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PERCEPTIONS AND RESPONSES TO CLIMATE CHANGE: UNDERSTANDING ADAPTATION STRATEGIES AND MULTI-LEVEL CAPACITIES IN NORTHERN BANGLADESH USING LIVELIHOOD RESOURCES

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Climate change has become a concern due to its adverse impacts on local livelihood and human security globally. This may affect livelihood options in a disaster-prone country, Bangladesh, particularly in the northern region, which experiences high temperature, low rainfall, and frequent disasters. This paper presents empirical evidences that indicate perceptions on climate change and local responses on this change to take different adaptation strategies using available livelihood resources. Primary data was collected in northern districts by applying Climate Vulnerability and Capacity Analysis method and Focus Group Discussion. The study demonstrated that local communities experienced climate variabilities and disaster incidents. Several adaptation strategies were employed at different levels of capacities based on livelihood resources. The study demonstrated government level capacity would mostly influence resources utilization. Policies and programs aimed at enhancing and strengthening the adaptation strategies need to deliberate livelihood resources and capacity levels significantly.

Keywords: Bangladesh, climate change, disaster, livelihood resources, adaptation strategies, multi-level capacity.

Introduction

Climate change affected livelihood security in many countries globally. The intensity of changes and natural disaster occurrences varied due to the geographical location. The location of Bangladesh is particularly vulnerable of climate change and other disaster incidents [1, 29] and the country has frequently cited as a one of the most vulnerable country in the world [13]. However, country has developed several strategies to deal climate change impacts at the national level to improve livelihood [2, 3, 17], still several approaches need to rethink new strategies and to enhance capacities for better livelihood at the different parts of the country.

Several studies indicated that climate was changing and it became more unpredictable every year in Bangladesh [1, 12, 15]. The frequency and severity of many natural disasters were rapidly escalating because of climate change. Globally, it was evidenced that people used local knowledge and skills to understand climatic changes and to response it in emergencies [9, 10, 12]. Limited studies focused on climate change perception in Bangladesh. In addition, perception may differ in different location and people may use different approaches to response it. Therefore, understanding people's perception is critical to develop effective adaptation strategies, which will be feasible locally.

Globally many studies focused on adaptation strategies by considering local context. Very few studies identified adaption strategies due to climate change and natural disaster in Bangladesh [3, 4]. However, most of these studies focused on national level strategies, which may not suit at different regions of the country. A recent study particularly focused on flood resilience in wetland of the northeastern Bangladesh [14]. Government policies and action plans also focused on national level strategies by giving less emphasize on regional level [8, 25]. In many areas, local people use different strategies to combat climate change by using available resources. Therefore, location specific adaptation strategies need to consider in national polices and action plans.

Use of local resources seems to be a critical asset to tackle any emergencies globally [16, 18, 19, 26, 28]. The resilient Bangladeshi people have always coped with the effects of extreme weather events by using local resources. For instance, accessto agricultural land effectively contributed in post disaster rehabilitation process. Understanding key livelihood resources is important, that can be used to cope more efficiently in hazardous situation. However, inadequate study has been employed to understand the influence of livelihood resources on climate change resilience.

In addition to livelihood resources, multi-level capacities are also very important. Combating climate

change is often relying on multi-level capacities including individual, household, community, and government. Less attention has been paid to understand the strength of varied capacity levels in the country [20–22], which contributes in taking various adaptation strategies locally. In addition, these are useful to develop and implement action plans at regional level for better management of livelihood resources. The main objective of the present study is to understand local presentation and response to climate change in the northern Bangladesh by using livelihood resources at multi-level capacity. The specific objectives research are: (1) to understand local perception of climate change, (2) to recognize important livelihood resources for climate change adaptation, (3) to identify multi-level adaptation strategies and resource use for climate change resilience.

Data and methods

Study area

The present study focused on the northern part of Bangladesh, which experiences high temperature, low rainfall, and frequent disasters compared to the rest of the country. In total twelve sub-districts (upzila) in four districts of the northern Bangladesh were considered including Kurigram (Kurigram Sadar, Nageshwari, Chilmari), Nilphamari (Nilphamari Sadar, Dimla, Chilmari), Panchagarh (Panchagarh sadar, Tentulia, Jaldhaka), and Gaibandha (Gaibandha sadar, Saghatta, Sundarganj) (Figure 1). These were initially delimited based on available information and the degree of vulnerability of climate change and disaster incidents from historic records, literature review, and national newspaper reports from 1990 to 2010.

