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Reducing adaptation costs to climate change through stakeholder-focused project design

The case of Khulna city in Bangladesh

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Acronyms

ADB	Asian Development Bank
BCR	Benefit-cost ratio
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBA	Cost-benefit analysis
CEA	Cost effectiveness analysis
FGD	Focus group discussion
IRR	Internal rate of return
KWCC	Khulna City Corporation
KDA	Khulna Development Authority
KWASA	Khulna Water and Sewage Authority
NPV	Net present value
SLR	Sea-level rise

1 Introduction

Cost-benefit analysis (CBA) is a tool for analysing the economic feasibility of projects. It is popular among designers of projects intended to provide a flow of future benefits over a period of time. Projects deliver a set of outputs, which are designed to have an impact and thus generate benefits to the society. In the context of CBA, projects with positive net present value or a benefit-cost ratio greater than one are considered feasible and hence are implemented. Economic feasibility studies using CBA use a wider definition of 'benefits' and 'costs' which includes benefits or costs accrued to the economy as opposed to just the project proponents.

Climate change poses a serious threat to economic and social life of the people in future years and hence many projects are now going through a 'climate assessment'. The Asian Development Bank (ADB) carried out a study in the context of building a water supply and drainage project for Khulna city in Bangladesh which is likely to be affected by climate changes. While the cost-benefit analysis was done without considering the climate change, The ADB initiated a study to analyse the impact of climate change including on the design of the project. The study resulted in significant change in the design of the project with effect from 2030(Asian Development Bank, 2011). Global climate models were downscaled for the purpose of this study in order to predict possible climate-related events in 2030 and 2050, such as precipitation, upstream run-off in rivers and salinity increase due to sea-level rise (SLR). A drainage model was then used to predict the impact of these climate events on the drainage congestion for the city.

Adaptation to climate change entails creating the ability to deal with future climate-related events and there are two types of adaptation actions: structural adaptation actions and non-structural adaptation actions. Non-structural adaptation options could mean a) capacity building among economic agents to deal with uncertainty through training and/or providing information; b) taking steps to modify behaviour, such as changing crops during flood or drought time; c) changing institutions or regulation to reduce future risks, such as zoning of the cities; and d) building awareness in the community and preparing them to manage some of the local infrastructure, such as managing drainage congestion through community-based actions. Unlike other projects, when an adaptation project is threatened with climate related events, all stakeholders should be included in the decision making. Such an inclusive strategy is likely to have impacts on project costs and benefits.

Given this background, this study has undertaken an additional analysis to understand the effect climate change on adaptation projects of using a 'stakeholder-based cost-benefit analysis'. The need for a separate analysis incorporating stakeholders of the project stems from several reasons. First, future climate events are uncertain events and so a 'full-proof' climate resilient strategy might be too costly to pursue. Second, many of the climate events are in the distant future and so it is likely that stakeholders will take autonomous adaptation measures which will reduce the overall impacts of climate change. Third, stakeholders will be exposed to two different climate related events, slow onset ones like SLR and drought, and rapid onset ones like flood, waterlogging or cyclones. Consequently, the project must be built with scope for future modification using a modular approach. In doing so, projects must take into account stakeholders' perception in order to reduce its costs. It is possible that not all stakeholders will find the project fully acceptable given the changes in the future socio-economic condition.

