

Water in Distress: Exploring the Adverse Effects of Flood and Adaptation Strategies in Kalpur, Bangladesh

Munshi Yasier Arafat, University of Dhaka. Email: vparafat@gmail.com

Aditi Sharif, University of Dhaka. Email: aditisharif10@gmail.com

Abstract

As well as being vulnerable to floods due to its geography, Bangladesh faces a higher risk of flooding associated with climate change. This article aims to explain the adverse impacts of floods on the overall ecology in the local context of Bangladesh, including accommodation and rehabilitation issues, damage to agriculture and infrastructure, increased vulnerability of domestic animals, difficulties in social relations and religious practices, health problems, water crisis, and livelihood and economic problems. However, people in that area tend to adopt different adaptation strategies, such as, changing livelihood strategies, alternative accommodation, floating agriculture, harvesting rainwater, creating net fencing, travelling by boat or raft, receiving relief assistance, taking refuge in schools and storing food to adapt to the damage associated with floods.

Keywords: *adaptation, flood, impact, vulnerability*

1. Introduction

“You know, brother. During the flood, everywhere you look is water. But you can’t use that water in any way. What a tragedy it is.”

One of the participants responded sarcastically when we asked them about the flood scenarios in their area. However, his sarcasm cannot hide the grim realities of the flood. Flooding is one of the most recurring disasters in Bangladesh, as it has unique geographical features that increase the risk of being exposed to floods (Islam *et al.*, 2024). After its independence, Bangladesh has been a victim of a total of 86 floods (Islam *et al.*, 2024). However, anthropogenic causes like climate change, land-use changes, and demographic changes aggravate the risk (Islam *et al.*, 2024). While floods have some positive impacts on agricultural production, they have a number of negative effects on the overall economy and environment of the country, including damage to crops, water resources, livestock, human lives, and human health (Rumana, Ahmed & Mostafa., 2018). Despite there being recommendations for structural flood management (Dottori *et al.*, 2023), many people in developing countries still rely on community-based adaptation strategies (Rumana *et al.*, 2018). The existing literature in this arena often investigates the negative effects of floods, but they have rarely explored how floods damage an entire ecosystem in a local context.

In this context, this article explores the adverse effects of floods on the multifaceted aspects of the environment in Kalpur, a small village in Gopalganj. As Kalpur is situated in a lowland region near the town of Gopalganj, it is frequently affected by floods for a certain period of time. For this reason, we chose this place to investigate the effects of the floods and people’s adaptation strategies to combat them in a local context.

Using a mixed-methods approach, we investigate how floods affect the lives of human and non-human beings. Additionally, we explore the adaptation strategies people adopt to cope with the disaster. As we were conducting an exploratory study, we did not have any prior hypotheses. However, two research questions guided our study:

- How do floods disrupt different aspects of the environment of Kalpur?
- How do people cope with the adverse impacts of floods?

2. Literature Review

2.1. Floods in Bangladesh

Bangladesh has often been vulnerable to flooding due to its unique geographical location. Bangladeshi people are regularly exposed to four types of floods, which are flash floods, local rainfall floods, monsoon river floods, and storm-surge floods (Islam *et al.*, 2024). Climate change has recently heightened the risk of flooding. As a result, an increasing number of people are vulnerable to the damage of floods (Islam *et al.*, 2024).

The existing literature on the adverse effects of floods indicates that it has devastating impacts on the overall Bangladeshi economy. However, Dhaka, Rajshahi and Sylhet are much more vulnerable to floods compared to the coastal region of Bangladesh (Haque & Jahan, 2015). A study conducted by Zayed *et al.* suggests that almost 25 % of household income and assets have been damaged in the flood-affected areas (Zayed *et al.*, 2025). While floods play an important role in preserving the balance of the wetland ecosystem, they have many adverse impacts on the environment, including damage to crops, water resources, livestock, human lives, and human health (Rumana *et al.*, 2018). Additionally, according to the researchers at Georgetown University, the flood victims are subject to suffering from mental health problems, including depression and anxiety (Thomson, 2023). Different factors, including health displacement, loss of income, and disruption of education, can be highly detrimental to the mental health of adolescents (Sunny *et al.*, 2024). A study conducted by Mamun *et al.* also suggested that suicidal behavior was increased among flood-affected people due to increasing psychological burdens (Mamun *et al.*, 2021). However, people living in disadvantaged areas are much more vulnerable than others when flooding occurs. Owing to the patriarchal culture of Bangladesh, women in rural areas are the worst victims of floods (Nahar, 2025). However, they adapt to the situation by utilizing local knowledge and taking economic and non-economic initiatives (Nahar, 2025).

