Impact of Climate Change Disasters on the Education Sector of Coastal Bhola District, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Review Article

ABSTRACT

Bhola is a coastal district in the southern part of Bangladesh which prone to natural disasters, mainly cyclones, and upsurges of saline water in the sea due to the impact of climate change through increasing temperature. Natural disasters are the key forces for river erosion, loss of assets, increasing poverty along some other socioeconomic impacts. The objectives of the study

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were to check the impact of climate change through natural disasters on the education sector of the district by creating various challenges and vulnerabilities in the education system, resource allocation, and maintenance resulting in students dropping out, child marriage, livelihood changes, etc. There is much research on climate change and its impacts on the coastal areas of Bangladesh but publications, and research works on the same topic were not found. Content Analysis has been adopted for this study to investigate the causes and effects of a tabulation method. Related books, articles publications in journals, and features on the topic in the reputed online media have been scrutinized for this study. The coding of the content analysis has been carefully checked and synchronized with the problem statement based on the research question of the study. The impact of climate change has a significant role in student dropout because of the destruction of infrastructures, migration of people, increasing poverty, child marriage, changes in the livelihoods of the people, etc. To address this problem massive and comprehensive intervention is necessary along with increasing capacity building and adaptation of the people.

1. INTRODUCTION

Bangladesh, the largest deltaic plain in the world is the 7th digester-prone country due the climate change [1]. The major driver of climate change is rising temperatures due to anthropogenic activities. Global temperature has been raised by 0.11 Fahrenheit (0.06 Celsius) in each decade since 1850 which is about threefold after 1982 (0.36 Fahrenheit and 0.20 Celsius) [2]. From history back, it is observed that Bhola has been suffering seriously from cyclones, tornadoes, floods, flash floods, and droughts. As the livelihoods of the people were agriculture and farming, they suffered much and that kept them under development [3]. Natural calamities not only impacted livelihoods but also, their shelter, housing, infrastructures, and road communication that impacted comprehensively against the rural as well as urban development of the country. One of the scientific reports [1] published by Nature has claimed SDG 13: Climate Action is the main agenda for sustainable development for addressing other 16 SGDs by 2030. Education, health, business, entrepreneurship development, and cottage industries are the other sectors that have been impacted due to natural calamities [4].

Bhola is a coastal district, in the southern part of the country which is one of the most affected districts due to climate change as the frequency of cyclones has increased gradually. Three massive cyclones attacked Bangladesh in 2023, which impacted the coastal areas as well as the southern and middle parts of the country with causality and damage to assets [5]. Cyclone causes inundation, swipe, and damage to assets, housing, crops, castles, bridges, culverts, erosion of river banks, and damage to plantations, forest areas, and biodiversity of the districts [3]. Bhola was seriously impacted by the Bhola Cyclone on November 12, 1970, as near about 3,00,000 people died immediately and passively more than 2,00,000. Another historic cyclone on 29 April 1991 killed 1,35,000 people and caused damage of at least 1.5 billion USD including killing innumerable castles, totally damaging the croplands, swiping and destroying road communication, institutions, etc. [6].

1.1 Research Questions

1. What are the impacts of climate change on the education of Bhola?
2. What is measured to address the problem in the short term and the long term substantially?

1.2 Research Objectives

1. To add to the existing knowledge about the impact of climate change and its causal effects of cyclones, upsurges, floods, rising sea levels, droughts, irregular monsoons, etc., especially in the coastal areas to the education with other sectors.
2. To investigate the required measures to address the problem and justify the measures already taken by the government of Bangladesh and other development partners of the country.

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[1] *The Central Role of Climate Action in Achieving the United Nations' Sustainable Development Goals by Walter Leal Filho, et al (2024)*

1.3 Statement of the Problem

Climate change is a major concern and a threat in the contemporary world [6]. The causal effects of climate change are increasing carbon, and rising temperatures for which the frequency of cyclones, tidal waves, irregular rain, and droughts are frequently observed in the Indian Sub-continent with some other parts of the world. Bhola, a coastal district is the most affected by the rage of climate change in Bangladesh located in the southern part of the country. Due to random cyclone effects, river bank erosion, and migration of landless people, the education sector is mostly affected by sectors like agriculture, communication, infrastructural development, entrepreneurship, etc. due to river bank erosion, landslide, govt primary schools, private schools, madrasa (schools for the study of Islam) have washed away, causing troubles to the community.

1.4 History of Coastal Bhola

Bhola is a district for natural calamities. Due to its geographical location, it has been prone to hazards like cyclones, tidal surges, tornadoes, erosion of river banks, etc. According to the Bakerganj Gazetier, Bhola was raised in 1235 and people started living from around 1300 AD. In 1500, both of Mogs and Portuguese established their power there and used to take tolls from the farmers and the fishermen. Bhola was under the Noakhali district up to 1869 and later it was included in the Barisal district. In 1984 Bhola was declared as an individual district with an area is 3403.48 sq. kilometers and a population of around 1.932 million (according to the census of 2022).