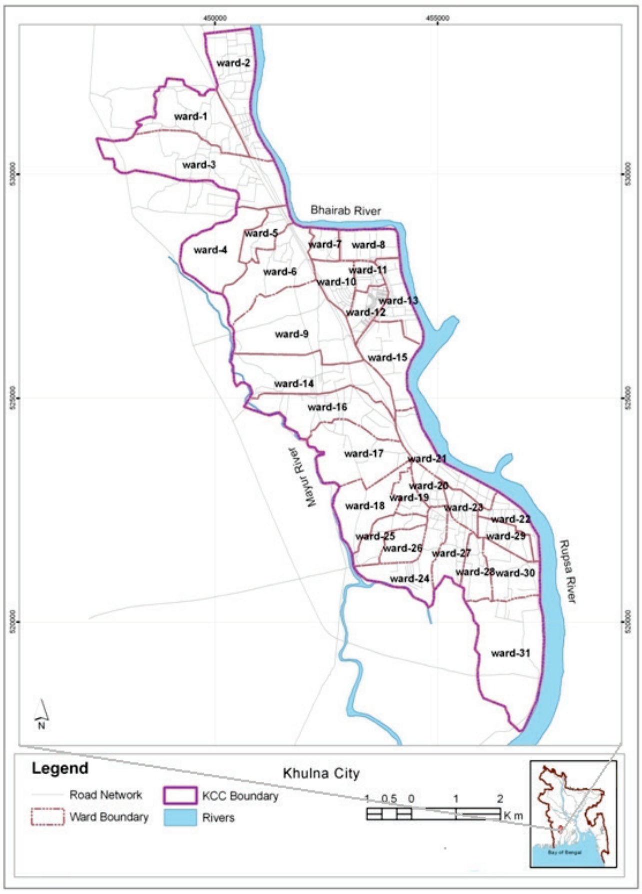
This stakeholder-based CBA has been done on a project which was designed by the ADB after adaptation to climate change had been carried out. The objective was to see whether a stakeholder-based CBA might change the adaptation strategies which had been previously envisaged for the project. This might mean either a change in the existing list of adaptation actions or reduction or additions to the list. It might also change the strategy of implementation, implying that all adaptation measures might not need to be implemented immediately or could be delayed. Furthermore, the analysis could also change the role of stakeholders in implementing some of the future adaptation measures. For example, some structural measures could be implemented by households, some could be by the community and some could be by the government. Finally, depending on the stakeholders, some measures might generate conflicting views among stakeholders. For example, an adaptation measure which blocks water from entering a locality could be viewed as an important positive measure for the people living in the area while the environmental groups might consider it detrimental for the ecology. Therefore, a stakeholder-based CBA could significantly affect the design as well as the implementation strategy of the projects which are likely to be affected by climate change.

2 Khulna city drainage improvement project

2.1 Khulna city

Khulna, the third-largest city in Bangladesh, is located in the southwest of the country. The city covers about 45 km^2. It is located between 89°00 and 90°45 E and 21°45 and 24°00 N. The city is bounded in the east by the Bhairab-Rupsha River, in the west by the Khudi Khal-Mayur River and in the south by the Harintana Khal. It is a coastal city and so the rivers are tidal rivers. Its population was around 2 million in 2001, the date of the last available census report, and it was growing at a rate of 2 per cent a year.

Figure 1. Map of Khulna City



Source: Institute of Water Modelling, Dhaka.

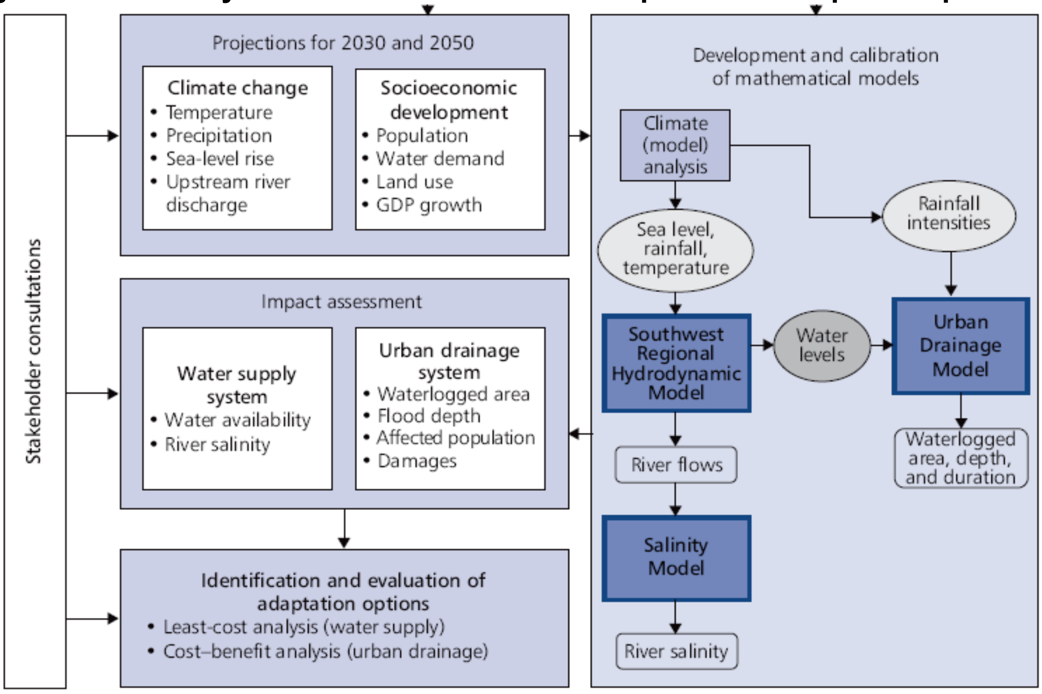
About 46 per cent of the land area of the city is now built up and is used for industrial, commercial and residential purposes. About 15 per cent of the land is under industrial use, 5 per cent is under commercial use and the remaining is for both residential and other purposes. Areas which are not yet built up are being used for agriculture and fisheries. Due to the land topography the drainage system of the city is linked to the western Mayur river. The whole metropolitan area is approximately 2.5 metres above the mean sea level.