Data collection

The present study used Climate Vulnerability and Capacity Analysis (CVCA) method [5–6], particularly Participatory Research Assessments (PRA) exercises (100-semi-structured interview) and several Focus Group Discussion (FGD) using face-to-face interview method to assemble data by involving numerous target groups (GO, NGOs, communities, households and individual farmers) in the study area (Figure 2).

Data analysis

The collected information was processed qualitatively as well as quantitatively. Descriptive statistics included average to present graphs to understand the local climate change perception, disaster incidents, and available livelihood resources. Qualitative analysis was performed to identify adaptation strategies based on livelihood resources at various capacity levels using Nvivo. A corresponding score if 1, 2, 3, and 4 were assigned for individual, household, community, and government level capacity respectively to perform associated adaptation strategies. An adaptation strategy index [27] for use of individual livelihood resource was computed to identify the important resource at various capacity level as using to perform different adaptation strategies in the study area (1):

$$ASI = R_i \times 1 + R_h \times 2 + R_c \times 3 + R_g \times 4, \quad (1)$$

where ASI = adaptation strategy index, R_i = number of responses with individual resource use at individual level, R_h = number of responses with individual resource use at household level, R_c = number of responses with individual resource use at community level, R_g = number of responses with individual resource use at government level.

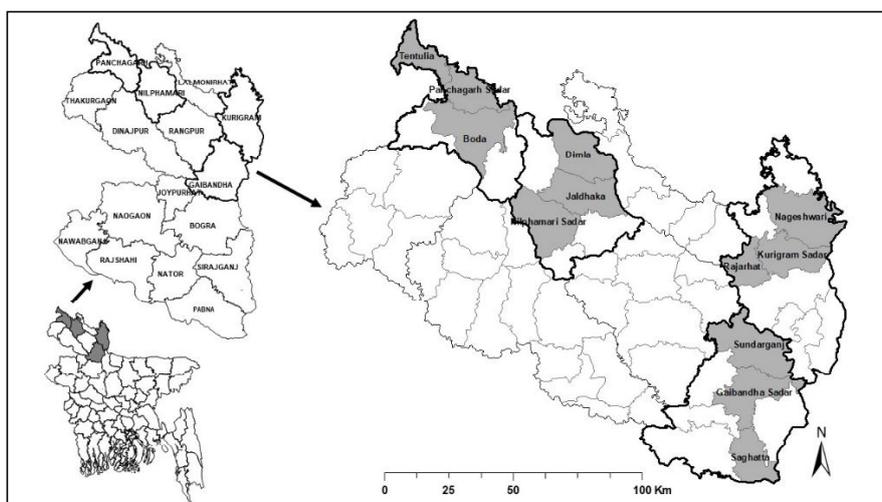


Figure 1. Study area including four districts and twelve sub-district in the northern Bangladesh (Source: prepared by author)

