

Waterlogging in the Southwest Coastal Areas of Bangladesh: Local Adaptation Techniques and Challenges

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Abstract

Waterlogging is a critical environmental problem in the southwest coast of Bangladesh predominantly in some parts of Jashore, Satkhira and Khulna districts which create substantial impacts on livelihood. Therefore, this research aims to analyze how the coastal society deals with the increasing pressure on livelihood that emerged during and after waterlogging episodes. This research is dependent on empirically gathered data using both quantitative and qualitative approaches. A total 210 in-depth interviews from six unions, two unions from each of the three districts were conducted using a semi-structured questionnaire. In addition, six focus group discussion sessions and six key informant interviews were organized. For statistical analysis of collected data, SPSS was used. The study identifies some critical impacts of waterlogging on livelihood which include physical and mental illness, crop failure and damage, disruption in cropping mechanism, loss of income, and increasing level of debt. The adaptation techniques practiced by the local people have been identified to be short term and insufficient to permanently improve livelihoods in the face of recurrent waterlogging.

Keywords: Waterlogging; Adaptation; Livelihood; Bangladesh; Coastal Region.

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1. Introduction

Bangladesh, a low-lying deltaic country in South Asia, is one of the most at risks of natural disasters in the world. Due to topographic features and geo-physical location the country is always vulnerable to various natural hazards, particularly to extreme climate-induced disasters [1]. According to the Stern Review and IPCC 4th Assessment Report, climate change will have adverse impacts on livelihood, with the “poorest people in the poorest countries expected to suffer first and foremost” [2]. The physical geography of the coastal area of the country is diverse and dynamic. The entire southwest region (SWBD) is extremely vulnerable to natural disasters-mainly tidal flood, storm surges and waterlogging [3]. The South West coast of Bangladesh (SWBD) is dominated by an extensive network of water systems forming the largest delta in the world [4]. A plethora of research indicate that coastal zone vulnerability would be critical due to the cumulative effects of climate change, upstream river basin management, natural disasters and unplanned development interventions [5]. Since the beginning of the 21st century, waterlogging has become a serious problem and at the forefront of major environmental concerns, predominantly in some parts of Jashore, Satkhira and Khulna districts. These areas have faced rainfall induced floods and prolonged waterlogging due to slow discharge of water in the embanked areas in recent years [6]. This situation is an amalgamated effect of the unintended consequences of the Coastal Embankment Project initiated in 1960 [7] and diversion of water in the upstream. On a specific note, waterlogging is a result of a combination of factors that include: excessive monsoon rains; inadequate drainage; mismanagement and a lack of maintenance of embankments; increased sediment and siltation of rivers; restricted river flows due to embankments built for shrimp farming; and the release of water from barrages in India [8]. This study scrutinizes six unions of Jashore, Satkhira and Khulna districts (2 unions from each district) highly affected by waterlogging. It aims to analyze how the coastal society deals with the increasing pressure on livelihood that emerged during and after waterlogging episodes. The research contributes to an understanding of the social dynamics following waterlogging season by addressing the following research questions: What are the impacts on livelihood due to waterlogging? What adaptation actions are taken by the coastal communities at the individual and household level?

2. Methods

2.1. About the Study Area

The study area, comprising six unions of Jashore, Satkhira, and Khulna districts, is located at the Ganges-Brahmaputra delta in southwest Bangladesh. Heavy rainfall during monsoon causes severe localized flooding in these southern districts of Bangladesh [9]. In some unions of these districts, water remains stagnant for a prolonged period even after flood recedes. The three districts faced the most severe waterlogging in 2017 [10]. Three environmental factors have substantially influenced to create a very complex and multi-faceted socio-ecological system in the study area [11]. First, a large-scale human intervention called, Coastal Embankment Project (CEP), was initiated in 1960 in order to protect the floodplain from periodic inundation of saline water to boost the agricultural growth in the area [12]. Though, initial outcome of this intervention was positive, it has also caused severe damages to livelihood of people. Second, export-oriented shrimp and crab farming in these areas have undergone rapid expansion over the last two decades in coastal region [13]. 80% of these shrimp and crab farms are located in Satkhira and Khulna [11]. In parallel to its large contribution to local and national

economy, it has already caused significant damages to the local ecosystems. Third, the unique ecosystem of the area is characterized by the Ganges Brahmaputra river delta that includes the Sundarbans, the largest single patch mangrove forest in the World [11].