2.2. Adaptation Strategies of Flood

Prior research on the adaptation strategies towards floods and flood management indicates that while developed countries rely on structural measures to adapt to floods, including strengthening protection through river dykes, creating detention areas, structural and non-structural modification of infrastructures, and relocation (Dottori *et al.*, 2023), most developing countries in the subcontinent rely on community-level adaptation strategies. For example, A study conducted by Devkota, Cockfield and Maraseni (2014) finds that people in the two Terai districts utilize different adaptation strategies (such as monitoring the rainfall, initiating communication, taking care of victims, selecting location, exchanging help with each other, preparing a temporary settlement plan, and coordinating with governmental and non-governmental agencies). Another research study, conducted on the char¹ farming households of Bangladesh, suggests that determining flood adaptation strategies is more critical for females than their male counterparts. Different aspects, including access to agricultural land, agrarian labor, and literacy, play influential roles in determining adaptation strategies (Naz, Doneys & Saqib, 2018).

2.3. Research Gap

Careful observation reveals that while much of the literature explores the multiple negative impacts of floods, they rarely portray how floods disrupt an entire ecosystem in the local context of Bangladesh. In this regard, this article strives to illustrate how floods destabilize the entire ecosystem of Kalpur by exploring the adverse impacts on the multiple aspects of the ecology. Additionally, it highlights the adaptation techniques that the flood-affected people adopt at the community level, which are hardly discussed in the previous research.

¹ Chars are temporary river islands formed by silt deposits.

2.2.1. Objectives of the Study

The objectives of the study are:

- to explore the adverse effects of floods on the multifaceted aspects of the environment in Kalpur and
- to investigate the adaptation strategies of the flood-affected people to reduce damage.

2.2.2 Conceptual Framework

We relied on the concept of the ecosystem to understand the adverse effects of the flood on the overall environment of Kalpur. The concept of ecosystem is intended to describe “a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life (Byjus, 2020).” We utilized the concept to describe how hazards, such as floods, can disrupt the balance of an ecosystem.

Another concept that we frequently utilize in this research paper is vulnerability. While the concept of vulnerability can be challenging to define, it may be conceptualized as “the conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of an individual, a community, assets, or systems to the impacts of hazards”. We have utilized the concept of vulnerability to understand how Kalpur's various ecological aspects are exposed to flooding.

Our article focuses on the disastrous effects of one hazard, and that is the flood. Flood is regarded as the most widespread water-related hazard and can be defined as “water overflowing onto land that usually is dry.” Another objective of our study is to investigate the adaptation strategies of Kalpur residents to mitigate or resist the impacts of floods. The concept of adaptation can be conceptualized as “the adjustment of organisms to environmental conditions and other living things either in an organism's lifetime (physiological adaptation) or in a population over many generations (evolutionary adaptation)”(Shetty & Waterlow, 2003).

3. Methodology of the Study

Based on a mixed-method approach, this study explored the multi-faceted impacts of the recurrent floods on the ecology of Kalpur, a village of Gopalganj. We have utilized both primary and secondary sources of data to investigate the adverse effects of floods. While at the beginning we reviewed secondary sources of data, including books, articles, and book chapters, we mainly relied on primary sources of data, which were collected from field research.

3.1. Data Collection

While we relied on quantitative data collection techniques to collect demographic information and occupational status, qualitative techniques were utilized to gather the impacts of floods on the lives of humans and nonhumans as well as their environment.

In our study, we collected data by conducting semi-structured interviews and focus group discussions. As we conducted our fieldwork in Bangladesh, we interacted with our participants in Bengali. Later, we translated the acquired data into English.

3.2. Sampling

We utilized random sampling to conduct our semi-structured interviews to avoid any bias in the study. However, purposive sampling has been utilized in conducting focus group discussions to ensure the participation of people belonging to different ages and genders.

In avoiding non-response bias, we kept our interviews short so that participants could talk spontaneously. On the other hand, despite utilizing the simple random sampling, we ensured that each member of the population had an equal chance to participate in the study, which helped us to avoid homogeneity in our information.

3.3. Semi-Structured Interviews

We conducted 26 semi-structured interviews to collect data on the overall flood impacts in Kalpur. By following this method, we ensured that we could control the time and quality of interviews to some extent while ensuring the participants' spontaneity.

3.4. Focus Group Discussions

We also conducted four focus group discussions to gather collective perceptions on the adverse effects of floods. The groups consisted of people belonging to different classes, ages, and genders. Moderation of a focus group discussion involved helping the smooth participation of the people in the focus group discussion. While moderating the focus group discussion, we ensured the fact that every person could participate in the group discussion spontaneously. We also gave preference to the voices of underrepresented people.