Therefore, mismanagement of the drainage infrastructure often leads to waterlogging in low lying areas.
Climate model results combined with the drainage model of the Khulna city suggest that climate change is expected to severely affect the drainage system of the city in 2050 while its impact will begin to appear from 2030 (Asian Development Bank, 2011). The city will face threats due to a) sea level rise over the next 50 years, b) expected higher levels of precipitation in the city area which will aggravate existing waterlogging, and c) higher inflow of water in the rivers due to rising river levels. The rivers are the main drainage channels of the south-western regions of the country.

2.2 Assessment of climate impacts on Khulna city

In case of the Khulna city drainage system adaptation project, the project used a combination of complex models in order to derive a set of strategies for adaptation to climate risks. In order to develop appropriate set of adaptation strategies the project considered four climate change phenomena: a) temperature change, b) precipitation change, c) sea-level rise and d) upstream river discharge. A global climate model predicted changes in these variables for the year 2030 and 2050. The results of the climate model were then fed into a regional hydrodynamic model to predict water flow, drainage discharge, salinity, and consequent flooding in these years. Similarly, using an economic growth model, changes in socio-economic characteristics such as population, water demand, land use and income were also predicted for these years. This is shown in Figure 2.

Figure 2. Summary of the model for the development of adaptation practices



Source: Asian Development Bank, 2011

Based on the above models, the model predicted a typical flooding pattern for the years 2030 and 2050.

2.3 Relevant climate scenarios

In order to develop a complete understanding the model used two IPCC global climate scenarios: the A2 and B1 scenarios. The A2 scenario represents business as usual while B1 represents a sustainable approach scenario. Table 1 shows the predictions of both scenarios against the four climate events.

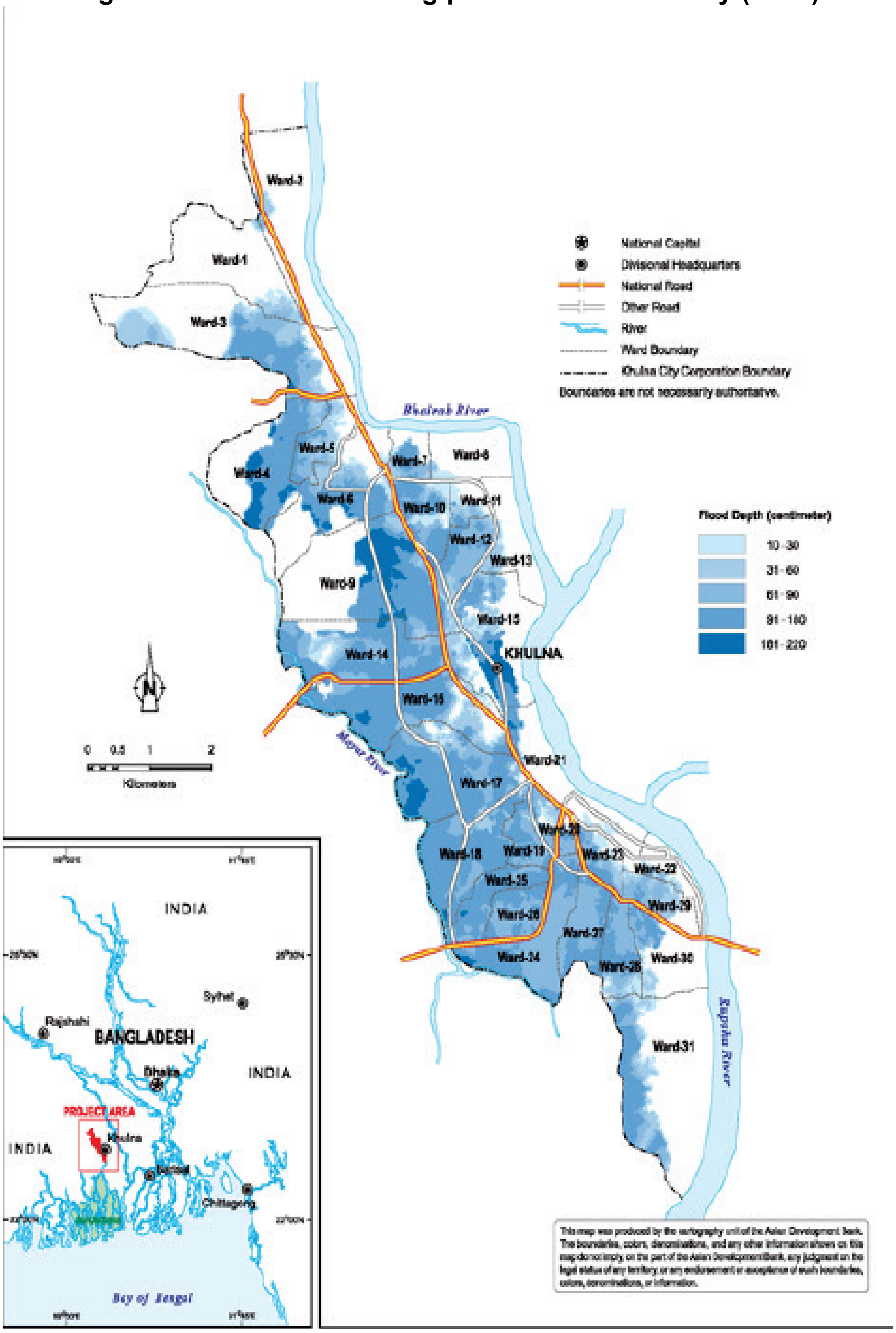
Table 1. Predicted climate events under future IPCC scenarios for Khulna City (2050)

