

Disruption and Adaptation: Assessing the Impacts of Climate Change and Adaptation in Arkandi Village of Bangladesh

Shanta Islam, University of Dhaka. Email: shantaislam.du515@gmail.com¹

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

Abstract

Though climate change is a global crisis, it has harmful effects on the lives and livelihoods at the local level and agriculture is one of the most vulnerable sectors exposed to this issue. The present study aims to explore the impacts of climate change on the agricultural sector and adaptation in a riverine village in Bangladesh. Utilizing mixed methods, this study attempts to unravel the disastrous impacts of climate change on the agricultural sector including reduced quality of agro-ingredients and lower rates of crop production that eventually disrupt the lives and livelihoods of the peasants. However, people in that village tend to adopt different adaptation strategies to combat such effects. In this regard, they make their decisions based on the types of calamities by utilizing local knowledge and perceptions, intuitions and experiments, and institutional guidance.

Keywords: adaptation, agriculture, climate change

1. Introduction

As agriculture is one of the largest sectors in the Bangladeshi economy, most of the people in this country are dependent on it (Ahmed, 2012). The weather patterns and geographical position of Bangladesh alongside numerous swamps are helpful for the agricultural sector (Ahmed, 2012). However, at present, it is evident that there are severe harmful impacts on this sector due to climate change (Ahmed, 2012).

“Climate change refers to any change in climate over time whether due to natural variability or as a result of human activity (Abbass *et al.*, 2022; Europäisches Zentrum für die Prävention und die Kontrolle von Krankheiten, 2010).” However, human activity is largely responsible for the present climate change crisis (Islam & Shafie, 2017). Climate change causes global warming around the world that can create numerous harmful incidents and disasters including ice melting, heavy rainfall, the rise of sea levels, high frequency of floods, drought, river erosion, salinity intrusion and impediments to the growth of plants (Islam & Shafie, 2017). However, the people of Bangladesh try to adjust to adverse realities through climate adaptation. When an accepted definition of adaptation is “... the processes by which organisms cope with environmental forces and stresses (Kottak, 2008),” climate adaptation can be defined as “... taking actions to prepare for and adjust to the current and projected impacts of climate change (Global Center on Adaptation, 2024).” In this regard, the knowledge of disaster management (whether formal or informal) is essential. Disaster management can be defined as “... a process of effectively preparing for and responding to disasters, involving strategically organizing resources to lessen the harm that disasters cause through a systematic approach” (Tulane University School of Public Health and Tropical Medicine, 2021). However, sometimes, people can apply local knowledge and perceptions to manage disasters that are obtained through generations (Hassan, 2000).

Being located in South Asia on the northern edge of the Bay of Bengal, Bangladesh is a small country, which is comprised of low-lying deltaic plains. Several rivers, including the Ganges, and Brahmaputra, crisscross the country. Except for the hilly areas of Sylhet and the forest regions of Chittagong, most of the lands are not more than 35 feet (10.7 metres) above sea level (Country Reports, 2024). Owing to its unique geographical location, Bangladesh is one of the worst vulnerable countries to being victims of climate

change in the world (Ahmed, 2012). In particular, people living in the riverine and coastal areas are most vulnerable to different types of hazards and disasters (Islam, Shitangsu & Hassan, 2015). Arkandi, a remote village in Bangladesh, is our research site; it is a riverine area (mainland), which is greatly affected by hazards and disasters multiplied by climate change, where most people depend on agriculture for their livelihoods.

Despite being a global crisis, climate change has largely disrupted the lives and livelihoods of Bangladeshi peasants and overall the whole agricultural sector in Bangladesh (Ahmed, 2012). In coastal areas, climate change-induced hazards have a serious impact on coastal agriculture, livestock and fisheries, which are the main sources of the livelihoods of the people living in coastal areas. In particular, those who are disadvantaged in terms of wealth and gender are more vulnerable to crisis (Hossain & Majumder, 2018). From the study by Ahmed *et al.* (2021), it is evident that the agriculture of chars (islands) has been largely affected by climate change. Besides, many studies have been conducted on the impacts of climate change on multiple sectors and the adaptation processes of people in Bangladesh (Ahmed *et al.*, 2021; Dasgupta *et al.*, 2017; Hossain & Noor, 2016; Hossain & Majumder, 2018; Islam *et al.*, 2015). However, studies, that highlight the impacts of climate change and people's adaptation processes on the riverine areas (mainland) in Bangladesh, can hardly be found.

