

Climate change and cultural responses of indigenous people: A case from Bangladesh

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ABSTRACT

In recent decades, climate change has become a great concern all over the world and indigenous people especially those who live in remote area and depend on natural resources are most vulnerable to this extremity. This research project is an attempt to find out the key indicators of cultural responses of indigenous people for adaption in climate change extremity. For conducting this study, 25 in-depth interviews were adopted by employing semi-structured and open-ended questionnaire to indigenous people in Rangamati sadar of Rangamati district in Bangladesh. The findings of the study indicate that indigenous people have idea about climate change and they get this idea from different media i.e., television, FM radio, local newspaper, peer groups etc. and blame developed countries for the causes of climate change events. The findings also indicate that for adapting to climate change, local people develop their own strategies, like planting trees surrounding their houses, performing religious activity, rendering mutual help to each other, taking relief or financial support from others for investment, applying indigenous technology, changing occupations etc. in their community. Very few empirical studies were conducted on cultural adaption of indigenous people in climate change, so this project findings can help policy makers as well as government to formulate policy to uplift this community in near future.

1. Introduction

Over the last few decades, climate change problem has become a great concern across the globe and a strongly felt imperative is to find a speedy and sustainable solution to overcome it (Kodirekkala, 2018). In many places of the world, climate change is now commonly occurred. From different scientific documents and reports, it is found that the world temperature and rainfalls are gradually changing, consequently increase the frequency and intensity of different climatic events i.e., floods, droughts, cyclone, etc. which severely affects to the subsistence, culture and health of human beings in the planet (Barnett, 2003; IPCC, 2007). In the developing countries, the gradual increase of diverse effects of climate change contribute to create a great threat in the twenty-first century. Moreover, the global climate change is to be continued and the intensity and frequency of extreme weather events also seem to be increased in future (IPCC, 2007). However, the concern is on rise that many developing countries, like Bangladesh faces acute scarcity in terms of financial, technical, and institutional capacity to tackle or minimize the adverse impacts of climate change (Ahmed and Haq, 2019; Beg et al., 2002; Bewket, 2012). In Bangladesh, indigenous people especially those

who live in remote area as well as in Hill tracts area face severe vulnerability in climate change extremity. This impacts severely on their lives and communities are generally anticipated due to their location in vulnerable and fragile environments, including small islands, high altitude considers margins and mountain based poor communication system. Indeed, indigenous and marginalized people directly exposed contiguous climate change extremity due to their continuing reliance upon resource-based livelihoods (IPMPCC, 2011).

However, Indigenous and marginalized people, are not likely the passive victim of climate change extremity but their accumulated and experienced knowledge make them excellent observers of environmental change and its impacts. Experiences and connection with this environmental variability, shifts and trends are integral part of their ways of life (IPMPCC, 2011). Indigenous people follow various coping strategies to overcome the impacts of climate change. Though they do not have much knowledge about the effects of climate change specifically, they do have extensive accumulated practical experiences adapting to environmental change. These practical experiences contribute to help them mitigating their vulnerability to the impacts of climate change and better survive in an increasingly adverse

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environment (Ahmed and Haq, 2019).

In recent year, there is a widely discussed opinion among the researchers/scientists that bottom-up approach of disaster management is more effective than top-down approach (Garai, 2017). This study is an attempt to find out the key indicators of cultural responses for adaptation of indigenous people that can help policy makers and government-driven developer to formulate policy and implement upon climate induced hazards prone area. Therefore, this research project shed light on cultural responses for adaptation of indigenous people in eastern part of Bangladesh.

2. Climate change and indigenous people in the perspectives of Bangladesh and the world

This study defines the term “indigenous people” a group who have a special connection with the natural environment and who are often seen as the ‘first people’ to inhabit a particular territory. For example, Munda community in mangrove forest of Bangladesh and Sami of the Arctic.

Different scholars around the world see the relationship between climate change and indigenous people’s livelihoods in different ways. Ferdous (2011), and Pender (2014), in their studies demonstrated about the inspection and perception of climate change impacts on livelihoods of native indigenous people residing in Bangladesh. Ferdous (2011) in her study findings highlighted that more than half of the respondents perceived that weather condition is changing, temperature is soaring up, rainfall patterns and other climatic condition is changings in that site which extremely affect their crops growth, food security, biodiversity and their livelihoods as well (Ferdous, 2011; Pender, 2014).

Similarly, Ahmed and Haq, (2019), in their studies demonstrated about the understandings of indigenous people in Bangladesh regarding the effects and causes of climate change and their knowledge level to manage forest resources and different coping strategies, they adopted in climate change extremity. Studying on two indigenous communities namely, Khasia and Tripura, this project delineates that indigenous communities have different believe about the perception of climate change and they use different strategies for coping with the environment following their believe and practices. The strength of this study is that it delineates how indigenous people can cope with the environment by using forest resources in their locality (Ahmed and Haq, 2019).