From the historical period, the education sector of the coastal district has been vulnerable to other sectors like agriculture, and infrastructure. The area was poverty-laden and impoverished in logistic support, communication, and even a good look at political wills (due to lack of consciousness of the society). It may be due to the regular hits of cyclones, tornadoes, and river bank erosion, the consistency of development in different sectors was interrupted. In Table 1 details of some natural disasters are given.

1.5 Two Historic Cyclones of Bhola

Bhola was seriously affected by a heavy cyclone named Bhola on November 12, 1970. Around 3 lacs people died instantly by the storm and upsurge of the Bay of Bengal. Standing crops, road communication infrastructures, and cattle were damaged seriously. Almost the coastal district was far behind from the other parts of the country. The country was going through a nationalistic movement to be freed from the Pakistan regime. Pakistan's Government didn't take proper measures to address the incurring loss of Bhola which expedited the movement of independence of the country. The mass movement for the independence of the country has been grown up against the rulers of then Pakistan who ignored the fatal impacts of the cyclone [11]. [2]

1.6 Education in the Coastal District, Bhola

Education in the Coastal Bhola district is somewhat challenging and different from other parts of the country due to the hardship of easy communication as major parts of the districts are disconnected by waterbodies like rivers, canals and the shore of the Bay of Bengal. Though Bangladesh has achieved the target of 100% enrolment achievement in primary education as per the target of SDG-4, the enrolment in the Bhola district is unsatisfactory. According to Ph.D. research [3] by Md Ahasun Habib, from Bangladesh University of Professionals (BUP), the dropout rate is 24.34%. At least 66.7% of the primary schools are out of smooth communication. Though almost all of the schools have school committees, only 43.3% have taken the initiative to achieve SDG-4[4]. The researcher claims that most of the schools do not start school on time. Not only that, Schools are run by proxy and para teachers[5]. There are only 15 % of teachers who are appointed systematically by the government. Only there are 10.12% and 40% from non-government primary schools. The unfortunate finding of the report is that the teachers visit schools only two to four days a month. It is clear that these schools lack teachers, teaching, monitoring, and supervision, and the factors arise only from remoteness, inaccessibility, and lack of permanent structures which have increased the sufferings of the education sector of the country in the coastal area of the country. In brief, the sorry state of the

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[2] *World Bank*
[3] *Stakeholders' perception of SDG-4: Investigating inclusiveness and quality in primary education of selected char areas in Bangladesh*
[4] *Ensure inclusive and equitable quality education*
[5] *Permanent teachers select teachers from the available resources*

education sector of Bhola is the inaccessibility due to the impoverishment communication network which is also caused by river erosion, landslides, and likewise other hazards.

An investigation and scientific report accomplished International Centre for Climate Change and Development (ICCCAD) recently published in the Daily Star (Dated February 12, 2024) from Bangladesh has claimed that 12-18% (1/7 of the total population of the country) of the coastal area of Bangladesh will go under the sea by 2050, creating a huge number of people as refugees for the climate change. Currently, the average yearly loss by the cyclone is 0.7% of the

GDP which is $ 1 billion. 6-9% of the total rice production will be decreased with severe intrusion by saline water in the sub-layer mainly in the coastal area.

A report published by the World Economic Forum (WEF) claims that vulnerability due to climate change has caused many difficulties including dropping out of students increasing poverty, food insecurity, and other social impacts like child marriage, polygamy, malnutrition, etc. [12]. In Table 2, the drivers of students dropping out have been chalked out, connecting natural calamities like cyclones, flash floods, etc.

Table 1. Natural disasters occurred in the study area[6]

Year	Disaster	Month of the Occurrence	Effect of the disaster
1970	Cyclone Bhola	Nov.12	Massive disaster of the history killed 300000-500000 people, cattle and have destroyed all set up administrative academic
1991	Cyclone Gorky	29 April	Super cyclone, killed more than 100000 in Bhola (total 1,40000 in the coastal area)
2007	Cyclone Sidr	Nov. 15	Charfassion Upazila was affected seriously in Bhola District cause of heavy rain, tidal waves, due to the Cyclone. Total 3363 people's death has been recorded in Bhola [7]
2009	Cyclone Aila	May 25	Massive upsurges in Bhola including other Coastal Areas of the country. Mostly affected areas are Daulatkhan and Charfasshion Upazila of the District.
2013	Cyclone Mahasen	May 16	Cyclone Mohasen caused 13 people deaths in the Coastal Area of the country including Bhola
2014	Flood	July-August	At Least 30 villages were inundated at Bhola Sadar, Monpura, Charfassion, Daulatkhan Upazila of Bhola District, which also devastatingly caused damaged to the agriculture and other livelihoods.
2017	Flood	June	At least 30000 people have been marooned in Monpura and Tajimuddin Upazila [8]. Agriculture and other livelihoods caused damage seriously.
2018	Flood	July	Tajimuddin, Monpura, Bhola Sadar and Charfssion were inundated [9][7]
2020	Cyclone Ampan	May 16-21	26 died and more than 20000 people has to be evacuated from the Coastal Area [10].
2022	Cyclone Sitrang	Oct. 23-24	9 people died in Bhola with devastating damage of standing crops and forest coverage in Bhola.
2023	Cyclone Mucha	May 11-14	6 people recorded death in Bhola though the government took measures seriously to lower the cyclone damage.

