bamboo bushes, and others worked for free to fix the house. Our neighbors' assistance enabled us to quickly get over our vulnerability",(Participant, Interview-36, Agro-labor,43,Kutuk Chhari Union).

Table 2
Illustrates various climatic hazards, their effects, and the coping strategies of indigenous people in the present and the past (last 20 years).

Climatic Hazards	Impacts and vulnerabilities	Coping mechanisms and adaptation strategies in the current situation	Adaptation and coping strategies in the past (last 20 years)
Floods	Destroy homes and gardens; Displace kitchenware; Well and tube well inundation; Losses incurred by businesses; Obstacles to mobility;	Adapt to an alternative kind of dwelling structure; Establish a little wall to block floods in front of the door; To prevent flooding, use materials that are resistant to water for the wall; Utilize a higher loft constructed of bamboo to preserve valuable materials Create a 3/4-foot-tall brick wall enclosing the house and a brick floor to protect it from flooding; Build house in the apex of hill to protect flood; Seek shelter at the homes of neighbors, schools, colleges, etc. Create a kitchen on the wooden and bamboo loft above the ground; Safeguard priceless items inside bamboo ceilings or tubes; Move children, the elderly, and the disabled to safe locations; Maintain household assets to the highest possible standard; To overcome vulnerability, accept a loan or relief; To escape a flood, make a raft out of banana trees; Canal excavation to prevent flooding	Take shelter at the top of a hill in the storeroom; Stayed at the home of a neighbor; Preserved household asset to the hilt; Used a mobile cooker to prepare meals Store dry fuels in the storehouse for cooking during days of flooding or precipitation Reduce or skip meals to preserve food. Plough harvests only one time (winter) in a year to get rid of damage Conserve harvests in higher places to prevent loss Construct a home with a flood-proof seal
Cyclones	Destruct houses and crops; Cause injuries to people or death; Livestock losses; Throw away kitchenware; Destruction of trees;	Build homes on a hill's incline to ward off the wind; To shield the house from the wind, plant trees all around it; To prevent trees from flying away, tighten the roof with rope; Cope with an alternate kind of house structure;	The residence's building was constructed low to ward off the strong wind; Rely on the natural/ environmental signs (i.e., actions of animals, and birds) to comprehend the persistent storms as there were no

(*continued on next page*)

Table 2 (*continued*)

Climatic Hazards	Impacts and vulnerabilities	Coping mechanisms and adaptation strategies in the current situation	Adaptation and coping strategies in the past (last 20 years)
		Hang bamboo on the roof to protect it from flying away; Make your home sturdy and brick-built to fend off cyclones; Seek shelter in other homes, schools, or homes made of brick. Pay attention to the radio and TV for weather updates; Use native knowledge to identify potential hazards; Pray to God to escape from hazards	available media at that time. Secure the house with a rope to the large tree from a distance; Villagers helped restore homes destroyed by hurricanes or typhoons, Hiding out in an angle of the house to shelter themselves from the storm's destruction. Unable to get aid or support from the government
Landslides	Damage croplands, filled-in soras and canals, and crumbling homes Human deaths or injuries; cattle losses;	Keep knives, axes, and swords in the house in case of emergency; If the residence is close to hills, relocate to a safe location during heavy rain; Put a halt to hill-cutting and remove stones from the ground; Over the phone, advise the surrounding neighbors to evacuate during landslides; Pray and exercise caution when it's raining a lot;	Landslides are rare because most people live on modest hills or plains; People abandoned the hill during the heavy rain and sought shelter at their neighbors' homes; It is rare to see people make random downhill cuts for housing or other purposes.
Thunderstorms	House collapses; Damage of trees; Fatalities or injuries to humans; Damage electronic appliances & others;	Seek shelter within homes. Take cover in dense jungles or beneath large trees when working in the outdoors; Strive to remain vigilant;	The thunderstorm did not produce enough intensity to instantly kill anybody. It only occurs during rainy seasons, and individuals can avert it by seeking shelter in a house or other secure location; It didn't occur in every season, unlike now.
Drought	Problems with domestic chores; Insufficient water in lowlands and canals; Irrigation difficulties;	Rely on contemporary technologies, such as power tillers, pumps, etc.; Excavate a deep tube well Dig a canal to replenish water; Conserve water; look for freshwater	Depend on rain for irrigation Owing to the high reservation quality of soil, there was water in the canal/ sora even though there was little rain and the summer was very hot.