3.5. Data Analysis

We have utilized a mixed-methods approach to analyze the acquired data. Interviews were conducted in the Bengali language as Bengali is the native language of the participants. Later, these interviews were translated into English. While we used quantitative methods like frequency distribution to reveal the percentages of the sociodemographic information of the participants, narrative analysis is preferred to analyze the qualitative data.

3.6. Study Area

Kalpur is a village of Gopalganj, which is situated in a lowland near the town of Gopalganj. This area is also known as a swamp area, which is frequently flood-affected throughout the year. Owing to climate change, floods have become more recurrent.

The communications system of Kalpur is not good. The study area and surrounding localities have only one road, which is flooded with water in the rainy season. Consequently, by boat is the only way to communicate with people at that time. As the overall ecosystem is suitable for agriculture, most of the people depend on agriculture for their subsistence.

4. Results

4.1. Adverse Effects of Floods

4.1.1. Accommodation and Rehabilitation Issues

During a flood, people in the affected areas often fail to find shelter. At that time, houses were submerged, so no one could stay. Sometimes, people go to their relatives' houses until the water level decreases. Sometimes they take refuge at the primary school in the neighbourhood. However, some people have to adopt alternative methods to survive such disasters. The following narrative can express it clearly:

“My house is just beside the canal. There is no other house around. In the time of the flood, the water in my house was up to the waist. The bed went under the water. Later, we were forced to stay on the roof. It is difficult for the whole family to be together there, but somehow I am adapting. If I need anything, I bring it to the boat. It has been very difficult to cook and eat for

a few days after the flood. We arranged to cook on the boat. There is no relative's house nearby from where we can cook and bring food or we go there.”

This narrative not only provides the helplessness of the participant but also indicates individual endeavours to adapt to the circumstances.

4.1.2. Agriculture and Food Security

Most of the people in this area depend on agriculture for their livelihoods. It has been observed in the study that agriculture is one of the most vulnerable sectors due to floods. At the time of a flood, farmers are unable to cultivate multiple crops, including rice, jute, and paddy.

Floods also damage farmers' stored seeds, crops, and vegetables. When buying seeds in post-flood areas, the cost of seeds is high, and most of them are procured from outside the local area. As a result, poor farmers are forced to use wet seeds, resulting in low germination. Changes in flooding also affects crop production. Owing to floods and inundation, in most cases farmers could not plant paddy on time. In addition to paddy harvesting, winter crops are also delayed. Changes in flooding also affects crop production. As a result of floods and inundation, in most cases, farmers could not plant paddy on time. In addition to paddy harvesting, winter crops are also delayed. On the other hand, crops failed to mature because of an untimely flood, which hampered the livelihoods of farmers.

The disastrous effects of untimely floods in the agricultural sector eventually threaten people's food security in the studied area. Poor people cannot buy food at high prices as frequent floods damage many crops. On the other hand, many people are forced to eat rotten food due to floods. The nutrition of pregnant women is also threatened. They should consume nutritious food with adequate protein during this time but it is not possible during floods. Consequently, both the woman herself and the child she gives birth to or is about to give birth to may suffer from malnutrition.

4.1.3. Infrastructural Damage

Frequent and untimely inundation continuously damages the infrastructure of this area, including roads, schools, dams, tube wells, and electricity poles. Roads leading to schools in flood-affected areas have been destroyed. Many roads in the area are still underwater. In particular, the newly constructed unpaved road leading to Kalpur Uttarpara was submerged in floodwater. As a result, the soil of the road has been washed away by water. In many places, the dam had broken and required to be repaired. The tube well in front of the school went into the nearby pond due to soil erosion. There is only one paved road in the middle of this village, which is submerged in floodwater. As a result, the road pitch has eroded in many places. Electricity poles were uprooted as the floodwater continued.

4.1.4. Unsanitary Sewage System

During floods, latrines are submerged or are in a state of being nearly submerged, except those whose latrines are slightly higher or in a better position; all the others get flood water mixed with the dirty water of the latrine, which overflows. Those whose latrines are submerged in water directly take boats or rafts to defecate into the water. As there is no urban system for sewage disposal in rural areas, sporadic defecation leads to contamination of other elements of the environment, such as water pollution. The consumption of this contaminated water can cause various diseases, including abdominal pain and worm infections.