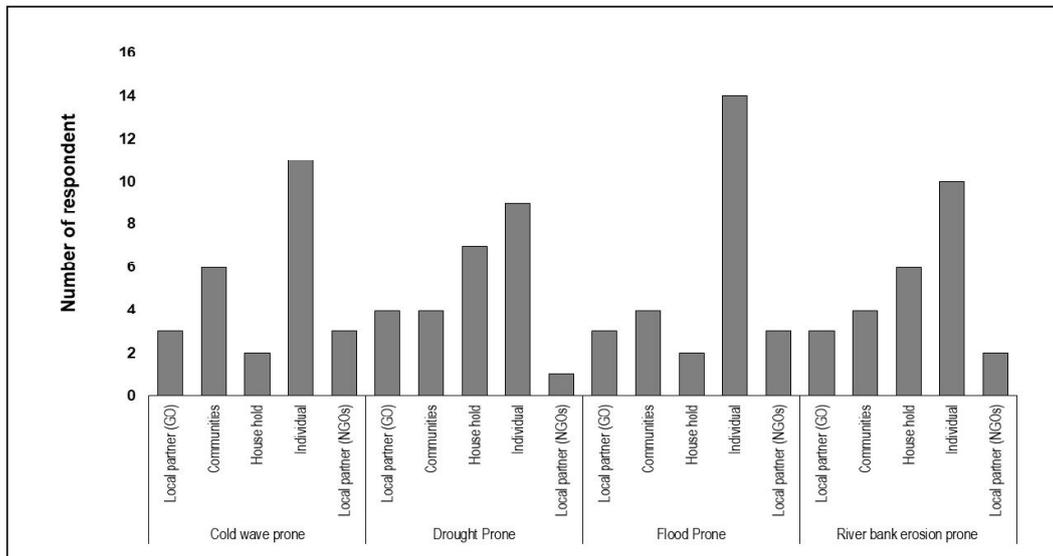


Figure 2. Number of respondents covered target groups in the study area (Source: Field survey)

A weighted average index [23] for different livelihood resource use was also calculated to find out the most relevant capacity level to use of these resources in the study area (Eq. 2):

$$CI = C_I \times I + C_H \times 2 + C_C \times 3 + C_G \times 4 / N, \quad (2)$$

where CI = capacity index, C_I = frequency of resource use at individual level, C_H = frequency of resource use at household level, C_C = frequency of resource use at community level, C_G = frequency of resource use at government level, and N = total number of adaptation strategies.

Results

Understanding local perception of climate change and disasters

The local people observed climate changes sign in the study area. Figure 3a indicated that 75% people were observed changes sign in Kurigram district, whereas 82% people observed changes in Nilphamari

districts. Nearly 77 and 80% people were observed changes sign in Gaibandha and Panchagarh district respectively. On the other hand, local people observation with no changes was smaller than the observed changes, 20, 12, 5, and 10% respectively in those districts (Figure 3a). In addition, 2 to 5% of respondents were not aware about any changes, therefore unable to comment on it.

Besides climate change, local people also observed disaster incidents in the study areas. Figure 3b represented the percentage of people noticed disaster incidents in study area. Kurigram district was recorded for the highest number of riverbank erosion incident (74%). Nilphamari district was detected for the highest number of drought incident (74%). Nearly 90% of people were claimed cold wave was the most prominent disaster in Panchagarh district. Gaibandha district has been observed for the highest number of

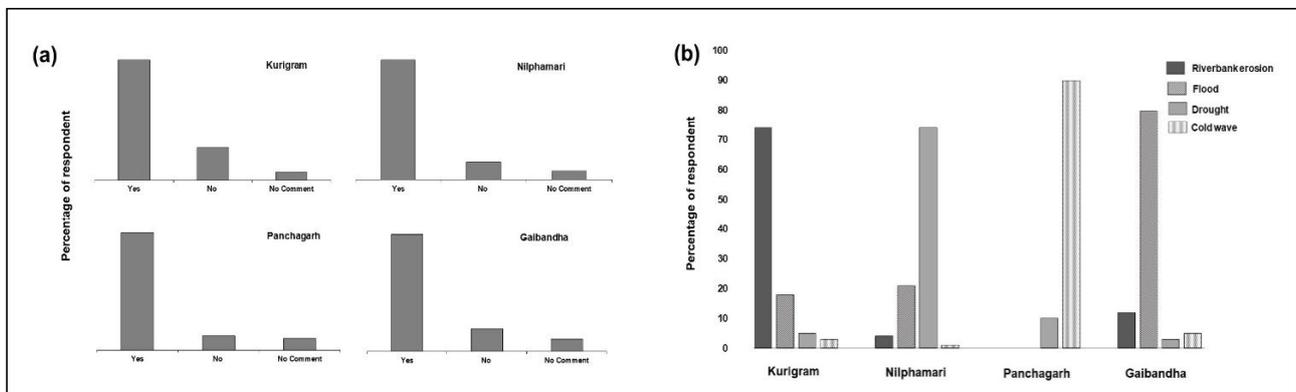


Figure 3. Percentage of respondent observed climate changes sign (a) and disaster incidents (b) in the northern Bangladesh (Source: Field survey)

Percentage of livelihood resources in the northern Bangladesh

Resource	Kurigram (%)	Nilphamari (%)	Panchagarh (%)	Gaibandha (%)
Agricultural land	73	64	53	58
Human resources	8	10	7	8
Livestock	10	13	11	13
Fisheries	3	5	8	9
Forest	2	4	8	8
Wetland	4	4	13	4

Source: Field survey

flood incident (80%).

