

## Effectiveness of Selected Planned Adaptations: Expectation and Reality

**Cyclone shelter, plantation, paka (permanent) and semi-paka (semi-permanent) house, loan, and communication infrastructure are five adaptation measures that were assessed for their effectiveness in a coastal community of Bangladesh. After evaluating people's perception, barriers and causal relations among the adaptation measures, it is found that cyclone shelter, paka & semi-paka house, loan, and communication infrastructure are not effective in local scale although they are recognized to be effective in regional scale. Only plantation is found to be effective at both the local and regional scale because of its high economic return.**

### Introduction

The unique geographical feature, the dominance of floodplain, high density of population, low elevation from sea level and geomorphological issues make this country more susceptible to climatic hazards. The coastal zone of Bangladesh, with the most dynamic delta in the world, has about 710 km long coastline which covers about 20% of total land area and over 30% of the cultivable lands of the country (BWDB, 2013a; Hossain and Selvanathan, 2013). The current average size of agricultural land per capita is 0.138 acre, but this will be reduced to 0.0617 acre by 2050 and population is expected to increase to 57.9 million (PDO-ICZMP 2004b). This coast is well known for severe cyclones and induced surges experiencing at least 70 major cyclones during the past 200 years that caused the death of more than 900,000 people (Blaikie et al. 1994; Ali 1999; Paul 2009a; Islam, 2004).

After the 1991 Chittagong Cyclone, the government of Bangladesh has taken several structural and non-structural initiatives in reducing the fatalities and damages. In recent times, adaptation has become the center of attention in both climate change research and policy implementation in Bangladesh so as to deal with limited resources (Akter et al, 2020). Adaptation is the process of adjustment to climate alteration that includes adjustments in behavior or economic structure that reduce the susceptibility of society to changes in the climate system (Smith et al, 1996). To assess implication of adaptation measures on a community, it is important to identify the risk hotspots, local demand for prioritizing adaptation measures, adaptation deficiency compared to the adaptation need, and implementation of adaptation measures.

### Method

After evaluating the past studies, it is realized that there is still a research gap in evaluating effectiveness of planned adaptation measures at the community level. This study is designed to assess the effectiveness of the planned adaptation measures at both the local and regional scales. Five planned adaptations were selected which are considered sensitive and effective in regional scale and a field site was selected where these adaptations are implemented at the community level. A field survey was conducted at the community level to assess effectiveness of these adaptation measures

### Key Messages

- Planned adaptation measures in regional scale need to consider the barriers which an adaptation measure faces in operational phases at a local scale.
- Causal relations among the adaptations and barriers make different existing adaptations (planned and autonomous) at local scale connected to each other.
- It is important that community perception at local level is considered during policy planning and implementation of adaptation measures. Ignoring community perceptions may lead them to perceive adaptations as ineffective.