Table 2 (*continued*)

Climatic Hazards	Impacts and vulnerabilities	Coping mechanisms and adaptation strategies in the current situation	Adaptation and coping strategies in the past (last 20 years)
		sources in hills and canals; To find water in the hills, dig soil;	

Source: Fieldwork

The 'Machang house' is a type of traditional house created by indigenous people in their village. However, because of the greater hazards caused by climate change, this type of house cannot last for long time because powerful wind from cyclones can quickly destroy the bamboo-wooden structure. Consequently, to fortify themselves against adverse events and foster community resilience, people construct brick or semi-brick houses that offer robust protection against natural hazards (see Table 2).

Indigenous people's social integration increases significantly during climate events. Everyone makes an effort to step forward to assist one another and get through any difficulties posed by the hazards. If anybody is unable to plant paddy in their field, others will assist them in doing so. In their community, people also exchange crops, fruits, and vegetables with one another to ease hardship. For example, if an indigenous people get an abundance of crops, he may share some of them with others in return for their products, which were also grown in the same area. When there are floods, people whose homes are submerged seek shelter in their higher-lying neighbors' homes. Until the flood situation improves, those who are impacted remain at neighbors' homes. Affected individuals use their neighbors' homes during this period to meet their daily needs, and the home owner treats them with the utmost courtesy. People in flood-prone areas build bamboo lofts and store important items there to prevent damage since they are aware of how high the water can rise (see Table 2). To illustrate the point, they take up residence in another house without water after storing their refrigerator, rice cooker, gas cylinders, some pricey furniture, and other things in a higher area where water cannot go. They further store some of their valuables, like cash, gold jewelry, and critical documents, in bamboo tubes or on their dwellings' roofs to guard against theft or damage from the water. Indigenous people have a genuine concern for the welfare of their community. To provide their neighbors with a friendly place to get an education and other facilities, they work together to clean the floors of schools, colleges, temples, and other structures after the flood (see Table 2).

About the adaption during the storms and floods, one of the interviewees in interview-7 stated-

> "We sought shelter in a neighbor's house where water could not get in during the flood. Before the water in our house dropped down, we were there for two or three days. We used their kitchen to cook in during this time, bringing our daily utensils, rice, veggies, oil, salt, and other items", (Participants, Interview-7, Farmer, 27, Kutuk Chhari Union).

During the flood, some indigenous people migrate to city or relatives/ friend's house where there do not appear hazards and return to their house when the situation become normal. Indigenous people during flood free their livestock from the sheds as it can take shelter in safest place to survive. They also keep their cows, goats in the top of the hill as these animals cannot get inundated in the water. Along with this, they keep some of their materials such as furniture, clothes, daily materials etc. on the top of hill to protect from flood water. Indigenous people preserve some dry foods for flood time such as puff rice, molasse, fried rice, biscuits, fruits, pure drinking water etc. as they can use it as contingency foods.

Naturally, indigenous people always attempt to find a way around natural hazards. To cope with the unfavorable effects of climate change, they create new concepts. Instead of building typical homes, they attempt to create homes made of brick and cement, which helps shield their home from flood waters. Indigenous people who have money only utilize brick, sand, and cement to build their homes. In addition, the people who have less money construct a two to three-foot-tall fence wall around their home, with a tin wall or fence built above it. When building a fence wall from the ground up, floodwater can harm it in a few years, necessitating its reconstruction. Additionally, they construct a little brick wall in front of the entryway to prevent floodwater from entering the space through the door (see Table 2). Since the lower side of the door cannot allow water to enter, they seal it during floods and place mud underneath it to halt leaks. This technique works incredibly well to keep floodwater out of the space. About this technique, one of the participants in FG-2 stated-

> "Water containing dirts and other wastes seeps into our room during floods. We shut the door to our room during a flood and plug the leak beneath the door with mud to prevent floodwater from getting inside. This prevents the wastes from entering our room. We adopt this technique to avoid the misery of floodwater because our houses are located in low-lying areas and are more vulnerable to flooding"(-Women participants, FG-2, Traditional cloth weaver,32, Sapchhari Union).

Most indigenous people in the past relied on portable ovens for cooking during floods because they lacked contemporary appliances like gas cylinders, stoves, water filters, rice cookers, etc. They cooked/prepared food for the family in this oven while keeping it in an elevated location or up in a bamboo loft. In the storeroom, they also kept fuels like dried tree branches that couldn't get wet in flood or rainwater. In times of flooding or heavy rain, they used these fuels to cook their meals (see Table 2).