The capacity of indigenous people coping with climate change is also demonstrated by Speranza et al. (2010) that agro-pastoralists in Kenya use indigenous knowledge to monitor, minimize and cope to drought. Agro-pastoralists form a basic knowledge frame to interpret metrological forecast for their decision making in the locality. For example, agro-pastoralists use indigenous knowledge as exponent of rainfall variability and they rely on indigenous knowledge as they believe the effectiveness of its usage (Speranza et al., 2010; Hiwasaki et al., 2014). Through the life long process, indigenous people develop their traditional knowledge about climate change variability, and perception and based on their locally perceived knowledge and practices of resources use. Indigenous people use this traditional ecological knowledge for adaptation to adverse situation and to monitor the changing environment of their community (Leonard et al., 2013; Speranza et al., 2010). This view has been proved by Leonard and others. Their study argued that indigenous people capture the detailed information about their local environment to monitor their natural resource usage and management and develop their own cultural values, tradition and worldviews with this knowledge. Along with resource management, this indigenous knowledge - Miriwoong traditional ecological knowledge also used for natural hazards management and preparation for adaptation in their community (Leonard et al., 2013). Like other Australian aboriginal community, Miriwoong people follow different strategies to adapt with climatic events such as sharing resources among group, migration, fire management, and practicing harvesting etc.

Throughout history, indigenous people can adapt to climate change extremity and overcome vulnerability through their cultural adaptation

procedure (Kodirekkala, 2018; Leonard et al., 2013). Many researchers like Kodirekkala (2018), demonstrated in a study that climate change affects indigenous people and through cultural adaptation especially using cultural components, indigenous people response to these impacts in their locality. He asserted that Konda Reddis people shift from Jee-lugu (fishtail) to tati (Palmyra pal) for their socio-cultural and economic dependence and follow traditional knowledge for their adaption in climate change events (Kodirekkala, 2018). The author claimed that mainstream discourse undervalued the local knowledge, and undermine the vulnerability of indigenous people but indigenous people can adapt to climate change extremity through cultural adaptation. The study indicated that Konda Reddis indigenous people have deep knowledge about local environment that influence them for effective adaptive capacity by overcoming climate change risk. Traditionally, they grow various types of crops for the purpose of minimizing the risk of crop failure caused by various climatic events. During the harvest failure and food crisis due to climatic events i.e., cyclone, drought etc. they change their cultivation methods and rely on alternative foods i.e., the forest, foods - Jeelugu, from which they extract starch and prepare porridge for their survival (Kodirekkala, 2018). In short, archaeological, anthological and historical evidences have proved that indigenous community possess absolute level of resilience and adjustment to environmental change and inconstancy (Leonard et al., 2013; Speranza et al., 2010).

For helping indigenous people in coping with climate change, it is important to establish a link between indigenous/local knowledge and science and technology before implementing it in disaster mitigation, preparedness and climate change adaptation. In order to do this, a diverse group of people such as scientists, community experts, practitioners, policy makers etc. work together by undertaking observation, validation and documentation of local and indigenous knowledge which are then recruited for integration with science. This integrated knowledge makes indigenous community to enhance their capability for resilience and adaptation against the impacts of climate change extremity (Hiwasaki et al., 2014). Similarly, the resilience of a community can be developed in climate change extremity by implementing updated, innovative and old technology and knowledge combinedly (Ellen, 2007). Moreover, it is widely recognized throughout the world that the collaboration and integration of tribal and local knowledge with technology and science can contribute to make an effective strategy to combat climate change induced hazards (Mercer et al., 2010; Mercer et al., 2009) and climate change resilience and adaptation strategies (Armitage et al., 2011; Speranza et al., 2010). Along with local knowledge, the latest technology and scientific assessment, can provide indigenous community and policy makers a comprehensive knowledge that can enable them to make resilience and adaptation in climate change extremity. Walshe and Nunn (2012), delineated the significance of indigenous knowledge and scientific knowledge as it played a great role in evacuating villagers for the survival in the 1999 tsunami in Vanuatu and in the Solomon Islands in 2007 respectively.

Similarly, Nursey-Bray (2018), remind us culturally appropriate and place-based developing tailored solution is necessary for the resilience and development of indigenous people. Though culturally and institutionally fit value-based climate change management still challenging but this study tries to explore the coping mechanisms that are needed to help indigenous driven adaptation initiatives if different cultural barriers are accounted. This study indicated that the adaptation procedure of indigenous people depends on close connection to traditional land together with cultural values, historical experiences, collective action and culturally responsive climate governance of that particular area (Nursey-Bray, 2018; Kodirekkala, 2018).

Though capacity of indigenous people coping with climate change and environmental crisis has been recognized, some factors such as poverty, insufficient natural resources, and inadequate preparedness impact on drought and contribute to limit their adaptive capacity in that particular area. For example, in some studies, factors that hamper the adaptation procedure of agro-pastoralist and suggest solution for

implementing indigenous knowledge-based forecasts on their decision-making patterns have been clearly identified (Hiwasaki et al., 2014; Speranza et al., 2010).

Climate change has a close relation with the socio-demographic aspects of indigenous people such as age, education, gender, and occupation of a particular community. A study conducted by Huda (2012), delineated that climate change susceptibility and perception influence socio-demographic aspects of a particular indigenous community such as age, gender, occupation, mass media, amount of land, education, income level and so on. Following the interview method, this study explored that indigenous people perceive that climate is changing over the years. The study further argued that age, education, occupation, availability of mass media, income level etc. are significantly associated to the understanding of climate change as well as climatic hazards. Moreover, education was found the best predictor of climate change perception of that particular area.