In this context, utilizing mixed methods, we explored the impacts of climate change on agriculture in Bangladesh with a focus on local adaptation processes in the riverbank (mainland) area at Pabna (a district in Bangladesh), by adopting a micro perspective. Besides, this study inquired into some significant issues such as local perceptions of climate change and alternative livelihood strategies. To retain authenticity, we used some Bengali words like *bigha* (a unit of measurement of land: 1 *bigha* is equal to 0.33 acres) and *beel* (a special kind of wetland in Bangladesh). Moreover, we used an abbreviation of an agricultural term that is HYV (high-yielding varieties), which refers to such varieties that can increase food production per unit).

1.1. Objectives

The main objectives of this paper are:

- to understand the impacts of climate change on the agricultural sector in Arkandi, Pabna
- to explore the local adaptive strategies of the peasants in this area.

2. Literature Review

2.1. Climate Change and Its Impacts on Agriculture

Despite being a global crisis, the harmful impacts of climate change often disrupt local lives and livelihoods (Islam & Shafie, 2017). Owing to its geographical position, Bangladesh is one of the most vulnerable countries in this crisis and climate change has hampered multiple sectors in the country. Being an agricultural country, where more than half the population is directly or indirectly associated with this sector, climate change can threaten the lives and livelihoods of a significant number of people in this country (Ahmed, 2012). Hossain and Noor (2016) described how the agricultural sector and food security of Bangladesh is being threatened by climate change (Hossain & Noor, 2016). Climate change causes higher temperatures, decreased rainfall in winter and rises in sea level that eventually damages crop production (Hossain & Noor, 2016). On the other hand, Islam *et al.* (2015) examined the harmful effects of sea level rise in the agricultural sector by demonstrating that it can cause salinity intrusion, recurrent floods and increased cyclone frequency.

Though a large number of people are dependent on the coastal areas, these areas are the worst victims of

climate change. The multifaceted consequences of climate change in the agricultural sector of southern areas in Bangladesh include higher infestation of pests, deficiency of water and soil moisture and salinity intrusion (Hossain & Majumder, 2018). Moreover, calamities like cyclones can make the situation even worse. For example, during the cyclone of Amphan in 2020 (Bangladesh Relief Web, 2020), the coastal areas of Bangladesh were largely devastated. Along with the lives and livelihoods of people, the harmful effects of the agricultural sector were highly visible (IFRC, 2020).

2.2. Climate Crisis and Adaptation

“Adaptation refers to the processes by which organisms cope with environmental forces and stresses (Kottak, 2008).” In this study, we have utilized the concept to understand the processes by which people can cope with the adverse situations of climate change. Based on a synthesis of micro and macro perspectives, Islam and Shafie (2017) illustrate the impacts of climate change and adaptation techniques in four districts of Bangladesh, which are each situated in different geographical regions. As the natural calamities and other difficulties caused by climate changes differ in terms of regions, people tend to adapt to their situation in different ways (Islam & Shafie, 2017). Islam *et al.* (2015) recommended some adaptive strategies such as control of saline water intrusion into agricultural land, coastal afforestation, cultivation of saline tolerant crops, homestead and floating gardening, embankment cropping, and adopting alternative livelihoods at the local level (Islam *et al.*, 2015).

Like most of the least-developed countries, Bangladesh contributes little to the global crisis. Nevertheless, it is one of the worst sufferers from the crisis. It is quite evident that it has limited adaptive capacity in the institutional, educational and economic contexts (Huq *et al.*, 2003). However, people in the country often adopt different forms of adaptation techniques that have been passed down through generations. The study of Hasan (2010) resonates with the fact as in his study he shows how Rakhain people perceive, predict and adapt to disasters like cyclones. On the other hand, some studies highlight the possibility of technology-based adaptation strategies (such as soil-resistant rice) to combat the harmful impacts of climate change in disaster-prone areas (for example-coastal areas) (Dasgupta *et al.*, 2017).