### Corresponding Author:

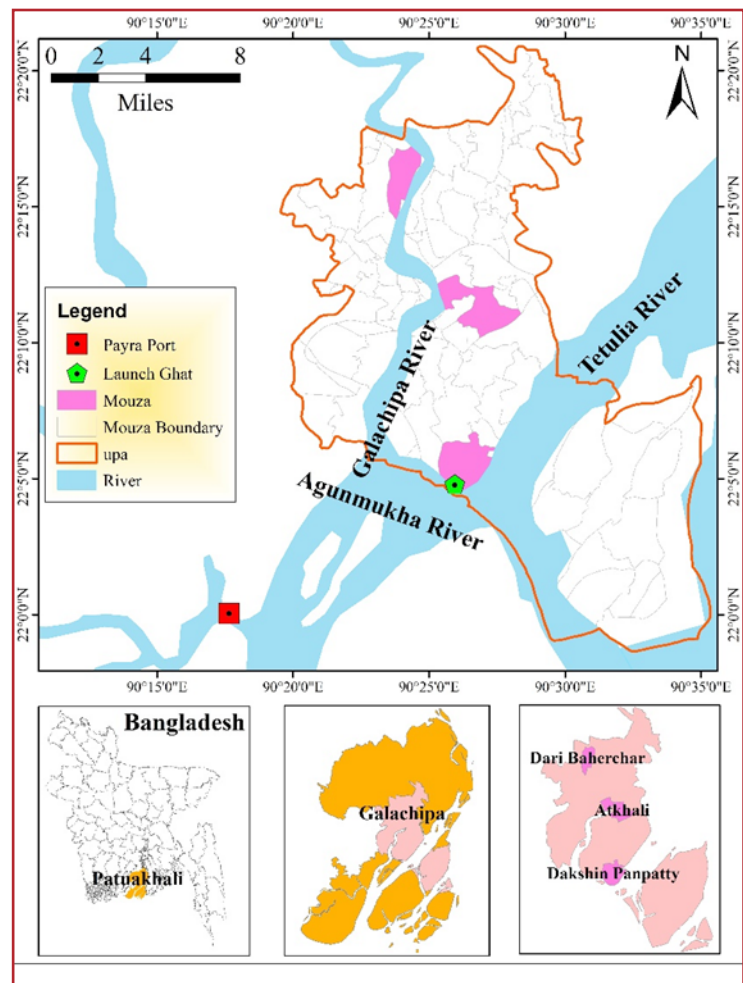
Md. Rayhanur Rahman, Marin Akter, Anisul Haque, Md. Munsur Rahman, A.K. Azad, Hamima Huma.

at local level. Comparison was then made to identify the differences of effectiveness of these five planned adaptation measures at the local and regional scales.

The study was mainly based on primary data collected by household surveys. Secondary data were also collected from BBS (BBS 2011). A semi-structured questionnaire was prepared to collect primary household data through Key Informant Interviews and Focus Group Discussions across the study area.

In this study, Galachipa Upazilla of Patuakhali district is selected as the study area which is highly vulnerable for cyclone induced storm-surges because of its geographical location on the bank of the Ramnabad River. Sampling for selecting the units of observations (households), cluster sampling method is adopted in this study where the unions are considered as clusters. However, 430 respondents were surveyed in 10 days. After applying the PPS technique, three Mouzas of Galachipa Upazilla are finally selected for the survey. These are: (1) Dakshin Panpatty Mouza from Panpatty Union (2) Dari Baherchar Mouza from Amkhola Union and (3) Atkhali Mouza from Dakua Union.

The criteria to select these adaptation measures are: (a) among the top 10 most sensitive adaptation measures are available in the study area (b) adaptation measures which have more than 50% deficiencies compared to future need and therefore effective in regional scale (Akter et al., 2020).



**Figure 1: Study area**

### Likert Scale

Likert scale is applied to measure peoples' perception on the effectiveness of adaptations. An indexing formula is developed to rank the adaptations based on their Likert score.

A five-point Likert scale (Likert, 1932) is used to investigate the people's perception. Each household respondent is asked to select one of the five options given below in order to describe the effectiveness of selected adaptation practice.

1 = Totally ineffective, 2 = Ineffective, 3 = Not understandable, 4 = Effective, 5 = Highly effective

The level of effectiveness or the options of Likert scale are defined as (Islam et al, 2019):

- **Totally ineffective:** Only a little benefit is available for the people with significant difficulties. As a result, outcomes are far away from expectations.
- **Ineffective:** People are getting some benefits, but the level of usefulness is below expectation. In other words, the benefits are outweighed by difficulties, but this gap is not significant.
- **Not understandable:** People are confused to rate the adaptation as the advantages and disadvantages remain unclear to them.
- **Effective:** People are getting good benefits that can be considered as satisfactory. Although there are some difficulties within the functions of the adaptation, but the level of advantages is outweighed by the level of disadvantages.
- **Highly effective:** People are getting very good benefits from adaptation that can be considered as highly satisfactory. However, minor difficulties are found within the functions of the adaptations, which is negligible.