Landslides occur in mountainous regions and happen in the blink of an eye, leaving little time to escape the risk. At this point, nothing can be done. To avoid the risk of landslides, particularly during the rainy season, indigenous people who live close to hills take extra precautions. To protect the soil surrounding their home, they plant a variety of wooden trees. Shibu trees are protective against landslides, so they planted them around their house in recent years. To quickly cut through their house's wall or fence and exit the chamber, indigenous people always store blades, axes, knives, and other tools inside (see Table 2). For their closest neighbors to arrive in time to rescue them from the landslides, they also let them know where they are. In this milieu, one of the participants in interview-23 quoted-

> "My son urged me to prepare weapons such as axes, knives, and blades inside the room at night so that, in the event of landslides, we could escape by destroying the room's wall or fence. We prayed to Buddha throughout the night of intense rain and a hurricane, begging him to keep all living things safe and secure among the hazards", (Participants, Interview-23, Jhum Cultivator,56, Kutuk Chhari Union).

Since the indigenous people used to live on plains or tiny hills in the hill tract area, they seldom faced landslides in the past. Furthermore, landslides were extremely uncommon in the past since humans did not stealthily remove hills and did not illegally collect stones from the earth. But, to reduce the risk of landslides after heavy rain, the residents of the hillsides sought shelter in a neighbor's home if they felt that their homes may fall (see Table 2).

Indigenous people suffer significant shortages of drinking water during floods because the soras, or wells, are drowned and rendered worthless as water gathering stations. The tube well is also submerged beneath the floodwater. When there is flooding, they gather rainwater and use banana leaves or tin to keep it safe to drink. During drought, they also use rainwater as drinking water in the community.

In the recent years, the new dimension of climatic hazard is thundering and lightning which were not so severe in the past. In the past, only during raining, thundering and lightning was occurred, but now this has been changed a lot. Sometimes in the sky, there is no clouds but thundering is happening in the locality causing massive damage to both lives and properties. During raining, people can prepared for escaping from thunders, but if thundering is happened without raining, people cannot take preparation to shelter to escape from thunder. However, indigenous people try to remain at home during thundering or take shelter in dense jungle or beneath a large tree to escape from the hazards.

Indigenous people face a variety of climatic risks in their life which may cause whole or partial destruction of their houses/properties. In this instance, they must fix their houses so they may live there, but they are struggling financially. Various banks and NGOs step up to lend money to these impacted individuals so they can fix their residences. One of the interviewees in this context stated-

> "We borrowed $825 from CIBD to fix our property. We must provide evidence of our land or home ownership to receive the loan, and we must make regular payments of $25 to repay the loan within the allotted three years. Paying the NGOs back over three years will cost about $940. In addition, we take out a loan from family members to fix the house and repay them whenever it suits us",(Participant, Interview-21, Small-Scale Businessman,47, Sapchhari Union).

Money and emergency necessities are the most crucial things for indigenous people during and after a disaster. To meet their immediate necessities, Chakma people lend money to family members or apply for loans from NGOs. This loan must be repaid within a year, plus a portion of the interest.

In the community, both men and women fight to sustain the family and overcome economic vulnerability. Considering this context, one of the women particpants in FGD-1 demonstrated the following example: *"My spouse works in the timber business and earns a pay by doing manual labor; I stay at home and knit clothing that I sell in the market for profit. We used to raise animals at home, such as hens, pork, goats, and cows, but we had to sell them in the market to pay off the loan. My spouse tries to use his salary to pay debt installments to alleviate vulnerability, while I attempt to provide for the family by working"(Women participant, FGD-1, Traditional cloth weaver,28, Kutuk Chhari Union)*.

Indigenous people take different training from the NGOs and governmental organizations. These training includes crop productions, fish cultivation, tree plantation, paddy and vegetable plantation, disaster management etc. which help indigenous people especially women to be self-sufficient and develop resilience in the community after climate induced-hazards. Different development organizations provide this training to the indigenous women without taking any money. Moreover, agriculture officers sometimes instruct indigenous farmers to cultivate hazards-tolerated crops to minimize the losses and develop resilience in the community.