Careful observation reveals that some of the studies, relevant to the impacts of climate change and the adaptation strategies to combat climate change, are focused on disaster management, while others focus on the impacts and adaptation processes of multiple sectors in Bangladesh. Some studies indeed focus on the agricultural sector but they have been conducted in coastal areas or adopted a macro perspective. However, the present study illustrates the impacts of climate change and the adaptation process in a local context from a micro-perspective.

3. Methodology

3.1. Sources of Data

Though this article is based on an empirical study, we have collected data from both primary and secondary sources. The primary sources of data include qualitative data collected from fieldwork whereas the secondary sources were books, research papers, newspapers and the internet.

3.2. Selection of the Site

As we decided to conduct a study that investigated the impacts of climate change on agriculture and the adaptation processes people adopt to combat such effects, we selected a remote village named Arkandi in the southern area as a research site, where most of the people are associated with agriculture and the area is largely affected by climate change.

3.3. Sampling

As ours was a qualitative study, we decided to do an in-depth study with a small sample size. Therefore, we talked with the thirty participants most vulnerable to the situation. While most of the participants were peasants, some of them were associated with local businesses.

As we wanted to assess the impacts of climate change from an anthropological lens, we chose to talk with people who have clear ideas about it or those who are the sufferers of climate change. So, we adopted purposive sampling to select participants in our study where we particularly chose peasants and people who are closely associated with farming. We also tried to select participants from all classes, religions and genders so that the sample could successfully represent the study population.

3.4. Methods of Data Collection

In our research, we have used several anthropological methods to collect sufficient data. All the interviews and notes were taken in Bengali as the native language of both participants and researchers is Bengali. After the data collection, we translated these into English. While translating the interviews and notes, we strive as much as possible to retain the original meanings.

The methods, by which we collect the data, are:

- Key informant interviews: we have interviewed some professionals and businesspeople who have well-articulated notions about the impacts of climate change in the locality. These interviews were helpful to guide us in understanding the local dimension of this global crisis.
- Observation: we have also observed the activities of our participants and the surroundings to understand the impacts of climate change on their daily lives and how they adapt to such changes.
- Semi-structured interviews: in our fieldwork, we mostly used semi-structured interviews to collect data from our participants. In this method, we had some predetermined questions about the impacts of climate change and adaptive strategies that can be used to combat climate change-induced hazards and adverse situations. We also provided sufficient freedom to our participants so that they could utilize their agency in explaining their knowledge and experience.

3.5. Data Analysis

“Qualitative analysis- in fact, all analysis - is the search for patterns in data and for ideas that help explain the existence of those patterns (Bernard, 2006).” Like most of the qualitative studies, our data analysis began when we started to collect data from our field. At that time, we used to review our notes (that were collected during the interview or observation) and found the gaps that were required to fill.

After our fieldwork, we utilized the triangulation method to analyze the collected data. At the outset of the study, we used some quantitative techniques to identify the frequency and percentage. After that, we classified our qualitative data by some general themes including the impacts of climate change on the agricultural sector and the local adaptive strategies to such adverse situations.

4. Findings

4.1. Socio-demographic Characteristics of the Participants

As mentioned earlier, at the outset of the study, we collected some fundamental demographic information. These are presented in the following table:

Table 1: Demographic Profile of the Participants; source: Original Research

Variables	Options	Percentages
Gender	Male	41.7
	Female	33.3
	Children	25.0
Household Pattern	Nuclear	73.3
	Extended	26.7
Academic Attainment	None/Non-formal	20.0
	Literacy	20.0
	Primary	3.3
	Secondary	26.7
	Higher Secondary	3.3
	Above higher secondary	26.7
Yearly Income Range (TK)¹	0-19,999	16.7
	20,000-50,000	46.7
	50,001-100,000	26.7
	100,000 +	10.0
Amount of Agricultural Land (Bigha)	Landless	16.7
	1 to 5	60%
	6 to 10	20%
	Above 10	3.33%