For the conservation and management of global ecosystems, indigenous knowledge as well as indigenous people are widely encouraged to include in management system (Ens et al., 2015; Hiwasaki et al., 2014; Speranza et al., 2010). In this context, Ens et al., (2015) pinpointed that some colonized countries such as USA, New Zealand and Australia are taking some programs for involving this people in the management system but referred it as challenging for setting up the priority and preference of management procedure of indigenous and non-indigenous people in balanced way. Researcher used Australia as a case study site and examined the previous documentations about using Indigenous Biocultural Knowledge (IBK) and measured their significance to ecosystem management. The findings of the study indicated that indigenous IBK has great contribution to biological and ecological conservation that might include fire management, endangering fauna and rights of water and planning. The core strength of the study is that it focused the significant of IBK that can not only help to the ecosystem management but also protect indigenous people from the severe effects of climate change and keep them close to nature (Ens et al. (2015).

Indigenous people faced substantial risk and uncertainty to their health because of the impacts of climate change and extremity (Ford et al., 2018). Community Based Adaptation (CBA), a new coming top-level approach need to be employed for research process to formulate health policy and managing the risk of this vulnerable and marginal community. Through the incorporation of practical knowledge of interdisciplinary and the multi-national tribal health adaptation to climatic events, researchers can evaluate the strength, difficulty and potentiality of health-related CBA study in the local setting of indigenous community. CBA is an approach that can help to co-generate knowledge about the vulnerability of health due to climate change, resilience, and adaptation procedures, capacity building and decision making (Ford et al., 2018). Similarly, Flynn et al. (2018), highlighted about the Participatory Scenario Planning (PSP) approach for studying climate change impacts, vulnerability and adaptation of indigenous community. Using systematic review as a method and reviewing more than 43 peer review and grey literature revealed that only half of the reviewed studies utilize climate projection and community participations are different, raising the concern that the key future drivers of climate change are not fully accumulated. For conducting PSP, it is often found as challenging to engage community members intensively in the climate change adaptation process and resiliency. Local indigenous cultures, values, and belief system need to carefully consider to take preparation for overcoming the future climate impacts and making resilience of indigenous community (Flynn et al., 2018).

Schramm et al. (2020) revealed that climate change affects severely to the health of indigenous people together with impacting on their way of life, practices, self-determination, and physical and cultural health which make them uniquely vulnerable to climatic hazards. However, indigenous people to overcome this vulnerability and adapt to the climatic events develop innovative health-related adaptation procedure using their existing traditional knowledge and local approaches. This

study applies two projects namely “Tribal psychosocial climate resilience framework” and “Swinomish’s modified I-BRACE framework” to help indigenous community to encompass their local practices and traditional knowledge into climate change adaptation work. The first framework supports indigenous people especially Pala and other tribal people to secure their traditional well-being in climate change impact and vulnerabilities. This framework puts emphasize on connectedness, hope, security, and self-efficacy for strengthening psychosocial resilience and support indigenous people for adaptation based on their values, knowledge, and traditional practices. Another model follows BRACE framework to create I-BRACE, encompassing the concept of health of indigenous people. For enhancing the applicability and attention to equity, this framework incorporates indigenous value-based data and analysis that for decision making.

Ford et al. (2020) highlighted in their study that throughout the world indigenous people exposed environmental change that make them as “at risk” group among human kind in the world though many of them develop resilience in their community. This study investigates some factors that affect resilience by analyzing interconnected roles of place, institutions, collective action, learning and indigenous knowledge that help indigenous people to cope and adapt to environmental change. These interconnections are important because it make the foundation for belief systems, knowledge, identity, livelihoods, resistance and response to the vulnerability of environmental change. Moreover, many indigenous people also face vulnerability due to land dispossession, resettlement and landscape fragmentation that challenged their persistence knowledge systems due to environmental change.

Considering the existing literature, it can be said that throughout the world indigenous people are at ‘high risk’ group to climate change extremities but they try to adapt to this adversity in their own ways.