Recognizing important livelihood resources

Varied livelihood resources were mentioned in study area including agricultural land, human resources, livestock, fisheries, forest, and wetlands (table 1). Approximately 53 to 73% of respondents were agreed with agricultural land as one of their key livelihood resource. Human resources, livestock, fisheries, forest, and wetlands were also considered as a livelihood resources with different percentage.

Using adaptation strategies to response to climate change influences

Local people adopted various adaptation strategies to response climate change in the northern Bangladesh by using available livelihood resources mentioned above. Table 2 summarized local adaptation strategies in the study area. Respondent identified in total 22 adaptation techniques under 6 livelihood resource categories which they were practicing frequently in their locality.

Identifying important livelihood resources and appropriate level of capacity

The indexed value for adaptation strategies differed across livelihood resources at different level of capacity. It is presented in Figure 4a. The indexed values for access to human resources and livestock were the highest, 30 and 24 respectively. The second major resource was agricultural land (22), then forest (20) and wetlands (20). The lowest value was calculated for fisheries resource (11).

The capacity level diagram that plots the average weighted score of the contributing capacity level to use of livelihood resources are shown in Figure 4b. The capacity index value was highest for government level (0.7), whereas it was lowest for household level (0.4). The capacity index was 0.5 and 0.6 for individual level and community level respectively.

Discussion

In the northern Bangladesh, most of the respondent observed climate change including increase temperature, late rainy season, decreasing the rate of rainfall, increasing the intensity of cold wave, increasing the rate of riverbank erosion, and prolonged fog in winter season. Of these, all of the respondents united in one point that they observed lack of rainfall when it was needed. There was no systematic way to understand seasonal differences there. In addition, natural characteristics of six different seasons were not clearly visible in the study areas. Similar observation was evident in occurring disaster. For instance, frequent riverbank erosion, drought, flood and cold wave were observed in Kurigram, Nilphamari, Gaibandha and Panchagarh district respectively. This was entirely validated with previous information available on disaster occurrences in those districts. It was very interesting that none indicated about flood occurrence in Panchagarh as it was located in highland and considered as a flood free zone compared to other areas in the northern Bangladesh. There was no riverbank erosion occurred in the district too. The results demonstrated that people perception of climate change and disaster incidents varied due to different districts considered in the present study.

In addition, local people clearly understood livelihood resources, which they belonged to perform adaptation strategies in changing conditions. The livelihood resources also varied in four districts. This indicates an uneven distribution of livelihood resources across districts. For instance, landless people in Nilphamari district processed different adaptation strategies. Though the present study focused adaptation strategies based on available livelihood resources, still many strategies need to be incorporated for the vulnerable people who had no resource.

Adaptation strategies based on livelihood resources in the northern Bangladesh

Livelihood resources	Adaptation strategies
Agricultural land	Cultivate diversified crops
	Using indigenous knowledge to understand soil condition
	Having sufficient irrigation facilities
	Using indigenous knowledge for information
	Accessing post-disaster land rehabilitation
Human resources	Having diversified employment opportunities
	Having better health and education
	Migrating other places in lean season
	Balancing gender issues
	Developing infrastructure
Livestock	Taking care of existing livestock
	Getting information from extension officers
	Having disaster preparedness to save livestock
Fisheries	Accessing fish variety and commercial fishing
	Digging more ponds for fishing
	Using locally available skills
Forest/Trees	Having space for forestry
	Maintaining value trees
	Homestead gardening
Wetlands	Maintaining and utilizing wetland appropriately
	Preserving rainwater
	Protecting wetland from sand and pollution

Source: Field survey

The present study considered adaptation strategies, which were frequent in all four districts (Table 2). However, strategies may differ because of local circumstances in those districts. For example, local people took several initiatives to protect agricultural land due to riverbank erosion and flood in Kurigram and Gaibandha district whereas there was no flood and riverbank erosion in Panchagarh district. Frequent flood damaged agriculture crops every year in Gaibandha district. Similarly, excessive cold wave hampered crop quality in Panchagarh. Agricultural land was found useless in many areas of Nilphamari district for unfavorable drought

condition. Another example was fisheries resources, which received critical responses in the study area. During rainy season, there was a plenty of fish but lack of fishes was observed in dry season in Niphamari district. Fishes were frequently migrated during flood season in Gaibandha districts, hence contributed less in strategies in the district. These demonstrated adaptation strategies differed due to local circumstances. However, maximum concise dimension was considered with high level of attention to standardize adaptation strategies based on local people responses and capacity level.