4.1.5. Vulnerability of Domestic Animals

Many families in this area keep livestock to meet their family needs. Livestock are often affected by floods. During this time, people focus on taking care of themselves, often ignoring the needs of the livestock. In severe flood situations, people have to move out of their homes in search of shelter, and in many cases, they cannot take livestock with them. Again, there is a shortage of animal food. Cow health

deteriorates due to a lack of adequate food. Milk supply decreases. In many cases, milking stops. It causes severe economic losses. In times of economic crisis, human beings sell their animals for economic survival.

4.1.6. Difficulties in Maintaining Social Relations and Religious Practices

Most people in the area are Muslims. A big mosque in the area, named Kalpur Dakshinpara Jame Masjid, is built very nicely on the side of the road. There is a huge field, a madrasa, and a graveyard next to it. In the morning, children come here to study, and Muslims come to pray. In the afternoon, games are organized in the field where everybody meets and talks. Moreover, if someone died in the area, their funeral prayers were offered in the field because there was less space in front of the mosque. Children cannot attend the Madrasah due to travel difficulties caused by floods; those who have a boat or a house with a char (a bridge or wooden *sako*), i.e., a transport system, go to pray. The whole system of social relationships gets disrupted.

4.1.7. Injury and Drowning

In the time of floods, people in the study area are exposed to drowning and different forms of injuries. People are particularly anxious about the drowning of the children because they usually cannot swim. Sometimes little children fall into the water while playing and no one can rescue them. One of our participants told us about such a horrible incident:

“We have 3 children aged 3 to 5 years at home. They always play together. One day during the floods, my 3-year-old child fell into the water while playing. Two other kids were sitting there crying. But no one tried to lift him out of there because they could not swim either. No one called me either. I suddenly ran there looking for Naheed (the baby who had fallen in the water) after hearing the sound of crying. I went and saw my son drowning in the water. I quickly lifted him out of the water and squeezed the water out of his stomach. Amjam uncle (a middle-aged man) heard my cries and came and breathed into my baby's mouth to restore breathing.”

Local people are also afraid of snake bites during the floods. Snake infestation increases in the country during floods, and since this is a remote area, venomous snakes are a menace during monsoons. According to one of our participants:

“Snakes come and bite people by the road, by the house, in the bush, and even inside the house. People are afraid to go out of the house. Especially if you go out at night, you must take a light and a good stick. Those who fish by boat at night see 3-4 snakes almost every day. Sometimes, if they see a poisonous snake and there are some people nearby, they kill the snake out of anger. According to their commentary, each snake is 3 to 5 hands long. However, snakebites did not usually occur. One said it happened once a few years ago. The snake bite victim died on the road while being taken to the hospital.”

4.1.8. Transportation

The only road in the village suitable for the movement of water was damaged in the flood. People reported that road conditions are very bad during monsoons due to continuous flooding. Almost every year, during the monsoon season, heavy rainfall causes extensive damage to all local roads in the study area. Owing to rising sea levels and northerly water pressure, rainwater is unable to drain away from the locality. As a result, the suffering of people is extreme as the water is stagnant for a long time. There is only one bazaar (*haat* in local parlance) for the surveyed village and several other surrounding villages. People depend entirely on local village markets and weekly village markets (*haats*) for their income as well as livelihood. People living here use the local market to buy and sell their products. There is only one road for the people of the surrounding seven villages to go to the market or hospital, bank, police station, or any official work. Therefore, the condition of the road is affected by its use. Due to floods, its condition worsened. According to one participant:

“Apart from going anywhere from home, the boat was the only vehicle for maintaining social contact. Transportation and social communication were much more difficult for this region. Boats are the only way to go to the market to meet someone, see a doctor, buy medicines, or buy vegetables and food for the family. If you need to do these things, you have to go to those who have boats and ask for them. Again, if people take the boat on the market day, they have to ask to go with them. Then they can take it. Many times they get upset, say harsh words. But I can't afford it, so I listen to all that and pretend not to hear it.”

4.1.9. Waterborne Diseases and Health Problems

As a result of the flood, water accumulated in various places in Gopalganj and caused waterlogging. At this time, this health problem became evident due to the lack of a proper water drainage system. Many people defecate in open spaces around the river. The water of the reservoir is polluted by human waste and various forms of garbage in the area. People have to drink the water of these reservoirs without purifying it, use it for food purposes, or use it for washing dishes, washing clothes and so on. Because of this, diarrhea, cholera, and typhoid are among the various waterborne diseases that affect people. When the water goes down, these diseases become more common. The rate of disease depends on how much immunity a person has, how many germs have entered their body, and what kind of environment they live in. Water is the carrier and vector of various germs. So there is a high risk of various skin diseases from touching this water. Owing to damp weather, various types of skin diseases like skin scabs, fungal infections, and itching occur.