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[6] *The information of this table has accumulated from different available sources like print and electronic media, government records.*
[7] *Water Development Board*
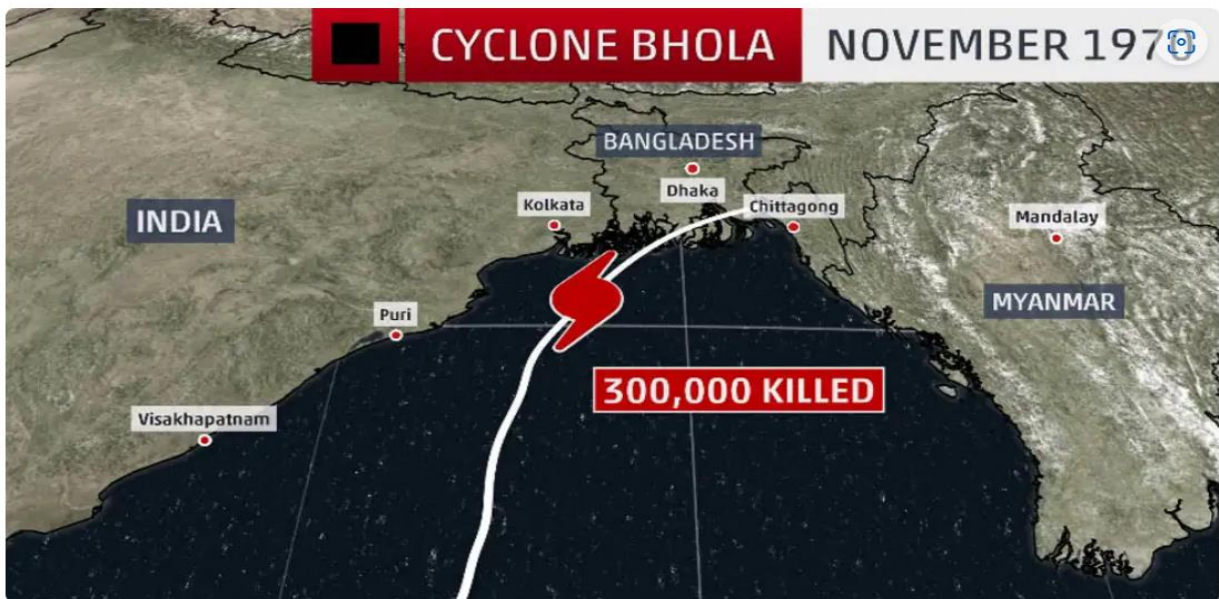
The white line denotes the track of the Great Bhola Cyclone in November 1970.
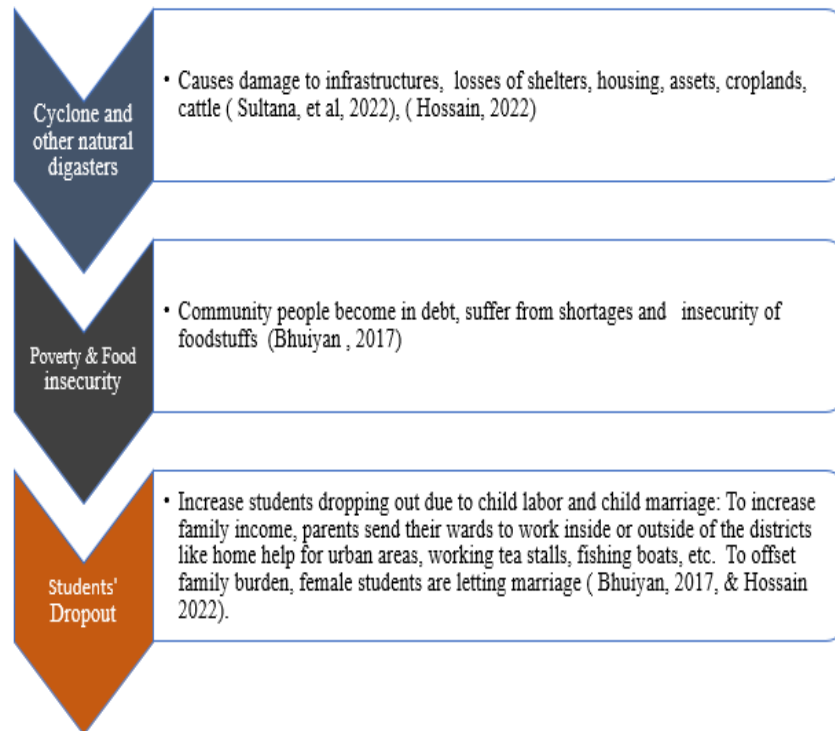
Fig. 1. Route map of cyclone Bhola
(Source: The Deadliest Tropical Cyclone on Record Killed 300,000 People by Chris Dolce and   Brian Donegan May 01, 2019)