4.2. Types of Crops in the Locality:

Though the peasants in Arkandi used to produce different types of crops, nowadays, they only produce rice, jute, wheat, mustard, sesame and vegetables in three particular seasons. The following table can illustrate this variation in detail:

Table 2. Seasonal Crops and Its Production Rate; source: Original Research

Cropping Season	Duration	Produced Crops	Average Amount of Crops
Kharif-1	March-May	Rice, jute, wheat etc.	Medium
Kharif-2	June-October	Aman rice, summer vegetables etc.	Medium
Rabi	November-February	Mustard, sesame	High

4.3. Impacts of Climate Change on the Agricultural Sector of Arkandi

4.3.1. Climate Change and Arkandi Village

The area is vulnerable enough in the case of climate change. The western part of the area is close enough

¹ 1 US\$ is equal to 117.5 Bangladeshi taka (BT).

to the River Padma and the eastern part is connected to the Chalon *beel* through various channels. The entire village is residing on segregated soil heaps which are somewhat elevated from the land. In the dry season, people collect soil from their water reservoir and with that soil they heighten their residing land. They do it to adapt to flood but the agricultural land is low-lying, so that land becomes easily flood-affected every year.

In the rainy season, agricultural land was inundated very swiftly at the start of the flood. There are two specific reasons for that catastrophe, first of all, the geographical position and the second one is climate change. The effect of climate change accelerates the rate of vulnerability and that is why the situation has progressed to an extreme level. The crops have gone underwater before harvesting. Those who try to harvest them have had no end of trouble.

In the dry season, people cannot maintain the irrigation process properly. All the channels and the river also dry up and consequently people install shallow or deep pumps for irrigation. Though there is a sluice gate under the dam, the quantity of water that flows through it is not enough to cover the area. So, the peasants have to carry water to the land from afar or use deep pumps in the dry season. Moreover, hailstorms, heavy rainfall, heatwaves, cold waves and so on are common natural disasters that make it very difficult for people to cope.

A statement from one participant, Afzal Pramanik (60), can reveal the overall situation:

“In our childhood, we saw many kinds of crops that our ancestors cultivated. My father and grandfather used to farm many kinds of cereal crops like *buro*, *cown*, China, *ukunmodhu dhan*, *kalojira dhan* [different types of paddy] etc. At that time, we had to face an irrigation problem because pumps were not so available on that time. The HYV paddies had not been cultivated at that time. We had to depend on precipitation or channels for river water. The fact is, we didn’t face so many natural catastrophes but now we are doing so. Every natural phenomenon occurred at an exact time in the past. We didn’t go through frequent floods, rainstorms, heat waves, or cold waves. Every kind of calamity happened in moderation. But at present, we are experiencing them in extremity. Some unwanted and terrible situations are happening frequently. Our village was full of trees and roads were not covered with pitch. We were segregated from the municipal area. We used a boat as our transport system. Now, more recently, people have cut many trees to construct those bridges and roads. Now we are in touch with the modern transport system but the system cannot reduce our suffering. Moreover, we are facing strong gusts of winds because of the trees having been cut down.”

4.3.2. Quality of Agro-Ingredients: Past and Present

The quality of some essential components for agriculture including soil, seeds and water sources has been disrupted by climate change. The comparative chart can clarify the matter:

Table 3. A Comparative Chart on Agro-ingredients Quality; source: Original Research

Component	Past	Present
Soil quality	Moist and fertile from natural means Low land erosion Moderate pH level	Dry soil Low fertility Rise of soil erosion etc.
Seed quality	Moderate germination power Well-nourished and free from insect attacks	Reduction of quality Reduction of germination power
Water source	River water through channels Moderate precipitation	Deep or shallow pumps required
Fertiliser use	Moderate rate of using fertilisers and pesticides	Excessive use of fertilisers and pesticides
Form of plants	Sufficient growth naturally	Insufficient growth Extensive insect attacks