Every words/mouza in indigenous community has a headman and karbary who are selected by DC (District Commissioner) and the following headman and karbary are selected by lineage. If anyone refuges to take the post of his/her father or brother then election may be held to select the new leader. Three members work under the instruction of headman such as karbery, village police, and members. Headman and karbary are given training on different issues in the DC office and instructed to solve different problems in their community. Headman and karbery help indigenous people by giving suggestions, even by money/relief to combat climate related challenges and develop resilience in the community.

5. Discussion

Being living in remote areas and depending solely on natural resources for subsistence, indigenous people envisage unprecedented

suffering due to climate change-induced natural hazards. However, they try to adapt to this adversity in their ways and develop resilience to overcome it. The local government of CHT is indifferent to the adversity that indigenous people experience from climate change-induced hazards. They do not arrange any alternative working opportunities in CHT that indigenous people need to maintain their subsistence. Even during emergency periods, they cannot get contingency support such as food, pure drinking water, primary medicine, or even psychological support from the government. Consequently, indigenous people work collectively, help each other, to combat hazards and develop resilience to survive in climatic events.Through cultural adaptation and resilience, this study aims to understand indigenous people's coping mechanisms under climate change-induced hazards. The study's conclusions show that the Chakma people celebrate "Biju," one of their biggest festivals, following Buddhism's belief in and worship of nature as God. Full Biju, or the Springtime celebration, is the name of the first day of the Biju celebration. Biju is the name of the second day, and Nuya Bojor, or Gojja-Pojja, is the name of the third day (Dawan, 2018:158; Kanungo, 2018: 191). As they celebrate the day together, the indigenous people have tremendous communal feelings as a result of this sacred gathering. Regardless of class, caste, wealth, poverty, age, gender, or anything else, young Chakma people assemble to celebrate the day, greet and acknowledge the elders, feed animals varied meals, and attempt to forget what class they belong to. This sacred gathering strengthen their resilience capacity to combat hazards in their community. Today people consume "Pajon Tonne," a type of mixed cuisine, in the hope that if they could eat seven families of "Pajon Tonne," they would have fewer illnesses throughout their lifetimes (Dawan, 2018: 158; Kanungo, 2018: 191). The deep ties among indigenous people enable them to decide as a group on any matter. In addition to practicing Buddhism, they revere nature, and to do this, they all come together and select a location, a large tree, or a large stone to worship God. Following the ceremonies, they typically have a glass of wine and engage in group singing and dancing, which strengthens social cohesion. Together, these ritualistic practices and the classless bonds that grow between individuals from diverse backgrounds create a solid foundation that helps the community's most vulnerable members weather hazardous circumstances.

The study's findings show that indigenous people's ceremonial practices have expanded significantly as a result of threats brought on by the climate change. People hold the view that risks are rising as a result of the expansion of evil activities in the cosmos and that this issue can only be resolved by engaging in ceremonial activities and appeasing God (Leonard et al., 2013**).** In recent years, people have increased their religious activities and prayers in the hope that doing so will relieve their stress related to dangers and threats and improve their families and communities (Leonard et al., 2013). Indigenous people have become more involved in ceremonial activities in recent decades as a result of the frequency and severity of natural calamities in CHT, as they have few other options to deal with their difficulties. The local authority is unable to take any actions to help these helpless people when an emergency arises. Additionally, official funds and relief efforts frequently fail to reach the impacted populations due to corruption and conflict of interest. The government needs to keep a close eye on these problems to help this group overcome its susceptibility.

At the local level of the indigenous community, the official warning and forecast system of recurring hazards is not functioning correctly. Indigenous people frequently do not understand their dos and don'ts in an emergency. Indigenous people can recognize reoccurring dangers by observing natural symbols and indications. It is possible for older individuals, in particular, to understand what happens when they watch animals and other natural creatures in movement (Petheram et al., 2010:686). By examining the characteristics of clouds and winds, indigenous people can recognize recurring risks and make adequate preparations to deal with them. In the sky, cyclones can form if clouds move swiftly, but they can also form aggressively if clouds move slowly, according to Speranza et al. (2010), Luseno et al. (2003) and Garai (2017). But if the cloud seems dense, black, and moving slowly, then heavy rain is probable. Indigenous people try to prepare for potential natural hazards by observing anomalous behaviors in wildlife and specific noises made by birds and other wild creatures in the forest (Speranza et al., 2010: 305).