Fig. 2. Devastation by cyclone Bhola (Aerial view of the coastal area of Patuakhali littered with dead cattle after it was hit by the tropical cyclone center in November 1970. (Express Newspapers/Getty Images)

Table 2. Drivers connecting students' dropout (thematic analysis based on literature review and other research findings)

- Cyclone and other natural digasters
  - Causes damage to infrastructures, losses of shelters, housing, assets, croplands, cattle (Sultana, et al, 2022), (Hossain, 2022)

- Poverty & Food insecurity
  - Community people become in debt, suffer from shortages and insecurity of foodstuffs (Bhuiyan , 2017)

- Students' Dropout
  - Increase students dropping out due to child labor and child marriage: To increase family income, parents send their wards to work inside or outside of the districts like home help for urban areas, working tea stalls, fishing boats, etc. To offset family burden, female students are letting marriage (Bhuiyan, 2017, & Hossain 2022).

Another report titled *Climate Disasters Drive Bangladesh Children from Classrooms to Work*[8] published in the Thomson Reuters News by Mosabber Hossain on May 9, 2022, focused on the issues discussed in Table 2. It is unfortunate, that children who drop out mainstream of education are engaging in risky hazardous works like shipbreaking yards, chemical factories, etc. The same report claims that 7 million children are working in Bangladesh and the schooling student's dropout rate is 17% which is alarming for the nation.

From the mainstream of education due to river bank erosion, infrastructures damaged by natural disasters, early marriage of female students, and migration of the people due to natural calamities. 'There are many case studies published in different print and electronic media that people who are migrated due to river erosion, changing of livelihoods, people hardly think about the education of their wards' that has been reported by the Daily Standard on its June 13, 2021, in its report named' How climate change is undermining education in coastal areas of Bangladesh''. In 2016, at least 50 primary schools of Bhola were damaged totally with partial and full damage to 105 high schools, 20 madras, and colleges due to a cyclone that has been reported by then the District Education Officer Nalini Ranjan Roy [13]. It is also noted that all the educational institutions were damaged by the deadly Bhola Cyclone and Cyclone Gorki that was in 1970 and 1991 which led to massive damages in the education sector of the district. Cyclone Aila, Sidr, and Ampan, also have heavy impacts on the same sector.

1.7 Research Gap

Though there are many kinds of research about the impact of climate change in different sectors including the education sector of the country and different parts of the world with the best of my search any research, article, or any form of report was not found as the same or close title.

1.8 Scope of Future Researchers

Future researchers of climate change, development, and other connecting fields have a great scope to further research on the impact of climate change disasters on education in the coastal areas of another district of the country.