Scenario	A2	B1
Temperature	The average monthly temperature rise by 2050 varies from +0.5ºC in October to +1.7ºC in January and February.	The average monthly temperature rise by 2050 varies from +0.5ºC in June, July, and August to +1.5ºC in February and April.
Rainfall	The annual rainfall increases by about 5.0% by 2050 (1,860 mm per year) from the reference period.[a]	The annual rainfall increases by about 9.3% by 2050 (1,739 mm per year) from the reference period.[b]
Seasonal rainfall	Increase in July–September by 4.6% and a decrease in December–February by 26.3%	Increase in July–September by 10.5% and a decrease in December–February by 46.2%.[c]
Rainfall intensity	50 mm or more rainfall in 6 hours increases from 4.20 times per year to 5.90 times per year in 2050.	50 mm or more rainfall in 6 hours marginally increases from 4.20 times per year to 4.25 times per year in 2050.

Source: Asian Development Bank, 2011

These predictions were then used to develop a picture of future drainage congestion in the Khulna city. As Figure 3 shows, nearly 26 of the 31 wards of the city are likely to be inundated if the predictions of the model are correct. Based on this, the technical team designed a set of adaptation measures to ensure that the level of inundation remains close to the baseline situation, that is the current level of flooding in the year 2010. The team consulted various stakeholders such as communities, government, and the private sector in order to design the set of adaptation measures. The cost of the project refers to the cost of the adaptations and benefits refer to the amount of avoided damage due to the adoption of adaptation measures. The analysis shows a 3:1 ratio of benefits to costs for a future scenario when considered over a 5 year return period and a ratio of 5:2 using a 10 year return period. The costs of damage avoided include avoided losses to income, assets, health and other property-related damages.

Figure 3. Predicted flooding pattern in Khulna City (2050)



Source: Asian Development Bank, 2011

2.4 List of adaptation measures

The study suggested a list of adaptation measures which is shown in Table 2.

Table 2. Adaptation measures to be implemented after 2030 for Khulna City

Construction of new roads
Construction of culvert/bridge
Construction of new surface drains
Redesign of building
Raise the plinth of land/earth filling
Sluice gates improvement and clean up the siltation from outlets
Re-excavation of drain with lining
Re-excavation of Moyur river
Re-excavation of canals/drainage channel
Widen the canals
Widen the drains
Repair of prevailing dam/embankment/bridge
Temporary embankment construction
Repair of culvert
Resettlement of affected people
Preserve rain water
Keeping valuables away
Migrate during disaster
Proper solid waste management
Arrange campaign/education program to create awareness among people
Inform people before disaster

Source: IWM and AI Terra, 2010
NOTE: The study did not suggest any structural measures before 2030 except improvement in the management of the existing drainage system of Khulna city.