## Index

The following indexing formula is developed to rank the adaptations based on a calculated score using percentage of frequency and weight of each Likert option

$$\text{Effectiveness Score} = \{(PTI \times 1) + (PI \times 2) + (PNU \times 3) + (PE \times 4) + (PHE \times 5)\} \dots \dots \dots (1)$$

Here PTI = percentage of totally ineffective, PI = percentage of ineffective, PNU = percentage of not understandable, PE = percentage of effective, and PHE = percentage of highly effective.

## Probabilistic Analysis of Barriers

There are few barriers (social, economic, religious, cultural and political) for the local people when they practice any specific adaptation. These barriers are internally dependent on each other, i.e., they are mutually inclusive. Sometimes, each individual faces one or more barriers at a time. The impact of barriers are assessed in the probabilistic way.

Venn diagram is constructed to describe the difficulties of taking selected adaptations. A complex inter-relationship among different adaptation measures practiced in the field is established through descriptive statistical method and Venn diagram (Figure 2).

## Community Perceptions on Effectiveness of Existing Adaptation Practices

The ranking is done using the highest to lowest weighted score. In Table 1, plantation gets the highest score of 397 and is ranked as Number 1. Coastal plantation is believed to work as a buffer against the cyclonic wind and surge wave. In addition, homestead plantation provide the community timber for housing, food and fruits, fuel and money.

**Table 1: Community perceptions on effectiveness of existing adaptation practices**

Adaptation	Practices	Highly ineffective	Ineffective	Not understandable	Effective	Highly effective	Total
Communication Infrastructure	Rank	1	2	3	4	5	3
	no	38	200	81	31	0	350
	%	10.9	57.1	23.1	8.86	0	100
	E.S	10.86	114.3	69.43	35.43	0	230
Pucca and Semi pucca House	Rank	1	2	3	4	5	5
	no	82	173	66	28	1	350
	%	23.4	49.4	18.9	8	0.29	100
	E.S	23.43	98.86	56.57	32	1.428	212.3
Loan	Rank	1	2	3	4	5	2
	no	8	34	132	174	2	350
	%	2.29	9.71	37.7	49.7	0.57	100
	E.S	2.29	19.43	113.1	198.9	2.85	336.6
Plantation	Rank	1	2	3	4	5	1
	no	2	18	47	205	78	350
	%	0.57	5.14	13.4	58.6	22.3	100
	E.S	0.57	10.29	40.29	234.3	111.4	396.9
Cyclone Shelter	Rank	1	2	3	4	5	4
	no	95	131	92	32	0	350
	%	27.1	37.4	26.3	9.14	0	100
	E.S	27.14	74.86	78.86	36.57	0	217.4

Another adaptation practice loan is ranked as an 'effective' adaptation in the study area. Based on community perceptions, the weighted score of loan is 337.

The local NGO informed that the number of loan receivers generally increase before monsoon and after a climatic hazard. Several NGOs (Grameen Bank, Codek, SHEDF, ASA) are active in the study area as loan providers.

Communication infrastructure is considered as a long-term adaptation. Due to significant financial involvement, the government is a dominant stakeholder in the implementation of this adaptation. As an adaptation in the study area, the community has a mixed perception on the existing state of communication infrastructure. With a score of 230, the rank for communication infrastructure is 3.

Based on the weighted score of ‘effectiveness’, cyclone shelter is ranked 4 with a weighted score of 217 indicating low effectiveness at community level. Especially female group of the respondents identified several barriers like social, cultural, religious, and political during moving to cyclone shelter at the time of disaster. Besides, the shortage of number of cyclone shelters, distance from home and poor communication systems are other reasons behind the low ‘effectiveness’.

In the study area, 95% of respondents live in katcha (temporary) house which is made of mud, tin, timber, bamboo, and other temporary materials. Financial barrier plays a major role behind selection of katcha house as a dwelling. As the majority of respondents live is katcha house, effectiveness of semi-paka and paka house gets a low score (212) and ranked in 5.