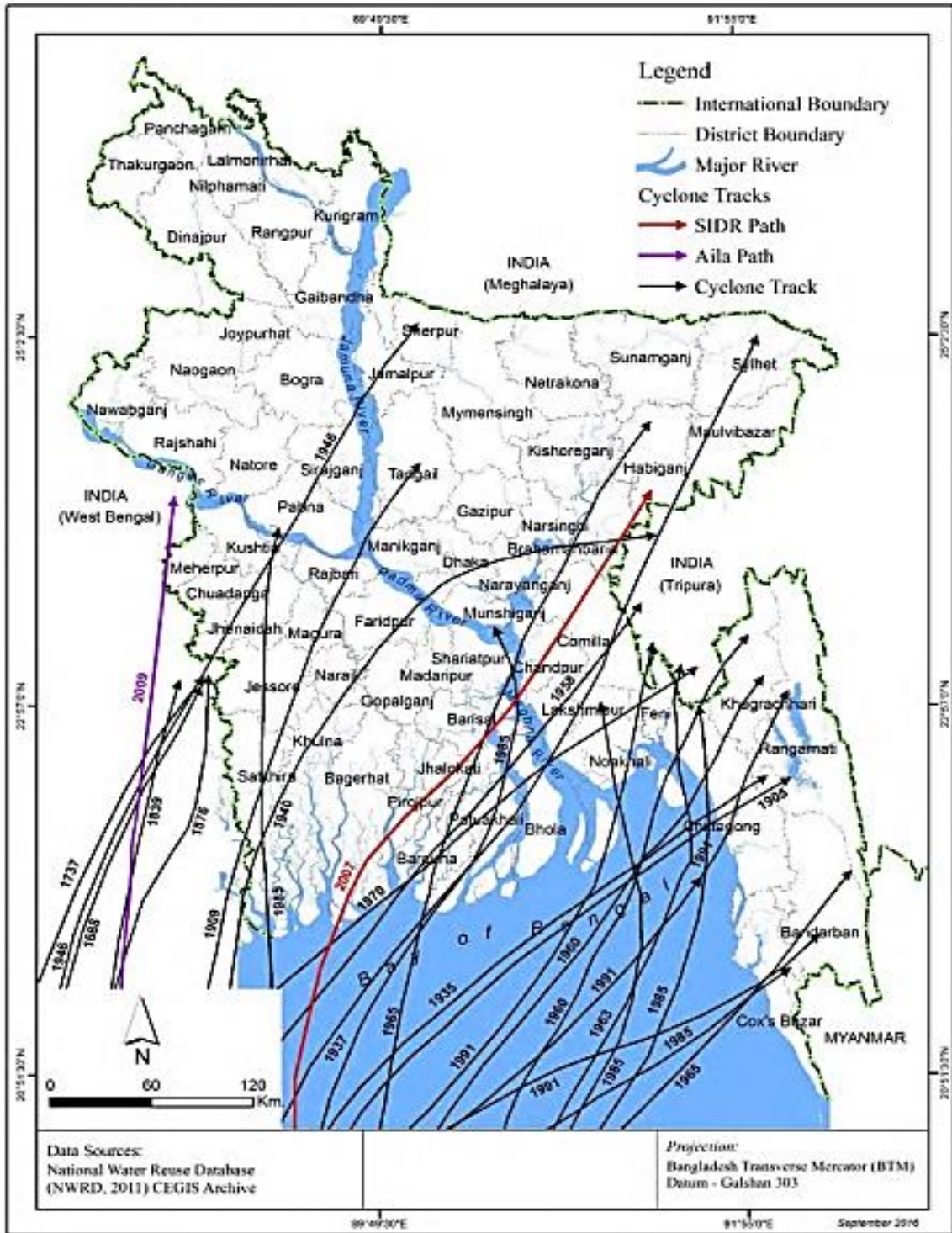[8] *https://news.trust.org/item/20220507212405-85gbq*

Fig. 3. Risk from major cyclones during 1960-2009
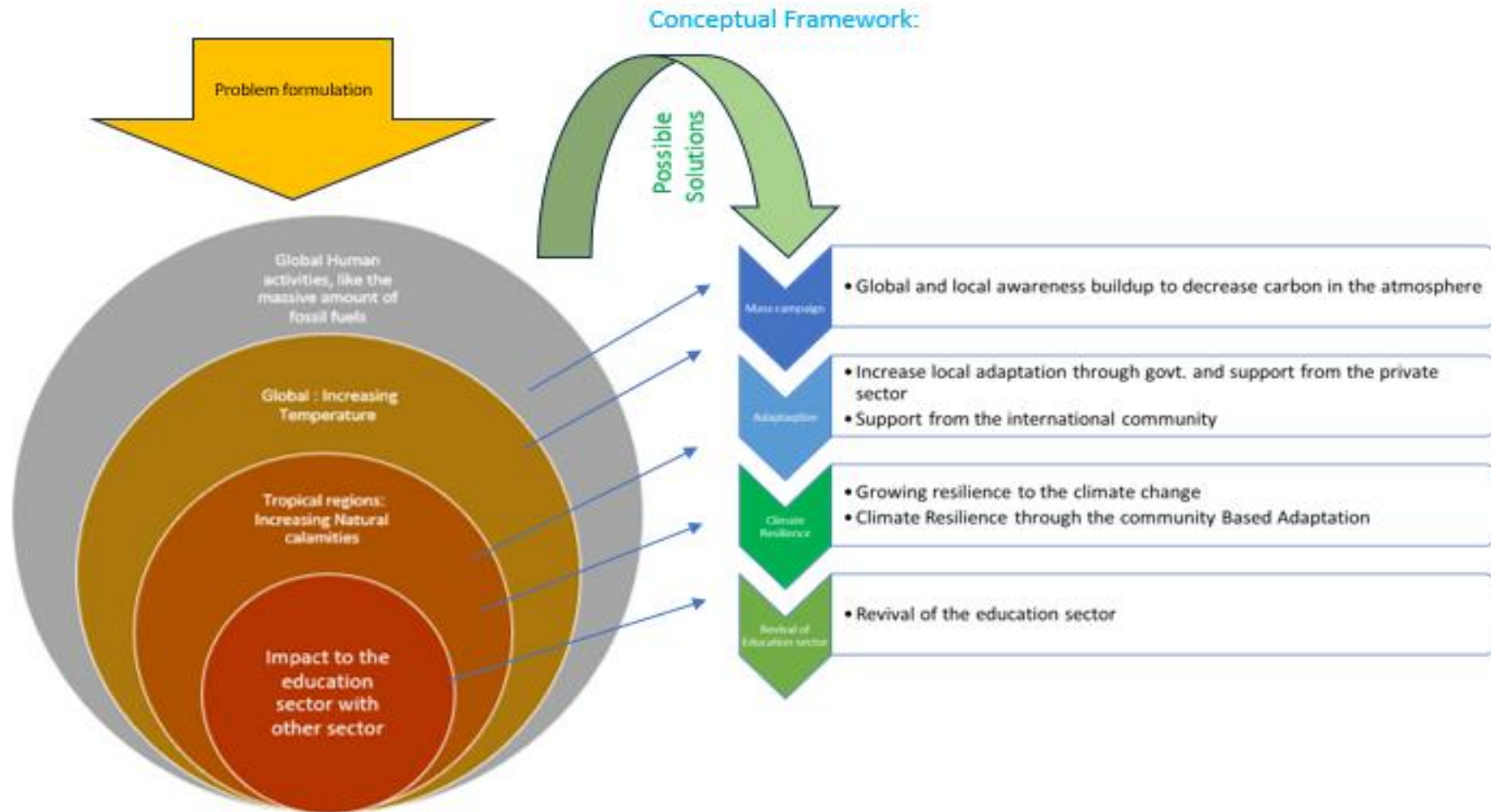*Source: CEGIS, 201*