It was found from all the respondents of this survey that health facilities were heavily damaged during floods. There is only one health care centre for this area, which is located on the riverbank at Boulatli Bazaar. It is almost impossible to go there and get treatment if someone is sick in the time of a flood. Moreover, the health centre is often closed during the rainy season due to flooding. During this period, various waterborne diseases like diarrhoea, cholera, jaundice and skin-related problems are most common. In particular, children and elderly people usually suffer from these types of health-related problems. On the other hand, floods affect the health of expectant mothers. Pregnant women do not have access to any health facilities during floods. According to the local people of the study area, one has to go far away from the flood-prone areas for any kind of health facilities. Floodwater enters the entire area. Water is contaminated by various bacteria and toxic substances. Although contact with this water is harmful to human health, they also complain that due to a lack of safe water, they are forced to use this water for various daily activities. According to one of our participants:

“At the end of last year's floods, my five-year-old son was infected with typhoid and was in Sadar Hospital for a long time. At that time, I also suffered financial loss due to the flood. Additionally, a lot of money was spent on the treatment of my son. Since then, I and my family have always drunk and used tubewell water, even though the tubewell is far away from my home. When it is not possible to bring water from tube wells, we boil water and use it.”

4.1.10. Lack of Water

Almost every house in Kalpur village has a faucet. But almost always tap water contains arsenic. Only two taps in the area are free of arsenic. But one of them is almost undrinkable due to the high salt content. As a result, everyone in the area uses the other faucet as the only source of water collection. In other regions, drinking water is usually collected by women but men in this area collect the drinking water. As the tubewell is located next to the mosque and far away from the house, men usually bring water to the house while walking or playing, or praying. If the man is not at home, the women bring water at a time other than the time of prayer. It is also seen that the tap is located up to one kilometre away from some houses. In that case, routine fetching of water is seen as a problem.

This problem becomes more severe during floods as there is water all around. Transportation becomes impossible. All the walking paths are submerged in the water. As a result, some families can sometimes

bring water with the help of those who have boats. Those who cannot fetch water have to boil and drink polluted flood water, which causes various diseases. People get sick.

4.1.11. Education

Owing to the floods caused by climate change, the people of Kalpur village of Boulatli union of Gopalganj district suffered damage to the education sector. In most cases, schools and colleges are closed for a long time due to flooding. Moreover, the activities of educational institutions as shelters during floods are also unavailable. This region is spread over a large area, but has only one educational institution. Even if the water does not enter the educational institution and classes stay open, students cannot come to the school due to the difficulty of transportation. Then the school will be declared closed anyway. Again, when the flood intensity is high, the infrastructure of these schools and colleges is damaged and it takes a lot of time to repair them. In most cases local people do not come forward to repair the infrastructure of these educational institutions and they will wait for government assistance instead. Sometimes this help takes a long time to come. Because of this, the activities of the educational institutions of the region are closed. Many students are unable to continue their studies while helping families with the flood situation and many students dropped out of school due to social and economic problems due by floods.

One participant of this study is Sajib (age 16 years). His father worked as a day laborer and supported the family by selling milk from their two cows. But two of their cows died during the flood. As a result, the daily income of their family comes to the bride. Sajib has to work in a restaurant in the district headquarters to meet this deficit and his studies stopped.

4.1.12. Livelihood and Economic Problems

The livelihoods of local people are often affected by flash floods. Most of the people in the village earn their livelihood by agriculture and agriculture-related work. All these people became unemployed due to the flood. Crops that had been hard-earned throughout the year were unripe and lost in the harvest or washed away by floodwaters. So those affected must spend the day eating food stored in the house. There is no money saved. As a result, they cannot buy and eat according to demand and so many have to make money by taking loans at available interest rates to buy their daily necessities. But later, they have to struggle to repay the loan.

4.2. Adaptation Techniques

4.2.1. Change of Livelihood Strategies

Despite people from various professions living in the studied area, most of the people depended on agricultural work for their livelihoods. During the rainy season, they earn a livelihood by selling their produce. However, they are forced to change their source of income due to the harshness of the environment, including catching fish and selling them, doing various temporary jobs (day labourers) in other people's houses. Many people are also migrating to other places in search of work. On the other hand, some people started fish farming using the floodwater. One of the participants in the study area said:

“We became jobless due to the flood. Later, we, four friends, decided to mark out a certain area and do fish farming with a net fence. Accordingly, we started working. We contacted the people who have land in the place we specified. Five people had to pay us cash for that place. They said that the rest of the landowners will be given a share of the fish during fishing. This is how we fish here. We didn't have to work too hard to feed the fish because of the free water between the bills and enough algae to grow. Costs are also reduced. But we always have to keep an eye on whether the fence is broken or the net is torn. Or whether someone is taking our fish. We have benefited greatly from fish farming in this way.”