## Future Perception of Community on Effectiveness of Adaptation

The respondents in the study area predicted the future effectiveness of selected adaptation measures based on the implementation of these adaptation measures in the near future (see Table 2). Here, the respondents used their imagination to answer the question and hence the uncertainty of these results are high.

**Table 2: Future perceptions of community on effectiveness of adaptations**

Adaptation Practices	After 10 year	After 20 year	After 30 year
	E.S	E.S	E.S
Communication Infrastructure	379	427	476
Paka and semi-paka house	378	429	478
Loan	399	446	481
Plantation	441	479	495
Cyclone shelter	373	437	485

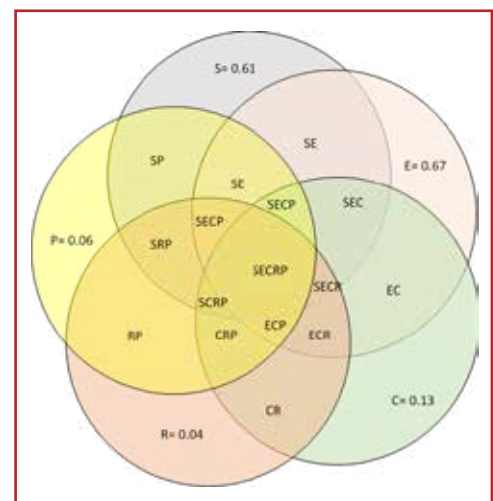
Table 2 shows the future perceptions of community on effectiveness of selected adaptations. The scores show an increasing trend, meaning that effectiveness of different adaptations will increase in future. For example, at present, the effectiveness score of cyclone shelter is 217 and after 30 years it will 485.

### Barriers for adopting adaptation measures

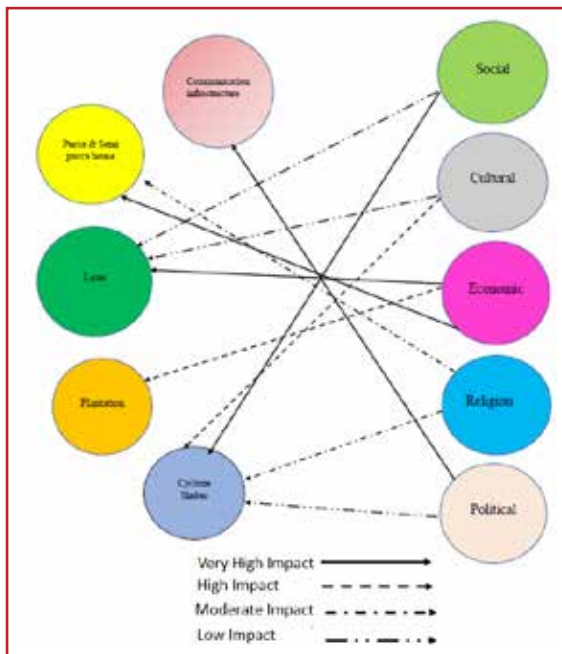
Social, cultural, economic, political, and religious constraints are identified as major barriers for adopting adaptation measures in the study area. These barriers largely influence respondent’s decision during adopting a specific adaptation practice. Impact of barriers are calculated in probabilistic way.

For probabilistic score (Table 2), a Venn diagram is constructed as shown in Figure 2. The figure shows that majority of the respondents face at least one barrier, few respondents face two or three barriers. No respondents face four or more barriers. Total probabilistic score of facing one barrier is 1.51 where the top three barriers are economic (0.67), social (0.61) and cultural (0.13). Interestingly, religious barrier has the minimum impact (0.04). Total probabilistic score shows that 98% of respondents in the area face at least one barrier and only 2% respondents do not face any barrier.