Fig. 4. Conceptual Framework

2. METHODOLOGY

This research has been administered based on content analysis. Data have been collected from different research papers, journals, books, and print and electronic media from home and abroad. Coding has been done as per the research questions and objectives of the research. The findings of the research have been accumulated through coding and keywords which are connected to the answers to the research questions. At the same time, justification of the coding has been accomplished by the team and compared with other research close to this topic.

2.1 Reasons behind the Content Analysis Method

The qualitative analysis name content analysis has been adopted for the convenience of the study to keep the research low-cost, more explanatory to address and find out the divers of climate changes, its impacts and aftershocks, and easy to interpret by a large number of audiences, even by the common people who are much related with climate change, its research, academic activities its impacts, etc.
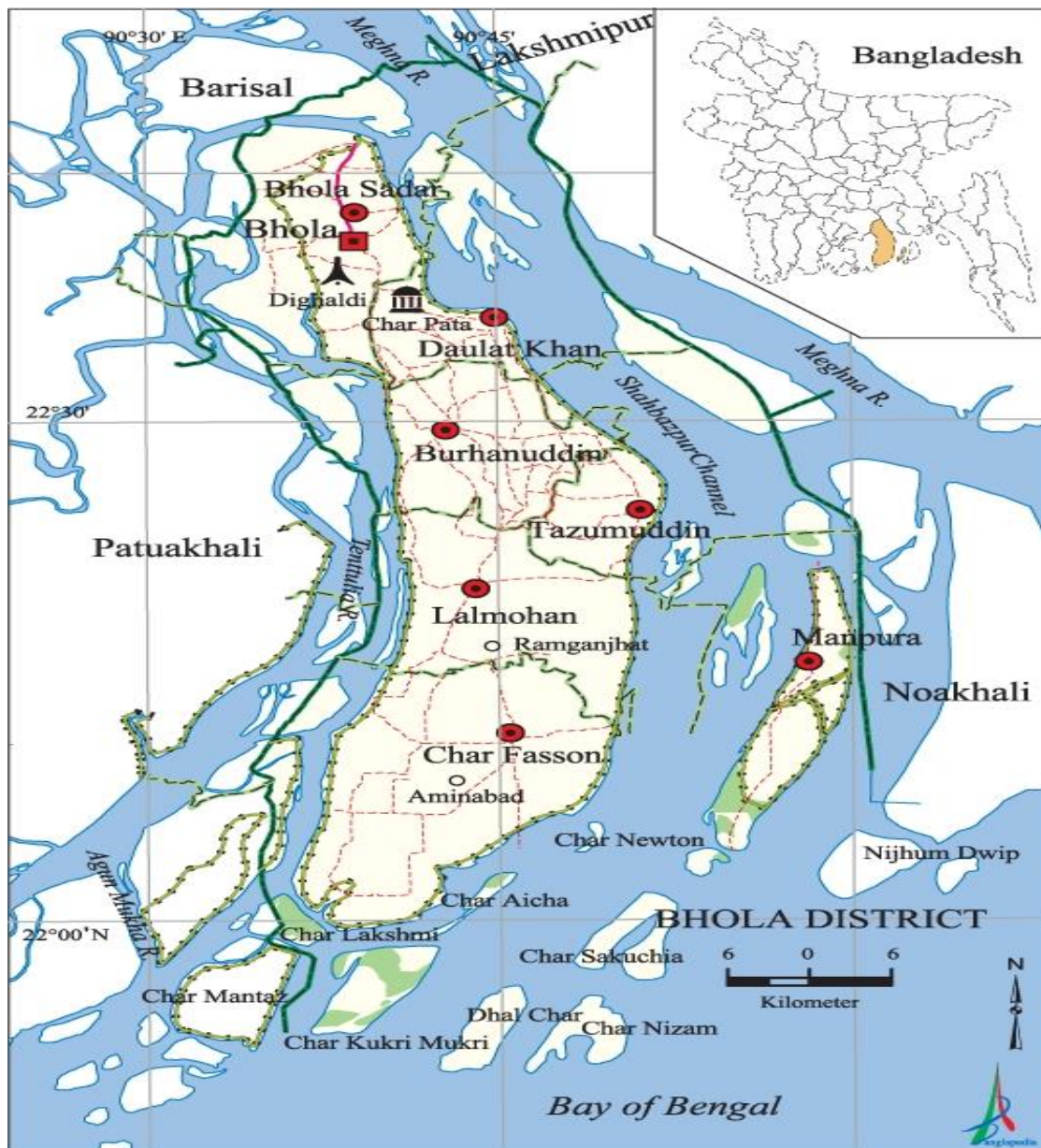