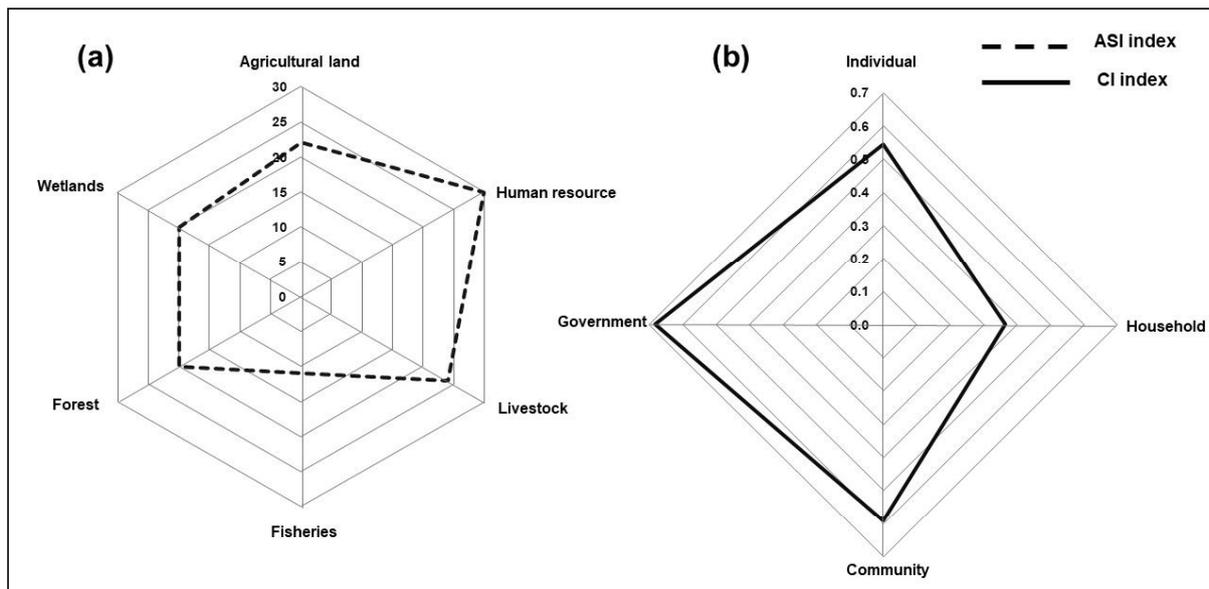


Figure 4. Important livelihood resources of the adaptation strategy index (a), and the dimension of the capacity level (b). Source: Field survey

The present study also demonstrated the importance of capacity level, which determines the maximum use of livelihood resources in the study area. Several studies indicated that community based adaptation effectively contribute to response climate change [24]. However, present study identified government level capacity would be the most influential. Other capacity levels (individual, household) were as important as government level. In general, combining all levels will eventually provide the greatest support to use of livelihood resources in study area to combat climate change influences.

Conclusion

The present study is focused on climate change perception, recognize important livelihood resources, and identify varied capacity level to implement usual adaptation strategies in the northern Bangladesh. This indicates the need of access to adequate resources in taking effective strategies. In addition, the present study demonstrates the role of capacity levels to enhance the process of adaptation. Hence, policies and programs aimed at enhancing and strengthening the adaptation strategies of the local people need to consider livelihood resources and capacity levels critically. Adaptation commitments should be based on local circumstance, and regional requirements need to be fulfilled appropriately. These should be integrated into existing national development plans and processes as government level capacity was evident most prominent in the northern Bangladesh. However, the existing community-based adaptation in the northern

Bangladesh needs to revise by considering other important levels. This requires the engagement of a wide range of stakeholders, individual vulnerable people, local governments, civil society, non-governmental organizations, and national policy makers. Future analysis should focus on model-based adaptation strategies by predicting climatic change conditions. It also demands a deep understanding of the existing vulnerability of individuals, households, communities, the institutional, political, physical and social environment in the northern Bangladesh in which local people live and survive.

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