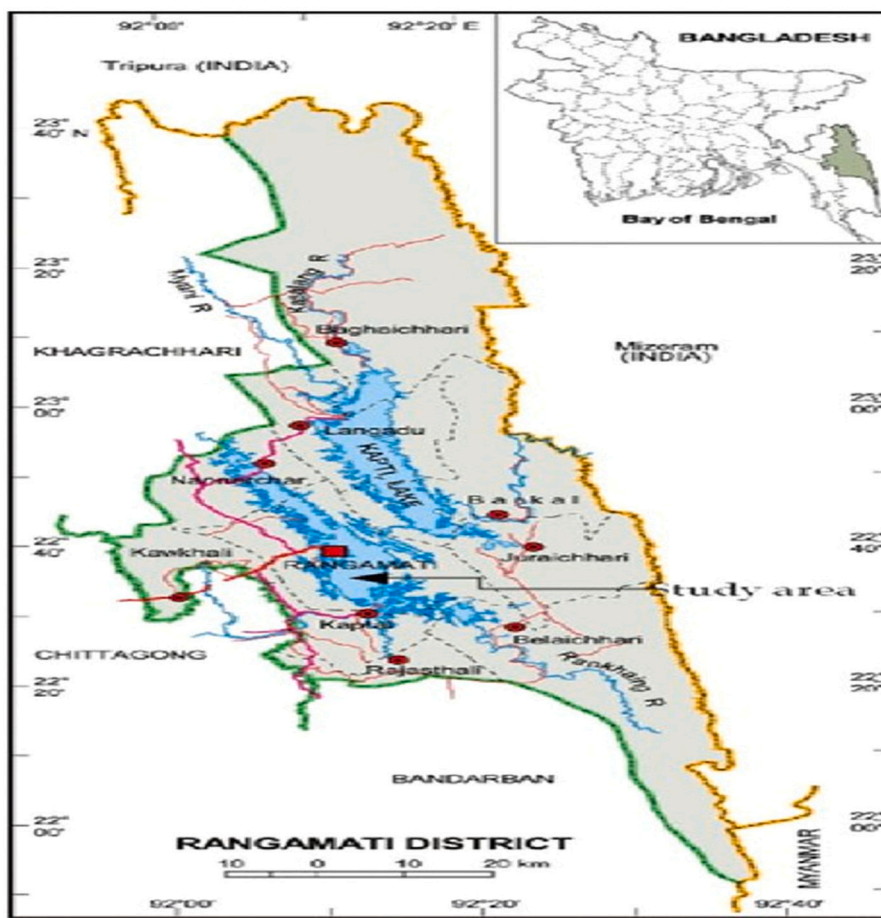
3. Methodology

This study is qualitative in nature. For conducting this study in-depth interview was adopted for data collection. This study was directed in Rangamati Sadar upazila (sub-district) of Rangamati district in Bangladesh. The logic of choosing this site as study area was that it is one of the severely affected climate change areas in Bangladesh. Moreover, about (52%) indigenous people are living in this district (Rangamati district portal, 2009) and majority of them largely depend on natural resources for their livelihood which is depleting day by day due to climate change extremity.

This study was directed following two field visits that were the time periods of November–December 2018 and October–November 2019, taking the sample 25 pursuing theoretical saturation process. This in-depth interview followed a semi-structured and open-ended questionnaire for data collection using purposive sampling. Chakma indigenous people aged (15–70) was the unit of this study.

The epistemological position of this study is “Constructivism” which is based upon the principle that reality is a product of one’s own creation, and constructivism demonstrates that all knowledge is a compilation of human-made constructions (Savin-Baden and Major, 2013). In this study, it is simulated that indigenous people construct knowledge and meaning through their experiences and interaction of living of that particular community.

Qualitative data analysis follows an iterative process of data collection as well as data analysis. These two processes almost continued simultaneously (Hesse-Biber and Leavy, 2011). For analyzing data, content analysis was employed in the study. First of all, I identify and naming the concepts derived from the in-depth interview through reading and rereading the transcript getting from the respondent. The emergence themes then verified with the respondent to ensure the accuracy and authenticity of the categories and coding. And then this category and index help for context analysis for making sense and matching with the findings and theory (See Map 1).



Map 1. Shows the study area of the research project. Source: [researchgate.net](https://www.researchgate.net)

4. Result of the study

4.1. Socio-economic profiles of indigenous people at Chakma community in CHT

Indigenous people in CHT largely depend on forest resources for their subsistence along with doing agricultural activities both in hills and plain land. Most of the indigenous people in the study area live on hand to mouth as half of the peoples' (52%) average monthly income is below 10,000 BDT and 40% people's income is below 20,000 BDT (see Table 1). A large portion of the people need to spent almost all the money they earned in a month even sometimes need to lend money from relatives for meeting the demand of their family. Living in remote area and having limited job opportunity in the study area, collecting forest resources and cultivating in the hill are the only main source of income to this people as approximately 28% people work as farmer in hill tracts area and around 24% indigenous people work as laborer in agriculture land. However, some indigenous women knit traditional dress, *pennon*, *khadi*, bags, etc. and sell that at local market for income as 32% respondents claimed this. Women also help their husbands in agriculture land, along with playing the role of housewife in the family. Some indigenous people also do small scale business for maintaining their family. Literacy rate in indigenous community is moderate as except some illiterate people (36%), most of the people get primary and secondary education (52%) and some of them complete higher education. Among the respondents in the study area 52% were women and 88% were married (see Table 1). All of the Chakma indigenous people in the study area believe in Buddhism.

4.2. Climate change and cultural response of indigenous people in climate change adaptation

Indigenous people depend on natural resources for their livelihoods. They perceive climate change in their own way and apply traditional strategies to adapt in adversity. Indigenous people possess distinct culture and they use different components of this culture for adaptation in climate change extremity.

4.3. Indigenous people's perception about climate change, its causes and impacts

In Chittagong Hill Tract (CHT) area, indigenous people possess their unique knowledge about climate change. They gather this knowledge through their life long experiences. However, the young generation of indigenous community possesses different views about climate change, its causes and consequences as they are starting to get formal education from the state. About the knowledge of climate change, one of the interviewees quotes -

"We have knowledge about climate change. Changing weather condition i. e., less rain in rainy season for cultivation, excessive heat in summer, excessive thundering and lighting, and frequently occurring of cyclone are the symptoms of climate change. We know the enormous pollution of the environment is the most significant cause of the change of climate. Climate is changing mostly for the greenhouse effects. We learn about climate change from globalization and it is happening locally and also observed globally".

After analyzing participants' response, it is found that indigenous people know about climate change and it is changing both locally and globally. About climate change one of the respondents quotes that- *"We cannot feel cold in winter and cannot find rainwater in rainy season as it*

Table 1
Shows the socio-economic profile of indigenous people in the study area.