4.3.3. Quantity of Crops

People of that village farm mainly two kinds of crops; paddy and mustard. Once they cultivated various other crops but at present the situation has become a little bit tough and is getting out of control. Here we can explain the situation with a case study. Gafur Pramanik (80) is an elderly peasant of the village who observed:

“We cultivated so many kinds of crops but we don’t do it now. The land has become infertile and that’s why we don’t get enough crops from that land. We can’t produce as much as we could before. As an example, once upon a time, we cultivated jute and other crops in the rainy season [Kharif-2]. We didn’t have to face many difficulties as much as we have to do nowadays. Heavy rainfall and excessive flooding impede the production level of jute cultivation. Moreover, the floods at unsuitable times and high-water levels of the flood make the situation much more adverse and this is not favorable to jute cultivation ... we were also used to cultivating wheat, barley and many kinds of cereals but wheat is grown in the summer and excessive heat now does not let the wheat grow properly. This is the reason we stopped cultivating so many crops. Nowadays, we only cultivate rice, mustard, some kinds of peas and pulses.”

4.3.4. Impacts on the Livelihood of Peasants

People have been going through this adverse situation for more than two decades and day by day the situation is getting worse. Peasants are trying to combat the adverse effects of climate change but in some cases, they are getting destitute. Low production rates and economic loss are pushing those people to move from agriculture. Most of the people are engaged in another profession besides agriculture and some of them have taken that profession permanently. The impacts of climate change have lessened the standard of living. People are working as day labourers, rickshaw pullers, bricklayers, auto-rickshaw pullers and so on. Some of them are moving to a city or town in search of work. After coming to a city area like Dhaka, they work at brick kilns in garment factories or as a day labourer. As they cannot manage their family through cultivation, they are breaking down economically. Some of them sell their land permanently and go to another place forever. We have found at least five households that have been left by their residents.

We asked some of those people’s neighbours why they left their dwelling house. One of their neighbours replied: “They couldn’t run their family. The prime members of those families are sharecroppers. For being a sharecropper, they can’t grow all of the produced crops required. As a rule of sharecropping, the sharecropper gets $\frac{2}{3}$ of the whole production and $\frac{1}{3}$ goes to the land owner. However, the sharecropper

gets the lion's share but this is not now sufficient to feed their family and not even enough to be compensation for their efforts. They have been broken down economically and mentally and that's why they left everything and gone to Dhaka to do something else so that they can eat three times a day properly."

This is how climate change makes changes in the pattern of livelihoods. People are losing interest in agriculture and they are being engaged in some other professions.

4.4. Adaptation Strategies for Climate Change

4.4.1. Calamity-Based Adaptation

In the village of Arkandi, people have no limits to the adversity they face. First of all, they live in a marginal area of Bangladesh and that is why they are deprived of so many of the advantages of the modern era. Moreover, climate change effects added an extra dimension to the problem. It is true that they really cannot get rid of this problem completely but they are trying to cope with the adverse situation by following some adaptation strategies. Generally, the peasants follow up the adaptation processes based on the calamity being faced. In the summer season, as the peasants face a water crisis, they plant drought-tolerant rice seedlings. Moreover, every year they cut the water reservoir deep so that they can store water in the monsoon season and use that for irrigation in the dry season. To avoid the flood effects, they make their homeland higher from the ground by heaping up soil. In the flood time, they cultivate some kind of vegetables on the sides of their land. In the rainy season, people use water hyacinths as cattle food. They gather together water hyacinths and bind them with rope and bamboo and cement pillars in the water.

4.4.2. Sources of Adaptation Strategies

There is an ongoing process of adaptation but people do not always discover and maintain this strategy respectively by themselves. In the village of Arkandi, they have learned the adaptation process in three ways.

The first is through local perceptions and knowledge. The people of Arkandi utilize popular local perceptions and knowledge that are circulated through generations. A statement can clarify the situation, Labu Sarkar (35) said:

"I am an uneducated person. I don't know how to survive or keep pace with civil society. That's why agriculture is perfectly suitable for us. We know how to cultivate and how to save our crops. Still, we are following some adaptation processes that we learned from our ancestors. We apply those processes whenever we need them. In the future, we will do the same thing but if we face any new difficulties then we have to discover some new survival tricks."