3 Objectives of this study

This study is based on the Khulna City drainage project study. The objectives are to:

1. Develop a stakeholder-focused cost-benefit analysis for Khulna City, which is likely to suffer from greater degree of waterlogging and flood due to climate change.
2. Develop a stakeholder-focused adaptation strategy for the city and see its impacts on the cost-benefit analysis.

4 Analytical framework for stakeholder-based CBA

4.1 Defining the stakeholders of Khulna City

Before developing the stakeholder-based cost-benefit analysis, it is important to understand the stakeholders of the project. For Khulna City, there are four categories of stakeholders, separated according to their possible adaptation strategies.

1. Private households. Households living in Khulna city are definitely the most important stakeholders of the city. In case of climate change these people are likely to suffer the most. Waterlogging due to climate-related events is likely to cause damage to their property and moveable assets as well as cause a loss of income, psychological pressure, health effects, reduced income from agriculture and so on. Some people might migrate to outside areas bringing in further uncertainty in life. Households, therefore, are likely to demand help from the government to reduce the impact of climate change. Households will include

entrepreneurs, businesses and other entities which are primarily owned and operated by households.
Households have already experienced similar events over the past decades; acceleration of either the frequency of occurrences or the intensity of the event will further aggravate the situation. As such, households might resort to take adaptation measures to protect their assets during such climate extremes.

2. Communities. Communities in Khulna City are a different type of stakeholder. In the event of a disaster, the role of the community is that of a potential saviour, organising measures to protect life and property, including providing guards to protect public and private resources. Prior to disasters, communities mobilise households to work together to protect public goods either through labour or through financial support. The primary objective of communities is to reduce hardship on the households due to climate related events.

3. Government. Government bears the ultimate responsibility of providing public goods for the city people. Government includes the local metropolitan city council, water and sewage authority, city development authority, and other departments. Khulna City Corporation (KCC) is responsible for development and maintenance of the surface drainage system while the Khulna Water and Sewage Authority (KWASA) is responsible for underground drainage systems. The Khulna Development Authority (KDA) is responsible for the development of the city master plan and approval of housing infrastructure. KCC is also responsible for development and maintenance of the city roads. Climate-related events like prolonged waterlogging will affect them and so these and other relevant departments of the Government of Bangladesh are considered a separate group of stakeholders.

4. The environment. Environmental stakeholders primarily represent or work for the protection of the environment which includes the river water systems, fisheries and wildlife. Khulna City does not have any real wildlife itself but the rivers surrounding the cities are habitat for many aquatic animals and are the spawning ground for tiger shrimps. Environmental groups also work with communities dealing with public affairs related to health and community hygiene and often participate with local people during disasters by providing them supplies of water, and make them aware of outbreaks of major epidemics.
These four groups have separate interests in terms of dealing with climate-induced disasters. The research treated these four groups separately to understand their role and involvement in terms of planning for adaptations. The following analysis considers them separately and our research methods used multiple strategies to seek their views.

4.2 Stakeholder preference

CBA has been used to analyse the net welfare gain from a project and to select the best project for a given purpose. It usually includes analysis of direct and indirect benefits and costs from a project under different market and institutional conditions. While understanding the net benefits from climate change adaptation practices, we have hypothesised that stakeholders of such interventions (adaptations) are likely to be different because of their divergence in interests and so their perception of the benefits[1] accruing from an adaptation measure may not be the same. Consequently, stakeholders will vary in their preferences for and against a specific measure. This will lead to conflicts in their interests.

One of the important first steps in developing a stakeholder-based CBA is to elicit the preferences of the stakeholders in full For this, the team must develop a comprehensive list of adaptation measures, requiring the following steps.

[1] Benefit accrual does not mean that they individually receive all benefits rather it refers to the fact these groups of stakeholders either directly or indirectly perceive these benefits.

- Step 1: Development of climate scenarios appropriate for the project area for the next 30-40 years.
- Step 2: Development of a set of adaptation measures relevant for each group of stakeholders.
- Step 3: Elicit views with respect to these adaptation measures in terms of who should do what.

In this study, Step 1 was completed by the ADB team, which includes the author. The ADB team also developed a preliminary list of adaptation measures in consultation with experts, local community and government (Table 2). During this study, however, the team further examined this list and discussed it with specific stakeholder groups. For the community and environmental stakeholders, the team used focus group discussions (FGD) to explain the climate scenarios and effects on the city using maps and figures. Based on this, NGOs and community leaders provided opinions and expanded the list further. As a follow up, the team conducted in-depth face-to-face interviews with city officials (government offices) in Khulna City including the Department of Environment, Khulna City Corporation, the Khulna Development Authority, and the Khulna Water and Sewage Authority and academics and researchers in Khulna University and Bangladesh University of Engineering and Technology (BUET). These discussions resulted in an extended list of adaptation measures.