Socio-economic profiles	N = 25	%
Educational status		
Illiterate	9	36
Primary	7	28
Secondary	6	24
Higher Secondary	1	4
Graduate	1	4
Post-graduate	1	4
Sex		
Men	12	48
Women	13	52
Marital status		
Married	22	88
Unmarried	2	8
Widow	1	4
Occupational status		
Farmer/Jhum cultivator	7	28
Agro-labor	6	24
Govt. Job	1	4
Teacher	1	4
Businessman	1	4
Housewife/Knitting clothes	4	16
Knitwork	4	16
Poultry farm	1	4
Age of the respondents		
16-25	3	12
26-35	3	12
36-45	8	32
46-55	7	28
56-65	3	12
66-above	1	4
Income of the respondents		
00-10,000	13	52
11,000-20,000	10	40
21,000-30,000	1	4
31,000-Above	1	4
Expenditures of the respondents		
00-10,000	15	60
11,000-20,000	8	32
21,000-30,000	1	4
31,000-Above	1	4

Source: fieldwork.

comes lately but excessively. In summer, we feel excessive heat temperature and also experience frequent and extensive cyclones with lightening and thundering. We also observed from TV and heard from friends/relatives that the level of water in the sea is increasing and inundate adjacent area. We assume, it is happening due to climate change.”

Indigenous people can perceive that changing in rainfall patterns, change in wind direction, excessive heat, excessive thundering and lightning during rain, getting not sufficient water in rain season for cultivation, coming winter season lately etc. are the symptoms of climate change (see Table 2). The theme also indicates that indigenous people know about climate change from media especially television, FM radio, and internet which they get from urbanization and globalization.

From the thematic analysis of respondent’s views, it is found that climate change generally happens for two factors that are global and local. In global factors, they refer developed countries who emit carbon-di-oxide from their industry are responsible for the global warming and climate change. In this context, they blamed bourgeoisie/owner of the industries for emitting excessive carbon-di-oxide to accumulate much profit by producing plentiful products and extracting ample raw materials from the environment. About the local factors, they blame local people who cut down trees and make pollution in their locality are responsible for climate change and local problem. In this context, they blame Bengali people (mainstream people) who enter in Chittagong hill tracts and settled there and cut down trees excessively (see Table 2).

With the pace of time and expansion of education, indigenous people can perceive about climate change and its consequences through their life long experiences. About the consequences of climate change one of

Table 2
Shows about indigenous people’s perception, causes and consequences of climate change.

Nature of climate change	Causes of climate change		Consequences of climate change
	Local	Global	
Changing of weather patterns	Environmental pollution	Greenhouse gas	Landslide in hill tracks
Excessive rainfall	Cutting excessive trees	Establishment of large numbers of industries	Less yielding of crops/less getting of fishes in river
Excessive heat	Cutting of hill sides	Extraction of natural resources	Forced to change occupations
Excessive thundering and lightning during raining	Establishing brick kiln	Violation/negligence of environmental law	Damages of houses/forest resources
Drought	Gathering and extracting stones	Deforestation	Suffering of people even death/injuries

Source: Fieldwork.

the interviewees quote -.

“Due to excessive rain in rainy season, we experience landslides in our locality and many of the indigenous people died/injured collapsing their houses due to land slide. Excessive rain also brings flash flood, inundate our houses and crops and disrupts our communication system that creates huge damages both the lives and properties”.

In indigenous community, due to excessive rainfall in rainy season, a large number of houses built on hill tracks are collapsed. According to them, the inherent cause of this problem is due to cutting down trees excessively, the soil composition of the hills become fragile and it collapsed in heavy rain in climatic events. In this context, respondents demonstrated that on 13 June 2017, at least 137 people were died due to landslide including children, women and even army of that particular area.

About the consequence of climate change, another respondents’ utterance was like -.

“We cannot cultivate crops in our land due to scarcity of irrigation water. We also face acute shortage of drinking water as the canal/wells are dried up immediately after the rainy season and we need to go far away in hilly area to collect drinking water.”

In Chittagong Hill Tracts area due to climate change, indigenous people are forced to change their occupations as they cannot maintain their livelihood in their locality as the natural resources on which they depend are depleting day by day. In addition to this, respondents also said that indigenous people cannot get sufficient fishes in the river in their locality due to climate change (see Table 2). Along with fishing season comes lately, getting sufficient fishes also become difficult in the fresh river watershed in their locality. Moreover, the canal (sora) which is run inside the forest and hills are dried up after the few months or rainy season that may cause irrigation problems along with causing scarcity of fishes in the locality. Hill slides is another cause to fill up this canal and dry up quickly immediately after rainy season.

4.4. Key indicators of cultural response for adaptation in climate change extremities

Indigenous people frequently face different climatic events in their life. However, they response it in their own ways incorporating different components in their society. Many an indigenous people successfully adjust with the environment by employing these components but some may fail to cope with it.

4.4.1. Local assets as a response for adaptation

During the interview process, respondents were asked about their responses for adaptation in climate change, and they response it in their own ways. About the assets they depend for adaptation in climate

change in indigenous community, they response uniquely.

One of the participants' answers was like this-

"I depend on forest resources for maintaining my livelihood. I collect fruits, herbs, dried branches of trees, leaves, honey etc. from the forest and try to survive in my locality". I also collect crabs, prawns, fishes etc. from the sora/canal of the forest and maintain my livelihoods".

In the study area, along with depending on forest resources, indigenous people cut down some of the trees in their distress, for getting money to adjust to the adverse situation of their locality. They also collect forest resources i.e., fruits, herbs, dried branches of trees, leaves, honey etc. as three Fs (food, fiber, and fuel) for their survival in climate change extremity (see Table 3). Moreover, indigenous people cultivate different crops in the hills and plain lands for maintaining their livelihoods as they have very limited option for subsistence.