Fig. 5. Study Area: Coastal District, Bhola

2.2 Content Analysis

2.2.1 Tabulation techniques[9]

The content analysis for the study has been depicted in Table 3.

Table 3. Content analysis

Research Question	Interpretation Content & Coding (Causes and effects)	Explanation with example(s)	Our points/Counter argument if any)
1. What are the impacts of climate change on the education of Bhola?	Students' dropout	The education sector is more vulnerable in the coastal areas [14] . Bhola is seriously impacted by almost every major cyclone, erosion of river banks, and their subsequent effects [11].	From the cited content this argument is well-recognized that due to natural calamities, students drop out is taking place.
	Destruction of academic structures	In each of the cyclones, most of the academic structures were impacted. Most of the schools had permanent damage or even partial destruction. Due to poor infrastructure, the sustainability of the education is not working.	Due to the river bank erosion, permanent structures cannot be established which is another reason for increased vulnerability to the education sector
	Migration	River bank erosion is the main driver of migration of the people causing the loss of their homes, cropland, and livelihoods which is evidenced in Bhola. For example, the sustainable forests and livelihoods (SUFAL) project run by the Forest Department of Bangladesh has found that their beneficiaries have left one location for another for the	River bank erosion induces migration as people lose their homes, livelihoods, and croplands and it is evidenced in another research 'River Bank Erosion, Induced Population Migration, and Adaptation Strategies in the Sirajganj Sadar Upazila, Bangladesh' by Ali, et al (2021)

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[9] *Analysis in a tabular form against the Codes that guide the answer of the research question connecting problem statement*

Research Question	Interpretation Content & Coding (Causes and effects)	Explanation with example(s)	Our points/Counter argument if any)
		erosion of the river bank at Char Jahiruddin FCV[10].	
	Child Marriage	Due to the loss of everything in the erosion of the river bank, and loss of livelihoods, agricultural/farmland poverty arises which increases child marriage in the community (Bhuiyan, 2017). Around 150 are at risk of child marriage out of them a huge number are in the affected areas of climate change [15] . the sub-Saharan region is at the top of child marriage followed by India and Indonesia according to a report by UNICEF in 2019 though Bangladesh has reduced the trend from 90% to 51% from 1970 to 2019 [15]	Social instability occurs after any natural calamity due to a shortage of food and economic burden. It is quite normal; families try their best to offset the family cost and let the underage female child marry.
	Social unrest	It has been evidenced that after natural calamities, and political unrest some social unrests like encroaching of other homelands, and belongings have been occupied by the influential peoples of the community.	Economic unrest is the key driver of social unrest. All of the economic unrest influences social unrest and vice -versa which is much evidenced in the famine of 1943 in Bengle and 1974, in Bangladesh.
2. What is measured to address the problem in the short term and the long term substantially?	Interpretation Content & Coding (Solutions)	**Explanation with example(s)**	
	School on Boat	As to stopping cyclones, tornadoes are not a problem to address overnight, some measures should be taken just as temporary or movable schools. For easy movability and effective	This type of schooling is already in practice by *Shidhulai Swanirvar Sangstha* (SSS) for the flood-affected areas with the financial support of the Commonwealth of Learnings (COL)[11]

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[10] *Forest Conservation Village*
[11] *https://www.col.org/news/floating-boat-schools-bangladesh/*