4.3 Survey

Around 400 households from 26 wards[2] (out of 31 wards) in Khulna City Corporation were interviewed during survey. . In this research we considered four stakeholders categories. From different stakeholder's perspective, adaptation strategies and damages will be considered in the research.

Table 3. Summary of the field survey

Type	Number
Total wards in KCC	31
• Study area (wards)	26
Government office – in-depth interview	7
NGOs in FGD	14
Primary survey of households	400
by house type	
• Pucca house	168
• Semi-pucca house	148
• Kacha/jhupri house	84

4.4 FGD with NGOs

The team visited some wards of Khulna City to see the present waterlogging and talked with the local people. During the visit, a focus group discussion was arranged with 14 local Khulna NGOs: Prodipan, Citizen Centre, JJS, Shelter, World Vision, Nobolok, Rupantor, Asha, CSS, ADASAS, BRAC, Jagoroni Chakro, Oxfum, and UNDP. The meeting discussed the present waterlogging situation, problems, damage scenarios and the different adaptation strategies which are being taken by NGOs. The various NGOs emphasised collective activities between different government organisations and NGOs.

4.5 In-depth interviews with public officials

The team visited some government offices and interviewed key informants. The objective of the interview was to find out about the present waterlogging situation and drainage systems,

[2] 26 of 31 Wards of KCC are expected to be waterlogged between 2030-2050 if current drainage system is not improved. ADB study also predicted a range of adaptation strategies based on technical and political feasibility for Khulna city. These strategies were also examined during the primary survey in terms of preferences of the stakeholders.

and the various adaptation techniques being taken by different authorities, their ongoing work and future projected strategies regarding waterlogging in the KCC area. Interviews were taken with officials from the KCC, KDA, KWASA, Department of Environment (DoE), Bangladesh Water Development Board (BWDB), and some professors from Khulna University.

4.6 Extended list of adaptation measures

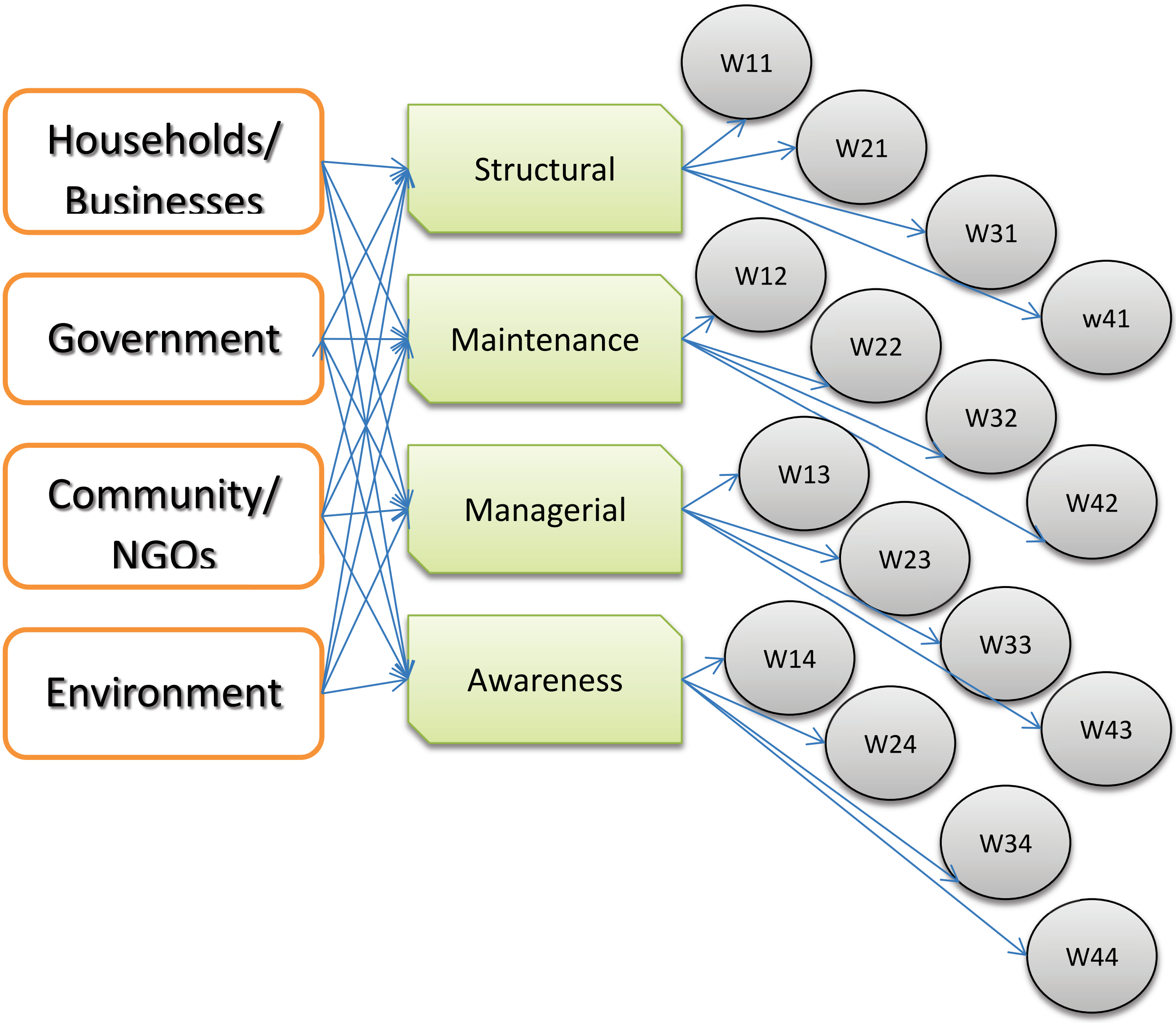
The extended list of adaptation measures with respect to climate scenarios presented in the ADB report is shown in Annex, Table 1. This extended list of adaptation measures was then tested among the groups using multiple strategies. For households, who represent consumers and businesses (as owners and operators), face-to-face interview techniques were used. For the other groups, a day-long workshop was conducted to derive their list of preference. Table 3 illustrates stakeholders' preferences for the various types of adaptation measures.
The list of measures can be divided into four categories.