In climate change extremity, if indigenous people face difficulty to cultivate Jhum (slash and burn cultivation), they plant trees there and choose other hillside for cultivating crops. From the thematic analysis, it is found that, indigenous people save money, dried foods, gold ornament etc. for worst time and utilize it during the adverse situation to adjust with the environment. Mutual help and co-operations among the neighbors are also recognized effective instrument to adapt in adversity in the community, because there is strong communal bondage among the members in indigenous community.

About the survival in adverse situation, one of the participants states-

"We sell our precious materials to the market i.e., gold ornaments, furniture, electronic objects etc. and manage some money for buying essential

Table 3

Shows about cultural responses of indigenous people for adaptation in climate change.

Key indicators		Cultural response for adaptation
Local assets	Forests resources	Collect fruits, herbs, dried branches of trees, leaves, honey etc. for maintaining livelihoods
	JHUM cultivation	Cultivate JHUM in diversified ways in hill slopes
	Gold ornaments, cash money/dried foods etc.	Use it during climate change extremity
	Human capital	Mutual help, trust, skill etc. are important assets to response climate change
Technology and investment		Protect from flash flood, cyclone and hill slides
	Building houses in hill slopes and planting trees all sides	Make the floor with brick, sand and cement with small wall surrounding the room to protect flood water to enter the room Make small wall in front of the door to restrict water to enter the room/house
	Small-scale cottage industries and boat making/running grocery	Invest money to Small-scale cottage industries and make alternative income to maintain livelihoods in extremity
Local government and NGOs	Raise awareness	Help to adjust to adverse situation and to protect landslide
	Relief, building materials, foods, cash money, psychological support etc.	Help to cope with climatic events
Cultural and religious adaptation	Worship nature i.e., trees, river etc.	Provide psychological strengths and healing difficulty
	Religious leaders and temple	Provide guideline for mitigation and give shelter in temple during hazards
	Circulation of news	Make preparation to protect hazards,
	Keep property in safe place of jungle	Save property and protect from sweep away from strong wind

Source: Field work.

materials to adapt to the adverse situation. Sometime, we also offer our land lease to other person for getting money to overcome the adversity and get back the land when the situation become normal and we can manage money."

The study findings also indicate that human capital such as trust, skill, mutual help etc. are also important assets for indigenous people as they help each other to overcome vulnerability and cope with the environment (see Table 3). Though a large portion of indigenous people in the study area are poor and marginal but they can easily overcome the adverse situation of climatic events in their locality. In this context one of the Chakma indigenous people quote – *"In the last rainy season due to excessive rain, our house was inundated under water for few days. In this time, we took shelter in neighbor's house and got very cordial supports from them. We used their kitchen, toilet, and other resources during our stay in their house."*

Another respondents' statement was like this – *"Due to severe cyclone our house was totally disrupted and roof top was flown away to other place. We had no money to repair the house but village people helped us to construct the house in terms of providing labor, money, bamboos, canes, and other house building materials."*

In indigenous community, strong communal feelings and mutual help make their life easy as they get help from each other during hazards to develop resilience in their life. Rather than being worried and frightened, they take this event positively and their mutual trust, life long experience and skills make it possible to overcome the distress ensuring limited harm to their community.

4.4.2. Technology and investment

Indigenous people were asked about what technology they use during climate change extremity and they responded that they apply their own technology to protect themselves from climate change extremity. According to respondents, they build their house in such a place of the hill that it can protect themselves and their family from flash flood and cyclone. Moreover, they plant different wooden trees surrounding their houses of the hill tracts to protect landslide and safe their lives. About protecting their house from flash flood and cyclone one of the participants quote -

"We build our house in the upper place of the hill that flash flood cannot inundate our house. We also make the floor of the house 3/4 feet high from the soil by bamboos and woods as water cannot enter the house during flood. Moreover, to protect the house from strong flow of wind/cyclones, we plant different wooden trees and bushy jungles surrounding the house as the wind cannot hit the house directly".

Indigenous people always try to overcome natural hazards in their own ways. They develop new idea to adapt to the adverse situation of the climate change extremities. To protect their house from flood water, they avoid to make their traditional houses and try to build house with brick and cement. If indigenous people do not have much money, they only make their ground of the house with brick, sand and cement. They also build the wall surrounding their house two to three feet and make fence wall or tin wall above the brick-built wall. If they make fence wall from the ground, then the flood can damage the wall within few years, and they may need to repair it again. They also make a small brick-built wall in front of the door as flood water cannot enter the room through the door. During the flood time, they close the door and put some mud below the door to stop the leak as water cannot enter through the lower side of door. This method is very effective to protect flood water to enter the room. One of the Chakma women quote about these methods – *"During flood time, water with mud and other wastage enter our room. To stop this wastage to enter our room, we close the door of our room during flood and cover the leakage underneath of the door with mud, so that flood water cannot enter into the room. Indigenous people whose house is lower place and prone to the effect of flood follow this method to escape from the suffering of flood water".*

In Chittagong Hill Tracts (CHT) area, indigenous people plant different trees/jungle to protect their houses from the strong wind of cyclone or other hazards. They cut down some branches of trees as it

cannot fall down over their houses. Participants of the study area also tighten the roof of their houses with big trees by rope as it cannot sweep away by the strong wind of hazards.