The second is through intuition and experimentation. Apart from local knowledge and perception, the people of Arkandi sometimes rely on intuitions and experiments while combating new forms of problems. Labu Sarkar's further statement can help explain the situation.

"It's true that we depend on techniques that we learned from our fathers, grandfathers or his grandfather. But sometimes we have to use our senses when a new type of problem appears. For example, if the situation is getting so difficult, we have to move to another place or shift our occupation. Nothing but our intuition told us to do so."

Finally, there is institutional guidance. To solve any critical problem that requires a scientific solution, various kinds of local-level agricultural institutions or agro-training centres play leading roles in guiding the

peasants. However, the people of Arkandi do not have proper institutional guidance. Rather, they rely a lot on local knowledge, intuitions and experiments.

5. Discussion

From the findings of the previous studies, it is evident that despite being a global crisis, climate change has disrupted the lives and livelihoods at the local level (Islam & Shafie, 2017). Due to its geographical position, Bangladesh is suffering a great deal because of climate change and the agricultural sector is one of the most threatened sectors in this country (Ahmed, 2012). The findings of the present study also reveal that the quality of agro-ingredients has been reduced due to climate change in Arkandi village. The production of crops has also been decreased, which eventually hampers the lives and livelihoods of the peasants. Some of them were forced to shift their occupation while some were forced to migrate.

As the national adaptive capacity of Bangladesh is quite low in educational, economic and institutional areas (Huq *et al.*, 2003), people tend to rely on local knowledge a great deal (Hasan, 2010; Hassan, 2002) and they utilize different techniques for different calamities (Islam & Shafie, 2017). Our findings also show that the people of Arkandi determine their adaptation strategies based on the patterns of calamities. For example, in the summer season, people tend to plant drought-resistant seedlings while they plant water hyacinths in the rainy season. It is also revealed in the study that people learn adaptation processes from three sources: circulation of local knowledge through the generations, intuition, experimentation and formal training. However, they usually depend on local perceptions and knowledge.

While most of the studies in social sciences that deal with the impacts of climate change on agriculture have been conducted in coastal areas or islands or adopted a macro perspective, this study sheds light on the impacts of climate change and adaptation processes in a riverine area (mainland), utilizing a micro perspective.

By utilizing in-depth qualitative interviews alongside some quantitative methods, the present study illustrates the impacts of climate change on the agricultural sector, as well as the lives and livelihoods of the peasants of a mainland riverine area, which can be quite insightful for South Asian studies and anthropology of climate change as it can shed light on the human dimensions of climate change as well as highlighting the impacts of climate change on agriculture that largely shapes the fate of Bangladesh, one of the most highly populated countries of South Asia.

6. Conclusion

Utilizing mixed methods, this study aimed to explore the impacts of climate in the agricultural sector in a local context. To investigate these factors, we selected a riverine locality, where people are victims of poverty and multiple forms of disadvantage. It reveals the impacts of climate change on the agricultural sector are multiple including compromised quality of agro-ingredients and decreased crop production rates that eventually hamper the lives and livelihoods of the people of the village.

Despite being the victims of various forms of discrimination, people adopt different adaptation strategies individually based on local knowledge, intuition and experiments. In some cases, formal guidance from different governmental and non-governmental organizations is available.

6.1. Limitations

As we both belong to the urban middle class, it was not quite easy to communicate with our participants, who were mostly peasants. Honestly speaking, most of them were confused about our research objectives and even skeptical about our purpose. However, when we told them in detail about our research, they

cordially assisted us. Moreover, our gender identity (female) also creates hindrances to observing the activities of the farmers.

6.2. Recommendations

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

- While determining the adaptation policies, local knowledge should be emphasized;
- More research should be conducted on the agro-tech sector;
- Local people should be provided with training and
- Joint endeavours of government and private sectors should be emphasized.

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