Research Question	Interpretation Content & Coding (Causes and effects)	Explanation with example(s)	Our points/Counter argument if any)
		learning, schools on the old ship may be set up by the government which may be full of resources with classrooms, libraries, and other facilities.	
	Setting Cyclone Shelter[12]	More schools cum cyclone centres should be built to support the disaster-impacted people and schools after disaster can continue their academic activities.	There are very few cyclone centres in the study area with low maintenance and required facilities. Though it has been practiced, as per the requirement, these are not enough. Last but not least, Spacious cyclone shelters should be prepared for the cattle so that, people might not lose their animal husbandry
	Training	Teachers' students and even the community should bring under training how they can save their schools, academic logistics, and what they will do after the impacts of the disasters.	Hands-on and skill development training should be adopted for smart agriculture[13], temporary farming in the marshy land, vegetable cultivation in the canal, river water in the off-season—poultry farming, duck rearing, etc.
	Community-Based Adaptation[14] (CbA)	Community-based adaptation should be used to resilience to the impact of climate change if a community helps the govt to set up its schools on the safe and relatively high land rather than on the low land and river bank (Sultana, 2022).	Some of the schools, and madrasas are already in the high or relatively settled land and have been set up with the help of the community and local govt.
	Indigenous knowledge/skills	In everywhere in the world indigenous knowledge for every problem may be applied. In the case of agriculture in the coastal area of Bangladesh, to save the crops from salinity intrusion, farmers are using different methods	Community members apply their indigenous knowledge to protect the setups by creating fencing using wooden piles, pillars, sandbags, temporary dams to protect from flood water, etc.

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[12] *Cyclone shelters are used for primarily as a place to stay people during the time cyclone and other disasters like floods, etc.*
[13] *The term smart agriculture refers to the usage of technologies like Internet of Things, sensors, location systems, robots and artificial intelligence on a farm*
[14] *Focuses on the approaches to climate change adaptation which are community-based and participatory*

Research Question	Interpretation Content & Coding (Causes and effects)	Explanation with example(s)	Our points/Counter argument if any)
	Community-Based learnings[15]	creating dams, rotation of crops, digging canals to pass the saline water, etc. [16] Community-based learning both for skills development training[16], capacity building[17], and academic activities is to be based on the geographical position of the community.	Due to continuous fighting with nature, community people are more resilient, hardworking, and have much experience in fighting climate change. Sometimes they know best how to survive in a challenging situation.
	Coastal Afforestation & Forest Conservation[18]	Forest Management and conservation is highly applicable to protect natural calamities like cyclones as forests work as obstacles to the harmful impacts to the coastal area (Bhola) and other parts of the country (Bhuiyan, 2017).As due to many socioeconomically factors, natural mangrove forest is degrading, massive afforestation is needed to strengthen the coastal protection.	A protective measure named Coastal Belt was initiated in March 2002 for the massive plantation across the coastal south of Bangladesh which already working as a protective barrier against the many destructive cyclones like Sidr(2007), Aila (2009), Ampan (2020), etc (Sultana, 2022).

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[15] *Community-based adaptation (CBA) is an approach to strengthening the adaptive capacity of local communities vulnerable to climate change*
[16] *Training for increasing the skills of the community people so that they can shift their livelihoods*
[17] *Community capacity building (CCB) focuses on enabling all members of the community, including the poorest and the most disadvantaged, to develop skills and competencies to take greater control of their own lives and also contribute to inclusive local development.*
[18] *Works for the favor of nature conservation against the divers of river bank erosion, siltation and for the favor of biodiversity both in the marine and plain land*

2.3 Summary of the Findings

From the literature review, through the process of content analysis, information connecting climate change has been gathered in the coding system where the causes and effects of climate change on education in the coastal area of Bhola have been outlined. Students dropping out mainly causes the loss of assets, infrastructure, livelihoods, food insecurity, and migration due to river erosion. Measures to address the problem have been outlined like capacity building of the people through training, infrastructure development, community-based adaptation, community-based learning, and using indigenous knowledge.

3. CONCLUSION

Coastal Bhola is the region that is much impacted due to climate change. Many natural disasters have raged in the region resulting in the killing of hundreds and thousands of people, cattle, and wildlife, destroying forest ecosystems, agriculture, along with education sector of the district. Salinity intrusion is one of the major problems of the land which also impacts agriculture, the health of living beings, forest crops, and the biodiversity of the forest land. Govt has set its key priorities for the coastal area of the country to increase resilience, capacity building, and infrastructure development in its plan Mujib Climate Prosperity Plan (MCPP) 2022-2041. Coastal afforestation is one of the measures named for creating a 'coastal belt' by the plantation of mangrove species which is not sufficient to fight climate change rather a massive realistic comprehensive plan should be taken immediately.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Artificial Intelligence has not been totally used in any form, anywhere in this research. The researchers are not against the modern technologies that are being used in the research but still human intelligence has applied everywhere in this research for the convenience and easy to handle and finally not to go any experiment with the hardworking updating data collection, which has some limitations in Artificial Intelligence.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/115041