Indigenous people invest money from their savings to survive in adversity. They invest money to small scale industries such as grocery shop, knitting traditional dress and selling that in local community market. In this context, one of the interviewees mentioned-

“Due to climate change extremity when we cannot access to forest resources, we invest money to small-scale business like grocery shop to our house premises. I run the grocery shop along with doing household chores but my husband sells handicrafts like different size baskets made of bamboos/cane in the local market and maintain our livelihoods”.

Indigenous people invest money to small scale cottage industry for survival in the climate change extremity. They make different types of handicrafts and sell it in the local market as an alternative source of income for their livelihoods. According to them, many of the indigenous people make boat and sell it to the local market (see Table 3). They also invest money to run small grocery shop in their locality which they get from relief or aid/borrowing money from neighbors, friends or relatives.

4.4.3. Local government and NGOs initiatives

The primary data derived from in-depth interviews, indicate that local government take initiatives to raise awareness among indigenous people about climate change extremity. They also monitor, and advice indigenous people about constructing houses in proper way to protect landslide in the hilly area.

About the awareness program, one woman participant quote -

“We participate different training programs such as how to manage disasters, how to evacuate people and protect landslides, how to cultivate crops/vegetables in the house yards etc. which are organized by different NGOs and local Government. Chairman and members/workers of different organizations sometimes visit our locality and give us different suggestions to solve our problems”.

In CHT, government provide indigenous people different types of supports such as relief, building materials, medicines, cash money, foods, drinking water, seedlings, agricultural inputs etc. in climate change extremities to help them to cope with the environment. Different NGOs also come forward to help indigenous people in their locality.

About the monetary and relief support, one of the male interviewees mentioned -

“We get emergency supports such as dried foods, drinking water, medicines, cash money from different organizations during and after the climate change extremities. We also get house building materials and cash money for repairing it if our house destroyed in the climatic events. Some NGOs also give us loan with soft interest for building houses after the events.”

About the relief distribution/getting supports from NGOs/local government in adversity, another participant expresses his frustration in these ways-

“During the climate change adversity, we get any support neither from local government nor from NGOs. Reliefs are got by those people whose family member/s died or severely injured in the extremity but poor affected people like us rarely get any support from them. Sometimes our names they listed for providing relief but when relief come from government, they provide it to their friends’ relatives, or devour it themselves.”

In Chittagong Hill Tracts, NGOs and local government help indigenous people in different ways such as raising awareness, providing reliefs and monetary supports, solving different problems etc. in climate change adversity. However, sometimes due to the greediness of some corrupted leaders and workers, some truly affected indigenous people may not get supports in climate change extremity.

4.4.4. Cultural and religious adaptation

Throughout the history, indigenous people in CHT perform different cultural and religious festival/rituals in their community which increase their bondage and communal feeling to adapt to the adversity. This cultural adaption not only helps to get resilience in adversity but also

provide them some emergency needs to overcome vulnerability. Religious prayers/ritualistic functions also provide them mental strengths to combat climatic events. About cultural and religious coping strategies one of the interviewees quote -

“During climate change extremity, we worship trees and pray (God and Goddess) to overcome it by singing, dancing and performing ritual activities. We also take shelter in the temple as we can save ourselves and our family from evil power of hazards”.

After interpreting transcript, it is found that during and post climatic events, ritualistic activities provide indigenous people psychological strength and it also works as healing to overcome different difficulties they face in life. It is also found that religious leaders help them and other villagers in terms of advice, giving money, making aware, along with giving shelter in the temple during climate change extremity. Moreover, those who frequently visited to city, informed indigenous people about the upcoming hazards and circulate it in their community for taking preparation to protect it.

One of the respondents age more than 60 mentioned-

“We can understand about the upcoming climatic events by analyzing winds directions, animal’s behaviors, weather conditions and take initiatives accordingly. If the wind comes from west corner and the sky looks dark black, it means that the nor’ wester may occur, if the cloud looks thin brown and wind blows heavily, it means rain may not occur but if the cloud looks dark brown and no wind blows, it means that heavy rain may come. After seeing these natural symbols, we make ourselves prepared to overcome it.”

Indigenous people have capability to perceive about the upcoming natural hazards by seeing some symbols or signs from the nature. By seeing the color and direction of cloud in the sky, they can understand whether rain or cyclone may be occurred or not. In the same way, by seeing the behavior of animals and birds in the forest, they can predict about the impending weather condition of their locality. On the basis of their analysis about the symbols/signs, they can take preparation of the imminent hazards, that contribute to help them to minimize risk/loss of natural hazards in their community.

In indigenous community during cyclone, they take shelter to concrete/brick-built buildings of their neighbor or government infrastructures like school, colleges, temples or stay in slope between two hills as the wind cannot harm them and their family members. Moreover, they keep their properties like precious materials (Gold ornaments, cash money, important documents etc.) to brick built house of their neighbors/relatives as these objects could not damage in the climatic events. They also keep these materials in a bamboo tube and put inside the ceiling, as it is not damaged in climatic events and nobody can steal it in emergency situation. Sometimes they also keep their domestic materials inside the jungle as it could not sweep away with the strong winds of the cyclone (see Table 3). According to interviewees, many of them take shelter in cyclone center if that is close to them but due to poor mobile network and mountain based poor communication system, very often the people who live remote area could not take shelter in cyclone center or could not reach cyclone center in right time.