2.2. Data Collection and Analysis

This research is dependent on empirically gathered data and based on a stratified random sampling surveying method. A total 210 respondents from six unions, two from each of the three districts were interviewed using a semi-structured questionnaire. In addition, this research included community based qualitative tool like focus group discussions for extracting relevant information from the affected areas. A total of 6 focus group discussion sessions and six key informant interviews were also conducted. Representatives from local government offices, NGOs, community leaders and affected people participated in the FGDs. Statistical analyses were performed using the SPSS software.

2.3. Limitation

This research has some limitations. First, the study area is quite inaccessible during waterlogging season and the field survey was therefore conducted during the dry season. Hence, responses from the interviewees might not have captured the all aspects of adaptation to waterlogging. Second, the study is heavily dependent on testimonies from individual respondents. A more rigorous social analysis is required to get a deeper understanding of adaptation practices and challenges in the study areas. Third, the survey was unable to reach the people who are known to have significant roles in exacerbating the problem. These are mostly the local influential people who could not be reached for interview.

3. Findings and Discussion

3.1. Socio-economic Background

Literacy rates in the study areas are low. Among the respondents, 34.4% male and 31.6% female never went to school. Rate of illiteracy is highest (46.7% male and 38.5% female) in the selected unions of Satkhira. It is generally accepted that a strong correlation exists between educational attainment and poverty [14]. Agriculture is the dominant source of income among the respondents in all the study areas (64.3% in Jashore, 62% in Khulna and 42% in Satkhira). Primary sources of income are farming, fishing, and small business. A good number of brickfields have been constructed in Satkhira and Khulna. Therefore, many among the day laborers work in these brick fields who used to work in shrimp pond or agriculture earlier. Typical household in the study areas consists of 5 to 9 members and earns an average monthly income of BDT 5000 (around 59 USD). Most of the household income is used for consumption, especially food. Only a fraction is saved or used for other purchases. Monthly deficit becomes acute during the months of July to September (Monsoon) in all areas and in winter (October to December). During monsoon, heavy rainfall causes waterlogging and causes widespread damage to crop. Several researches based on satellite imagery analysis indicate that there has been exponential increase in land inundation in these areas since 1973 [15]. Therefore, respondents face more financial deficit during monsoon. Savings are generally small for all households. 58%, 30% and 12%

respondents in Satkhira, Jashore and Khulna having monthly saving practices. Distress migration occurs to a very limited extent (1.4%) due to livelihood and productive asset losses. Around 75% respondents in Khulna and Satkhira and all respondents in Jashore stated that they face waterlogging in almost every year. The socioecological dynamics are different in Jashore than that in Khulna and Satkhira. Respondents in each area are aware of the geopolitical and historical background of the waterlogging problem in their areas.

3.2. Livelihood Impacts of Waterlogging

The impact of the flood extends to post-flood period in the form of waterlogging and in fact, during the whole year. The impacts are not only in form of loss and damage of life and property but affects the very basis of livelihoods and make communities vulnerable to a vicious cycle of losses, lack of capacity and poverty. Many of the households interviewed experienced shocks during and after waterlogging, including illness (both mental and physical), crop failure, food shortages and loss of income and livelihoods. Further, an increasing level of debt taken on as a coping mechanism made the vulnerability of flood and waterlogging affected households even worse. 37.7%, 39% and 23.4% respondents respectively from Khulna, Satkhira and Jashore take microloans from formal and informal financial institutions to combat the loss due to flood and waterlogging. Microcredit restricts the adaptive capacity of households, according to a study on linkages between access to microcredit and climate change resilience conducted in southwest coast of Bangladesh [16]. As waterlogging is a recurrent phenomenon, it has a composite negative effect on households who are already indebted. Eventually, such individuals and households end up taking loans from multiple NGOs, resulting in compounding debt and may finally be drawn into the vicious cycle of poverty. The livelihoods of the respondents in affected areas still rely mainly on agricultural farming and access to common property and public goods and services. Rural families have less access and lower savings to cope with unexpected shocks. The months of November and December are usually the period when rural households are busy with harvesting and selling labor for agricultural farming. The floods and waterlogging bring heavy additional stress to rural livelihoods by markedly affecting these job opportunities. More than 75% respondents in both Khulna and Satkhira and 100% respondents in Jashore stated that their livelihoods are regularly affected by waterlogging. Ruined agricultural lands and damaged infrastructures as a result of flood had both immediate and on-going consequences for people who depend largely on seasonal yields and employment for their livelihood. Damage of crops, water quality deterioration, inundated latrines, diseases and psychological and physical injuries are some frequently mentioned impacts due to waterlogging in the study areas. Some 80% respondents in Jashore said they lost agricultural yields due to waterlogging. Damage caused by a natural disaster, such as waterlogging, can push households into poverty and push already poor households further into the depths of the poverty cycle [17]. Households experience a significant level of decrease in income in the months of waterlogging and afterwards. Some 60% respondents in Jashore stated that they face severe deficit in the months of July to September (Monsoon). During this time, around 34% respondent in the same area face a monthly deficit of around 4000 BDT. Another 18% from Khulna and 13% from Satkhira highlighted on the monthly deficit of around 4000 BDT during the months of Monsoon. In addition, 32% household in Khulna face a monthly deficit ranging from BDT 1000 to 2000 during monsoon. As a result of these shocks, many of the affected households could not work, afford to buy food, did not have safe water, and could not send their children to school. The flood and waterlogging cause some health difficulties in the study areas. Around 70% respondents in all the areas pointed