Extreme weather events brought on by climate change have significantly reduced the forest's supplies. Indigenous people must therefore look for alternate employment to support themselves. They used to work for a short period and enjoy their free time because there were plenty of foods to be found in the hills and forests, but now they are unable to do that owing to a lack of resources (Jacob et al., 2010: 871; Ahmed and Haq, 2019: 679). Aside from the natural disasters brought on by climate change, people from the outside frequently enter forests and cut down trees and hills without regard for other species, causing a shortage of resources and unsustainable growths of resources in the forest. To conserve the forest and natural resources in CHT, the government should create an effective policy and aggressively enforce it. Before implementing any policy, local interests should be taken into account because it is frequently discovered that such policies are detrimental to indigenous people (Roy, 2000). Getting the opinions of the indigenous people could be quite important in this situation. Indigenous people are forced to alter their eating habits as well because the hills and forests do not have their customary foods. Additionally, in recent years, young people's interest in outside cuisines has grown among the community. A further factor that contributes to the decline of using their traditional meals in the culture is the current over-dependence on market-based mainstream foods caused by limited access to forest resources owing to climate change.

The results of the study also show that they modify their traditional homes to build brick dwellings as a defense against cyclones and floods. The magnitude of hazards prevents traditional indigenous dwellings from lasting very long. When there are natural disasters, the government ought to take action to protect indigenous peoples' traditional homes. To shield their priceless goods from floodwater damage, the indigenous Chakma people construct temporary bamboo lofts inside their homes. Certain dry foods, such as puffed rice, molasses, fried rice, biscuits, fruits, pure drinking water, etc., are preserved by indigenous people for usage in times of climate-related disaster. Because in times of disaster, official aid usually falls short of those who are most in need. Indigenous people occasionally store priceless items like cash, gold, jewelry, and important documents inside bamboo tubes that they keep inside the ceiling for security (Garai, 2017). The residents of Chakma are extremely cautious when it comes to landslides, particularly those who live near hills and experience prolonged periods of severe rain. Additionally, they always have swords, axes, knives, and other weapons within the area, so they can quickly hack through their house's wall or fence and flee from the space in the event of a landslip. Their location is also relayed by phone to the neighbors in case of an emergency, so they can evacuate. To minimize the danger of landslides, some people choose to spend that time at the homes of their neighbors.

This study focuses on the cultural aspects of climate change adaptation among Chakma people in CHT. This paper also highlighted how mountainous Chakma people develop resilience through their traditional practices and overcome hazards. This study only focuses on the cultural and traditional aspects of hilly people's adaptation processes, but the cultures of indigenous people of plain land are not explored. So, in the future, further study can be conducted to explore the adaptation process of indigenous people in plain land. Moreover, this study cannot focus on the gender aspects of climate change adaptation among hilly indigenous people, so in the future, studies can be conducted on converging gender aspects of climate change adaptation.

6. Conclusion

Bangladesh is a multicultural and ethnically diverse nation that is home to over 54 indigenous groups. Indigenous people make up around

1.8% of Bangladesh's overall population, according to the 2011 Census. Indigenous peoples provide a substantial contribution to the country's history, culture, environment, and sustainable development through their distinctive languages, traditional cultures, foods, and practices (Roy and Chakma 2015). Their fundamental rights—both as an individual and as a group—are routinely abused, even though their contributions are frequently ignored or undervalued (Chowdhury 2014). The traditional way of life of the indigenous people in CHT is greatly impacted by the environmental degradation caused by anthropogenic and climate-induced hazards; nonetheless, they overcome this hardship in their ways and adapt to difficult situations. For this they try to adjust to the hazardous environment, by changing cultural practices, altering housing structure, even integrating the communal bondages by increasing ritualistic practices and adhering to their indigenous knowledge and customs.

This research adds to the body of evidence demonstrating that indigenous people are proactive contributors to modernization, capable of addressing a wide range of issues resulting from natural disasters caused, for instance, by climate change. They have effective coping mechanisms thanks to their extensive life experience, local knowledge, and customary behaviors. Additionally, their cooperation, assistance, and united efforts enable them to overcome their susceptibility and build resilience, so they can adjust to challenging circumstances.

This study can help governments and policymakers understand how effective indigenous knowledge and local strategies are at preventing climate-related natural disasters. Indigenous practices can be mainstreamed into policy to develop efficient ways to mitigate climate-related hazards and build resilience for climate change adaptation in Bangladesh's local community and beyond.

Data availability

Data set will be provided based on request.

CRediT authorship contribution statement

Joydeb Garai: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Hok Bun Ku:** Supervision.

Declaration of competing interest

Authors have no conflict of interest to this manuscript.

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