5. Discussion

Indigenous people in Chittagong Hill Tracts area perceive climate change in their own ways. Throughout the history, indigenous people experience climate change as natural process and they try to adapt this process in their own ways. Elderly people do not know what is climate change but they know that weather pattern is changing and environmental degradation is happening in their locality (Ferdous, 2011; Pender, 2014). But with the pace of time, and the extension of communication technology together with increasing literacy rate among indigenous people, they perceive climate change in different ways and they assume that anthropogenic cause is the main factor for climate change and environmental degradation in the planet (Huda, 2012). Indigenous people perceive that feeling not cold in winter and getting not rain sufficiently in rainy season, excessive thundering and lightning

during raining, excessive heat and global warming etc. are the causes of climate change. Over the last few decades, they experience severe natural hazards such floods, cyclone, flash floods etc. which are also happening due to climate change. Apart from their own perception, they also get this news from the Radio, TV and other media in their locality. Ahmed and Haq, (2019) in their study also found that 'Khasia' and 'Tripura' people know about climate change from television, newspaper and NGOs but a large portion of them of that locality have no idea about climate change. Chakma indigenous people blame bourgeoisie/owner of the industries for emitting excessive carbon-di-oxide to accumulate much profit by producing ample products and extracting plentiful raw materials from the environment. Local mainstream people are also responsible for this as they indiscriminately cut down trees and hills, illegally extract stones underneath the soil, illicitly establishing brick kiln and degrade the environment.

During the climatic hazards, indigenous people depend on local assets for adaptation following the tradition of their culture. They collect fruits, herbs, dried branches of trees, creeds, leaves, honey from the forest and crabs, prawns, fishes etc. from the river and try to adapt in adverse situation avoiding the monetary cost in the market. Kodirekkala (2018) in his study also showed that trees/forests have great cultural significance for adaption because it provides subsistence as well as economic benefit to indigenous people. In recent decades, indigenous people plant sagwan trees in the hills which provide them much benefit financially to adapt in climate change. Similar finding is found in Ahmed and Haq, (2019) study, where indigenous people are seen to depend on forest resources for maintaining their livelihoods. It is also found that collecting forest resources i.e., fruits, herbs, dried branches of trees, leaves, honey etc. work as three Fs (Food, Fiber, and Fuel) for their survival in climate change extremity. Indigenous people sometimes sell their valuable gold ornaments, furniture, electronic objects and other prized materials to get extra money to repair their houses and resolving other emergency needs. Mutual help and co-operations among the neighbors are also recognized as effective instrument to adapt in adversity, because there is strong communal bondage among the members in indigenous community. Elderly indigenous peoples' knowledge, wisdom, mythology, etc. are also considered important cultural components for adaptation in adversity in the community.

Indigenous people make house in the slope of hill or built house 3 to 4 ft high from the soil as flood water cannot enter or damage their house (Islam, 2011). Some indigenous people who are economically solvent make brick-built houses as cyclone could not fly away their houses (Garai, 2017). Moreover, they plant trees surrounding their house as strong wind of cyclone could not hit their house directly. They also cut down some branches of trees as it could not fall down over their houses and tighten the roof of their houses with big trees by rope as it could not sweep away by the strong wind of hazards.

Indigenous people take different training from local government and NGOs to combat natural hazards and developing resilience in adverse situation. They also get some relief such as food, water, house building materials, medicine etc. during emergency periods to adapt to the adverse situation in the locality (Garai, 2017). Indigenous people have rich culture to perform ritualistic functions in their community which boost their communal bondage and integrate their relation and feelings. This social integration renders mutual help to overcome adversity and building resilience to adapt in the community. Religious prayers also provide them mental strengths to combat climatic events (Garai, 2017).

6. Conclusion

Though indigenous people constitute only 1% of the total population in Bangladesh but their contribution to cultural diversification and economy cannot be neglected. As Bangladesh is one of the most vulnerable country and indigenous people among the first who face the direct or indirect consequences of climate change for being highly dependent on environment for their subsistence (Ahmed and Haq,

2019). It is high time to come forward to help this people to overcome climate change extremity in their locality. It is worth mentioning that with the pace of time and intergenerational experiences, indigenous people develop their own cultural strategies to response climate change extremity and develop their perception about climate change as well as environmental change. Indigenous people can perceive the recurring climatic events by analyzing the wind directions, nature of clouds and other natural symbols and can take preparation to combat it considering the situation. They can adapt to climate induced adversity by applying cultural components such as investing small scale industries, depending on forest/natural resources, getting supports from neighbors, GO or NGOs and so on. Moreover, they can combat natural hazards by planting trees surrounding their houses, making houses in upper place (hillside) around 3 to 4 ft high from the soil or making brick-built houses in their locality. They also perform ritualistic activities and pray to God in order to escape from the evil power of nature/natural hazards, apart from following local coping strategies to combat climate induced hazards in the locality.

Government as well as policy makers should come forward to formulate policy to uplift this people, then the fate of this people can be changed. Moreover, along with indigenous cultural strategies, the government should incorporate modern technology and institutional response to combat climate induced hazards that can bring positive change to the lives and livelihoods of indigenous people in hill tracts area as well as other similar settings in the world.

Ethical approval

Not applicable.

Consent to participate

All participants spontaneously agree to take part in the interviews.

Consent to publish

Not applicable.

Author's contributions

Joydeb Garai is the first author and other authors supervise my work and give valuable comments and suggestion to enrich its quality.

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