out that they commonly face skin diseases due to flood and waterlogging. Diarrhea is another common disease faced by people due to such disaster. Other diseases reported by the respondents are coughing, fever, hair loss, muscle pain, eye irritation, vomiting, and chikungunya. Local populations attribute many of their health-related problems to the recurrence of waterlogging. Waterlogging exacerbates poverty and renders local populations unable to attract the types of resources needed for regional development to occur. Diseases after flood and waterlogging is exacerbated by the broken water supply and sanitation system in the study areas. 51% households in Khulna, 60% households in Satkhira and 20% households in Jashore faced broken water and sanitation system during and after periods of waterlogging or flood. Access to healthcare facilities is very limited and causing people to place greater reliance on local trained village doctors or on local pharmacies where medicines are sold without prescriptions.

3.3. Adaptation Practices and Challenges

Recurrent waterlogging effects are increasing the vulnerabilities of people solely dependent on agriculture. The vulnerabilities can be explained in terms of water shortage, food shortage, health issues and economic issues. Considering the vulnerability, this section provides findings related to adaptation and associated challenges. Most of the adaptation practices found in this study are autonomous adaptation practices. This implies that these practices are neither planned nor sustains once the hazard is over. These adaptation practices are oriented towards survival and not as a continuous process or solution. In terms of drinking water crisis, common adaptation practices include collecting rainwater, purchasing clean water, purifying water using tablets and potassium alum. In Khulna and Satkhira, community management of pond sand filter (PSF) is a key adaptation technique while in Satkhira collecting rainwater is dominant. Both the techniques are facilitated by local NGOs with support from national and international NGOs. However, none of these technologies are found sustainable after the management is transferred to the local people. The reasons behind the failure include lack of social cohesion, unwillingness to pay the cost of management and lack of ownership. Around 50% respondents on Khulna stated that they purchase fresh water (BDT 20 per 30 liters) when water sources are contaminated. This has exacerbated the livelihood condition of local people in two ways. First, a significant portion of their monthly income get drained out to fulfill basic water needs of the family. Second, local influential traders formed 'water syndicate' to make ill-motivated profit. In extreme cases, forced adaptation practices include drinking less water, drinking contaminated or saline water during flood and waterlogging periods. Increasing number of human populations along with rapid economic development in the region will exacerbate the water security situation in future [18]. Diversified farming techniques as well as using tube well and canal water for irrigation are two exceptional adaptation techniques used primarily in Khulna and Jashore. In terms of diversified cultivation techniques, the respondents are found to be cultivating fruits of different kinds in addition to traditional farming practices. In Khulna, lychee, apple and grapes farming is found in unorthodox locations. However, the practice remained at the household level and its commercial aspect needs to be verified. The practice of polyculture (rice, fish and duck) was found in some parts of the study area in Khulna. In caged polyculture system, vegetables are planted in a floating tub attached to the top of a cage and fish are then farmed within the cage itself. The vegetable cultivation process purifies the water and waste provided by the fish supplies much-needed nutrients for the growth of the crops. Both the crops and the fish selected are fast growing, meaning that up to three cycles of production can be completed each year. When the water rises, the