- Structural adaptation measures – requiring construction works to deal with waterlogging.
- Repair and maintenance measures – since climate events span a long period of time, many of the adaptation measures includes in-time repair and maintenance of the structures.
- Managerial measures – including measures like arranging for the resettlement of people, and community-based co-ordination for the management of water and waste disposal.
- Awareness measures – including campaigns, information dissemination, etc.

4.7 Residual analysis to determine weights

As has already been discussed, stakeholders differ in the choice of adaptation measures as they conceive them from their own perspective. Therefore, we used a field survey of households and workshops for other stakeholders to do a residual analysis, or 'who should do what?' Stakeholders were asked who should be responsible for taking the lead or the most responsibility in implementing the four different categories of measures. Figure 4 shows the 4x4 matrix of weights that was developed.

Figure 4. Schematic framework for stakeholder-based CBA



NOTE: wij means weights assigned by the i^{th} stakeholder on the j^{th} adaptation measure.

4.8 Weights to cost and benefit

In order to complete a stakeholder-based CBA the weights derived in the residual analysis can be used to determine the cost of project from the viewpoint of each of the stakeholders. This is done using the following equation:

$$TC_j = \sum_{i=1}^{4} W_{ji} \times C_j \qquad (1)$$

Where W is the weight matrix, C is the cost of the project for each type of adaptation measures. TC is the total cost of the project from the viewpoint of the stakeholders. Ci represents the cost for i^{th} type of adaptation. TCj is the total cost of adaptation from the viewpoint of the j^{th} stakeholders.

Consequently, if B is benefit of the project then the project could be assessed using the standard tool of cost benefit analysis.