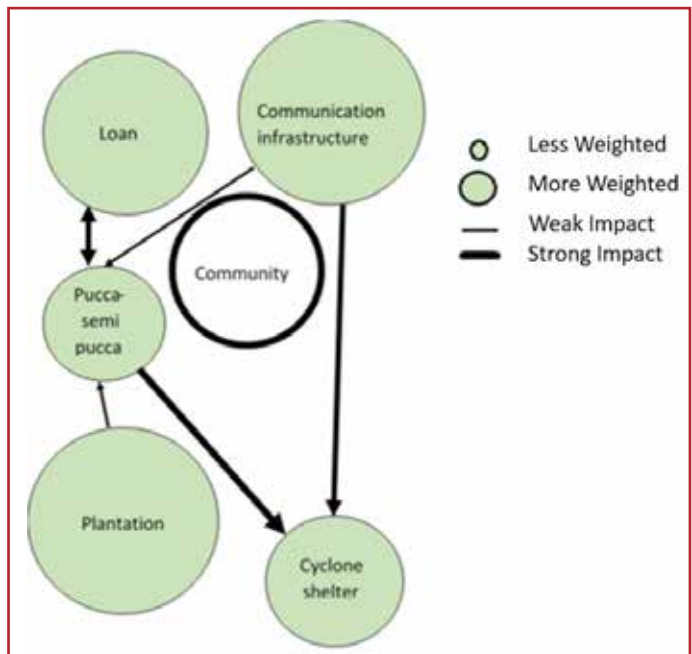
During the field survey, it was found that the barriers have indirect impact on adaptation measures. Figure 3 shows impact map of barriers on adaptation measures. It is seen that economic barrier has a very high impact on paka and semi-paka house (Figure 3). Social barrier has a very high impact on cyclone shelter followed by cultural barrier (high impact), religious barrier (moderate impact), political barrier (low impact). Plantation is an adaptation that needs some initial investment that acts as a high impact barrier



**Figure 2: Venn diagram of barriers (mutually inclusive) in the study area. Here, S= Social Barriers, C= Cultural Barriers, E= Economic Barriers, R= Religious Barriers, P= Political Barriers. Sample size = 350**



**Figure 3: Impact of barriers on adaptation practices in the study area**



**Figure 4: Network of causal relation among the adaptation practices**

against plantation (Figure 3). Even with this barrier, the high monthly return from plantation and its role to reduce storm surge effects makes this adaptation as ‘highly effective’. When we look into the barrier, it is found that impact of economic barrier is very high against loan is due to the high interest rate. Political barrier has a very high impact on communication infrastructure as construction of this infrastructure is highly biased by the political leaders that effect the accessibility for the common people.

### Causal relation among adaptations

Causal relation shows how a particular adaptation measure is related to other adaptation measures within the community and the impact pathways of adaptations along with ‘strength’ of the pathways (Figure 4).

The unidirectional ‘strong’ causal network relation among cyclone shelter, communication infrastructure and paka & semi-paka house shows that communication infrastructure is ‘more weighted’ than cyclone shelter and paka & semi-paka house. Loan and paka & semi-paka house have a ‘strong’ ‘bidirectional’ causal relation that means loan is ‘more weighted’ than paka & semi-paka house. Similarly, ‘more weighted’ communication infrastructure and plantation have a ‘weak’ impact on paka & semi-paka house. The unidirectional causal relation among communication infrastructure, cyclone shelter, and paka & semi-paka house shows that a better communication is essential (‘strong’ impact) for increased effectiveness of a cyclone shelter. The bidirectional causal network between loan and paka & semi-paka house shows that people can only (‘strong’ impact) build a better-quality house if loan is available (‘more’ weighted) and better the quality of house, requirement of taking a loan is less (bidirectional).

## Discussion and Conclusion

We have assessed whether these expectations of effectiveness of planned adaptation measures in regional scale are also perceived effective in reality at the local scale. Table 3 shows that cyclone shelter, which is the most sensitive planned adaptation and have 52% deficiency to minimize future risk in regional scale (thus demand for an immediate investment) is only 9% effective as perceived in the community at local scale. Planned adaptation measures in regional scale do not consider the barriers which an adaptation measure faces in operational phases at a local scale. In addition to barriers, adaptations have causal relations among themselves. These causal relations make different existing adaptations (planned and autonomous) at local scale connected to each other.