4.2.2. Alternative Accommodation

When the house was submerged in water due to a flood, they immediately took shelter in the school as it was on a slightly higher level. If water gets inside the school, they will take shelter in a relative's house nearby.

4.2.3. Floating Agriculture

During the flood, it is almost impossible to cultivate anything. In this case, the local people build *kachuripana* piles (water hyacinth or *gaito/gait* in the local language) and put rat-raised soil, rotting (kachuripana roots) etc. on it and cultivate there. Most of the time, creeping plants (gourds, pumpkins, peppers, cucumbers, rorbati, sem and others) are planted in this way.

One of the participants said:

“Due to prolonged flooding and inundation of the country's low-lying areas, it is not possible to grow any crops or vegetables in the local public fields, resulting in poor farmers in the area. They suffer from lack of essential nutrients along with financial malaise. In this case, it is possible to solve this problem mainly by cultivating vegetables and crops in rafts. Moreover, after the water dries up, the manure and compost can be used as organic fertilizers on the crop-growing land. Employment is created for rural people during floods. I think it is possible to increase the daily nutrition and income of the family as well as contribute to the national economy by cultivating crops or vegetables in rafts during floods or in waterlogged areas. Moreover, this system is very simple. In this case, first of all, bamboo rafts should be placed on the water. Depending on the stability of the waterlogged area, thick piles of debris should be piled on it so that it remains buoyant throughout the waterlogging. After 10-15 days with a layer of dung and compost, vegetable seeds should be sprinkled or seedlings should be planted. Various vegetables for floating cultivation such as lettuce, spinach, coriander, cauliflower, cabbage, tomato, beetroot, cucumber, bitter gourd, gourd, chichinga, rice pumpkin, sweet pumpkin, bean, turnip, brinjal, potato, pepper, onion, garlic, ginger and mustard can be selected.”

4.2.4. Provision of Net Fencing to Fish Enclosures

The fish farmers panicked during the flood because there was a possibility that fish would be released into the open water, causing losses to the fish farmers. They buy pre-prepared nets from the market, which are neatly hung around the perimeter during floods. As a result, the amount of damage is reduced to a great extent.

4.2.5. Rainwater Harvesting, Storage and Use

Most of the sources of fresh water were destroyed by floods. Moreover, almost all the tube wells in the area contain arsenic. The two wells that are arsenic-free are far and away. It is easy to get water from there during the dry season. But during the monsoon season, the roads become waterlogged, causing a major problem in traffic. In this case, more water has to be brought by others' boats or rafts. That is why they carry pitchers, jugs, buckets and bottles to carry water so that they do not have to fetch water for the next few days. Moreover, it rains a lot during this time. Rainwater is also stored in clean containers, which reduces the scarcity of fresh water.

4.2.6. Treatment by Indigenous and Local Knowledge

Flood victims are suffering from multiple health problems, including diarrhea and itching. They try to drink dietary saline liquids to prevent loose stools. If dietary saline solutions are not available, home-made salt-molasses syrup is used as an alternative. Additionally, rice starch, chira water, and canned water are used, with safe water as a fallback option, to ensure the patient recovers quickly. If the level

of diarrhea and vomiting increases and the child appears dehydrated, the child will be taken to the nearest health centre or doctor.

4.2.7. Travel by Boat or Raft

Travel becomes a major problem during floods as local roads are submerged. The road that connects the house to the paved road leading to the market or mosque is sunken. Some people are able to manage using a *char* and *sako* (a small makeshift bamboo bridge) combination. But the worst sufferers are those whose homes are far away and have no connections to make communications. All these houses look like islands in a flood. They build or buy boats for transportation. Those who cannot afford to buy a boat travel by using rafts made of banana tree wood or bamboo.

4.2.8. Relief Assistance

Residents get help from various organizations during floods. Low-weight relief is distributed from their village, and full-weight relief, like rice and wheat flour, is distributed from various agency centres. BRAC, Grameen Bank, NGO Prashika, Asha, Caritas, Self-reliant Bangladesh, Public Development Efforts, Legal Aid and other organizations provide relief, but the people of Kalpur village also get relief through wealthy local people, volunteer organizations, and others. The Grameen Bank helps people during floods. They also arrange loans for people.