age rises too. In some parts of Khulna and Jashore, farmers buy canal water and mix it with tube well water to make it suitable for irrigation. Tube well water in these areas are mostly saline. To reduce the concentration of salinity they mix fresh water from canals. Local influential persons who are the lessees of the canals do not allow farmers to freely use canal water. The farmers pay BDT 1000 for irrigation in 1 bigha (0.16 Hectare) of paddy field. During winter freshwater unavailability increases the salinity in these areas. Hence, irrigation becomes a major challenge for boro cultivation. Farmers embrace higher costs to manage irrigation in such context which impose additional pressure on the livelihood of farmers. Considering the difficulties, people often remodel their agricultural practices. Remodeling includes planting vegetables on land aisles, poly culture, maximizing the utilization of lands, homestead farming, using the roofs of the houses, and growing more crops during flood-free times. The driving force behind the adaption to medical emergencies are common occurrence of some diseases including diarrhea and skin diseases in the study areas. Self-prescribed medication is one of key adaptation techniques related to healthcare among the respondents. 31.4% respondents in Jashore and around 15% respondents in Khulna and Satkhira took self-prescribed medicines during health emergencies after flood and waterlogging. In all the study areas there are some trained doctors (not earned a medical degree) who are popularly known as “village doctors”. People mostly visit these doctors for primary health services. 30% respondents in Satkhira and around 22% respondents in Jashore and Khulna visit such village doctors. Human settlements are highly vulnerable as natural disasters take a huge toll on houses and sanitation infrastructures [19]. In the study areas, residents adapt to immediate housing problems during flood and waterlogging by seeking temporary shelter in relatives houses in the flood free areas. A more permanent adaptation technique is to raise the plinths of their houses. However, in this case, finance is an important constraining factor. A common observed trend regarding housing adaptation is the inclination of respondents to use more permanent construction materials such as bricks and concrete. As a result, a handful of brickfields have sprung up in these areas which have their own environmental effects. This has motivated some people to provide labor in these brick fields. Generally, as more people construct brick houses the motivation to evacuate to shelter during flood or waterlogging is decreasing. Small scale need based canal excavation is a common adaptation practice to facilitate the slow discharge of flood water. Farmers think that water movement becomes slower due to frequent creation of embankment for fish cultivation and leasing out canals. Depending on the situation, farmers sometimes create temporary channels to discharge water. The most acute problem faced by respondents during waterlogging is related to finance. Without a formal mechanism for support, the people in the study area have established their own financial adaptation strategies. In Satkhira and Jashore, around 20% respondents take loans from financial institutions like banks and cooperative societies. Though micro-credit is widely available, very few respondents (around 10%) in the study areas have this support. The reason behind such reluctance is the fact that repayment of the installments under the current repayment scheme becomes difficult while recovering from damages. Waterlogging episodes tend to have unseen long-term impacts on the locality, and it is often not possible to tangibly assess the financial needs. Therefore, the challenge is to restructure the existing micro-credit mechanism to incorporate current needs.

3.4. The Way Forward

This study identified some crosscutting issues behind the waterlogging problem in the study areas. First, faulty construction of embankments accelerated the siltation process and made the sluice gates non-functional. Second,

current practice of leasing canals to politically influential persons have changed the socioecological dynamics. Lessees construct embankments to demarcate individuals' areas in the canal severely disrupting the drainage network. Third, weak flow of freshwater from the upstream has caused a sudden decrease of downstream water flowing to these regions of Bangladesh. As a result, the rate of siltation on river beds increased at an unprecedented rate. In light of these, the study has some recommendations. It is to some extent realized that the basic, crosscutting cause behind waterlogging for many years, is a lack of an integrated and participatory approach. This study recommends to widely engage local communities in the operation and maintenance of sluice gates for effective drainage of water. Regular dredging of rivers will also increase the water carrying capacity of the drainage channels and will reduce the problem to a large extent. Meanwhile, affected communities can be provided training on alternative farming methods (polyculture, changes in cropping pattern and diversity) to mitigate the impacts of waterlogging. Like many other studies, this study also recommends to immediately remove all illegal infrastructure which clog the drainage network. To overcome the financial stress, actions like generating community funds, formalizing cooperative society, formation of farmers union and cultivation of medicinal plants are also recommended.

4. Conclusion

Waterlogging is a severe environmental problem in the southwest coast of Bangladesh which has substantial impacts on livelihood. The impacts of waterlogging extend to post-disaster period and make communities vulnerable to vicious cycle of losses, lack of capacity and poverty. The study found that this region is undergoing a dynamic transformation in its socio-ecological system while coping with waterlogging problems. At the outset of such transformation, common adaptation practices include cultivation of diversified crops and fruits, collecting rainwater, raising plinths, pursuing polyculture etc. The study has found that none of the adaptation practices are sustainable long-term solutions for secured livelihood in the face of waterlogging. Once the external support mechanism for community adaptation practices is withdrawn, the local community seems to be unable to continue the practice and the adaptation initiatives tend to stop due to lack of proper management. Therefore, there is a need for greater focus on sustainable adaptation practices to bring long term livelihood solutions in the coastal region of Bangladesh.

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