**Table 3: Expectation and reality**

Planned Adaptations	Expectation in Regional Scale		Reality at Local Scale
	Sensitivity Rank	Deficiency	Effectiveness
Cyclone shelter	1	52%	9%
Plantation	2	54%	59%
Paka & semi-paka house	7	63%	8%
Loan	8	61%	50%
Communication infrastructure	9	66%	9%

In summary, if community perception at local level is ignored during policy planning and implementation decision of adaptation measures in the regional scale, there is every possibility that effectiveness of these adaptations will be perceived as 'ineffective' at the local level.

## References

- Akter, M., Kabir, R., Karim, D.S., Haque, A., Rahman, M., Haq, M.A., Jahan, M. and Asik, T.Z. (2019), Determining the most sensitive socioeconomic parameters for quantitative risk assessment, *Climate* 2019, 7, 107; doi:10.3390/cli7090107, <https://www.mdpi.com/2225-1154/7/9/107>
- Akter, M., Karim, D.S., Kabir, R., Haque, A., Rahman, M., Haq, M.A. and Jahan, M (2020). "Development of an Adaptation Model by Applying Nonlinear Programming to Compute Adaptation Deficiency in Climatic Hotspots." <https://www.tandfonline.com/toc/tsdw20/current> (in review)
- Ali A (1999) Climate change impacts and adaptation assessment in Bangladesh. *Clim Res* 12:109–116.
- Blaikie P, Cannon T, Davis I, Wisner B (1994) at risk: natural hazards, people's vulnerability, and disasters. Routledge, London.
- BWDB (2013a). "Environmental and Social Management Framework: Executive Summary." Bangladesh Water Development Board, Ministry of Water Resources, People's Republic of Bangladesh.
- Hossain, M. and Selvanathan. A. (2013). "Global Warming Induced Extreme Weather Conditions and the Threats to Livelihoods in the Bay of Bengal Delta." *International Journal of Env*
- Islam, M.R., 2004. Living in the coast: Problems, opportunities and challenges. Working Paper WP011, Dhaka. 2004, Programme Development Office (PDO) and Integrated Coastal Zone Management Plan (ICZMP). pp: 13-15.
- Likert R (1932) A technique for the measurement of attitudes. *Arch Psychol* 140:1–55
- Paul BK (2009a) why relatively fewer people died? The case of Bangladesh's cyclone Sidr. *Nat Hazards* 50(2):289–304
- PDO-ICZMP (2004b) living in the coast: problems, opportunities and challenges. Dhaka
- Smith J.B., N. Bhatti, G. Menzhulin, R. Benioff, M. Campos, B. Jallow, F. Rijsberman, M.I. Budyko and R.K. Dixon (eds.), 1996. *Adapting to Climate Change: An International Perspective*. New York: Springer-Verlag. pp: 476.

## Acknowledgments

The study was carried out under Climate and Development Knowledge Network (CDKN) delta project administered by ICLEI - Local Governments for Sustainability, South Asia.

## About IWFM

The Institute of Water and Flood Management (IWFM) is a research institute at Bangladesh University of Engineering and Technology (BUET), established in 1974 as the Institute of Flood Control and Drainage Research, later renamed as IWFM in 2002. The Institute pursues research and capacity development in the field of water and flood management that is vital for economic development and social prosperity of the country.

IWFM provides advisory and consultancy services to the government and non-government organizations.



Photo Credit: IFWM, BUET



[www.cdkn.org](http://www.cdkn.org) | [cdknasia@iclei.org](mailto:cdknasia@iclei.org)



Ministry of Foreign Affairs of the Netherlands



**IDRC · CRDI**  
International Development Research Centre  
Centre de recherches pour le développement international

Canada



D E C C M A  
▼ ▲ ▲ ▼

SOUTH  
SOUTH  
NORTH



## Disclaimer

The views expressed herein do not necessarily represent those of DFID, Ministry of Foreign Affairs of the Netherlands, or of the International Development Research Centre (IDRC) or its Board of Governors, or of the entities managing CDKN.