4.2.9. Adaptation Process in the Education Sector

During the flood, students had no other way to travel except by boat. But not everyone has a boat. In that case, students come to school by catching a lift with those who have boats near their houses. Those who do not have boats may make banana wood rafts to travel to school. When educational institutions are closed during floods, many times local older children take responsibility for teaching the younger education and the elders of the area often try to keep these institutions open by repairing the infrastructure of the educational institutions by collecting subscriptions.

4.2.10. Storage

Most families in the area store as much of their food as they can. Some families have to sell crops instead due to poverty. They preserve food with their indigenous knowledge. Gola (made of *hogla* (cattail plant) or *khari* bamboo, raised with straw and fenced with mats) is used to store paddy. There are two places where rice storage takes place. One is the storage room where clay pots are made and the other is to be kept in sacks.

5. Discussion

This paper primarily deals with the multifaceted impacts of floods on the ecological aspects of Kalpur, a low-lying area of Bangladesh. Situated in a vast river delta, Bangladesh has been a recurring victim of floods (GRICCE, 2023; Islam *et al.*, 2024). Recently, climate change has elevated the flood risk to a significant extent (Hossain, Sohel & Ryakitimbo, 2020). The existing pieces of literature on the impacts of floods suggest that the recurrence of floods in Bangladesh may lead to different types of damage to various sectors of Bangladesh, including crops, agricultural products, infrastructure, and the economy (Rumana *et al.*, 2018). Additionally, people belonging to the disadvantaged sections of this country are much more vulnerable to this flooding. In this context, our article aims to show how a hazard like a flood disrupts the lives of human and non-human beings in a local context in Bangladesh. The findings of the article show that hazards like floods have adverse effects on people, animals, crops, and infrastructure. Victims of floods often deal with several problems, including damage to property, livelihood problems, disruption of normal lives, lack of clear water and fuel, and problems in income-generating activities. Owing to personal hygiene issues and domestic violence, women and children are considered the most vulnerable in such disasters. We utilized the concept of the ecosystem to understand how floods can negatively affect the overall environmental conditions of Kalpur. According to the

concept of ecosystem, both biotic and abiotic components are interrelated and play a vital role in protecting the balance of an ecosystem (Byjus, 2020). In this light, the study argues that the abundance of an abiotic component (water), because of the flood, destabilizes the function of the whole ecosystem of Kalpur and badly affects the living components of this ecosystem, which increases their vulnerabilities.

On the other hand, Islam and Sharif (2024) claim that Bangladeshi people tend to select adaptation strategies based on the nature of the calamity. While the prior research on flood adaptation strategies often recommends structural changes (Dottori *et al.*, 2023), people in developing countries still rely on community-based adaptation strategies (Devkota *et al.*, 2014; Naz *et al.*, 2018). In this regard, we aim to investigate the adaptation strategies of the people to cope with the damage of the flood in the local context of Bangladesh. It shows that the people of Kalpur adapt to the flood situation by changing livelihood strategies, searching for alternative accommodations, discovering new strategies for agriculture, utilizing rainwater for alternative harvesting and storage, getting relief assistance, and providing net fencing. In line with the findings of some previous research (Islam & Shafie, 2017; Islam & Sharif, 2024), this research paper also shows that people in the study area often use their local knowledge, like floating agriculture, to adapt to the problems caused by floods.

By analyzing the multifaceted impacts of floods in the local context of Bangladesh in terms of the ecosystem theory and exploring the various adaptation strategies that people utilize to mitigate the damage, this paper can provide valuable insights into the studies on climate change and disaster management in Bangladesh.

6. Conclusion

Based on a mixed-methods approach, we aimed to explore the adverse effects of floods on the overall environment of a local area of Bangladesh. For this reason, we selected an area that is regarded as frequently flood-affected. It has been revealed that a flood negatively affects multiple aspects of an environment, which eventually disrupts the balance of the ecosystem. However, the flood-affected people try their best to adapt to the situation by adopting different strategies at the community level.

6.1. Limitations

The study was intended to explore the multifaceted adverse impacts of floods and the adaptation strategies they adopt to reduce the damage associated with floods, which can be very time-consuming. However, the duration of the fieldwork was limited. Though we have utilized techniques like semi-structured interviews to gain more information in the shortest possible time, it is possible that valuable insights might have been missed. Additionally, no funding was available to conduct the research. But we tried hard to maintain the integrity and reliability of the research.

6.2. Recommendations

Based on the research, we want to suggest some recommendations for future research and policy initiatives. They are:

- More qualitative research should be conducted on the overall impacts of floods from a micro point of view;
- Local knowledge should be emphasized in selecting adaptation policies and
- An equal distribution of resources is needed to reduce the damage.

7. References

Byjus (2020). Ecosystem- Structure, functions, units and types of ecosystem. available at: <https://byjus.com/biology/ecosystem/>.

Devkota, R., Cockfield, G. & Maraseni, T. (2014). Perceived community-based flood adaptation strategies under climate change in Nepal. *International Journal of Global Warming*, 6, 113–124. DOI: <https://doi.org/10.1504/IJGW.2014.058758>.

Dottori, F., Mentaschi, L., Bianchi, A., Alfieri, L. & Feyen, L. (2023). Cost-effective adaptation strategies to rising river flood risk in Europe. *Nature and Climate Change*, 13(2), 196–202. DOI: <https://doi.org/10.1038/s41558-022-01540-0>.

Grantham Research Institute on Climate Change and the Environment (GRICCE) (2023). *Flooding in Bangladesh annex*, available at: <https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/08/Flooding-in-Bangladesh-ANNEX.pdf>.

Haque, A. & Jahan, S. (2015). Impact of flood disasters in Bangladesh: A multi-sector regional analysis. *International Journal of Disaster Risk Reduction*, 13, 266–275. DOI: <https://doi.org/10.1016/j.ijdr.2015.07.001>.

Hossain, B., Sohel, M.S. & Ryakitimbo, C.M. (2020). Climate change induced extreme flood disaster in Bangladesh: Implications on people's livelihoods in the Char Village and their coping mechanisms. *Progress in Disaster Science*, 6, 100079. DOI: <https://doi.org/10.1016/j.pdisas.2020.100079>.

Islam, M.J., Abdullah, M.S. & Alam, M. (2024). Flooding crisis in Bangladesh: Urgent measures required. *Biodiversity*, 25(2), 95–98. DOI: <https://doi.org/10.1080/14888386.2024.2330385>.

Islam, S. & Sharif, A. (2024). Disruption and adaptation: Assessing the impacts of climate change and adaptation in Arkandi Village of Bangladesh, *ASEAN Journal of Research*, 2(2), available at: <https://so03.tci-thaijo.org/index.php/KMR/article/view/277537>.

Islam, Z. & Shafie, H. (2017). *Anthropology of climate change: Culture and adaptation in Bangladesh 2017*. London: Figshare. DOI: <https://doi.org/10.6084/m9.figshare.8100677.v1>.

Mamun, M.A., Safiq, M.B., Hosen, I. & Al Mamun, F. (2021). Suicidal behavior and flood effects in Bangladesh: A two-site interview study. *Risk Management and Healthcare Policy*, 14, 129–144. DOI: <https://doi.org/10.2147/RMHP.S282965>.

Nahar, K. (2025). Women's lived experience of flood and coping strategies: A study in Bangladesh. *Open Journal of Social Sciences*, 13(3). DOI: <https://doi.org/10.4236/jss.2025.133030>.

Naz, F., Doneys, P. & Saqib, S.E. (2018). Adaptation strategies to floods: A gender-based analysis of the farming-dependent *char* community in the Padma floodplain, Bangladesh. *International Journal of Disaster Risk Reduction*, 28, 519–530. DOI: <https://doi.org/10.1016/j.ijdr.2017.12.016>.

Rumana, M., Ahmed, Z. & Mostafa, M. (2018). Floods in Bangladesh and their impacts: A review. *Rajshahi University Journal of Environmental Research*, 7, 105–115.

Shetty, P.S. & Waterlow, J.C. (2003). Adaptation – Nutritional aspects, in Caballero, B. (ed)., *Encyclopedia of food sciences and nutrition* (Second Edition), Academic Press, 18-23. DOI:

Sunny, S.R., Roy, A. K. & Islam, A. (2024). Effects of floods on mental health of adolescents in rural Bangladesh: A qualitative analysis in four districts. *Global Scientific Journals*, 12(10), available at: https://www.globalscientificjournal.com/researchpaper/Effects_of_Floods_on_Mental_Health_of_Adolescents_in_Rural_Bangladesh_A_Qualitative_Analysis_in_Four_Districts.pdf.

Thomson, F. (2023). Bangladesh flood: Mental health impact on Bangladeshi people. *Open Access Government*, available at: <https://www.openaccessgovernment.org/bangladesh-flood-2022-mental-health-impact-bangladesh/152860/>.

Zayed, S., Morrison, L.T.R., Lapidus, D., Gallaher, M., Letterman, C., Allpress, J.L E. & Cummings, S. (2025). Valuing the economic impact of river floods and early flood warning for households in Bangladesh. *Economics of Disasters and Climate Change*, 9(1), 29–51. DOI: <https://doi.org/10.1007/s41885-024-00156-2>.