Figure 5. Analysis of adaptation costs by stakeholders

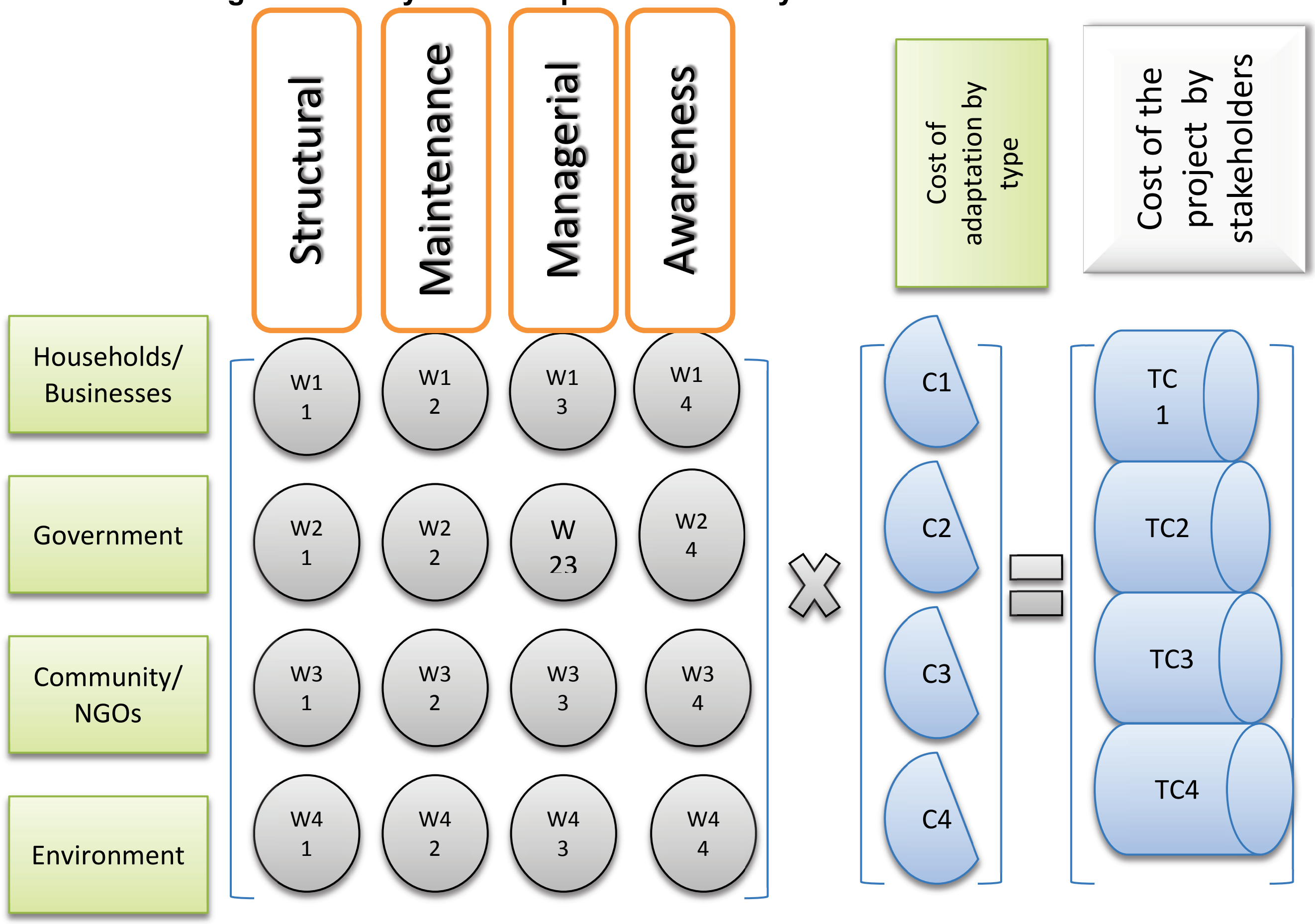


Figure 5 shows that for a project which is under climate risks, adaptation practices could be different. C1, C2, C3 and C4 may have been similar, but after multiplying with the weight, TC1, TC2, TC3 and TC4 may not be similar anymore. This is depended on the weights of the different stakeholders.

Similarly

$$B = \sum B_j \qquad (2)$$

Where B_j is the benefit from the adaptation activities accrued to j^{th} stakeholders.

Therefore, $NPV_j = PV(B) - PV(C_j)$, where – *PV(B))* =present value of the benefit and *PV(C)*= present value of the cost and *B* is the benefit from the project. Since there is only one project being considered the total benefit from the project is same across all stakeholders. As such, net present value (NPV) for all stakeholders will only vary across stakeholders if $PV(C_j)$ varies across the different stakeholders. Under these circumstances, the projects using stakeholder-based CBA means, analysis of cost effectiveness analysis (CEA) where the objective is to find the least cost design of the project.

However, if benefits vary across the stakeholders due to changes in the project design, the analysis will lead to differences in NPV or benefit-cost ratio (BCR) or the internal rate of return (IRR) due to changes in both benefits and costs. In this situation, the stakeholder-based CBA entails looking into the project with the maximum BCR.

5 Results of stakeholder-based CBA

The main activities of this research revolved around understanding the different preferences for adaptation measures of different stakeholders given the climate change scenario for

Khulna City. Using FGDs with various stakeholders and a primary household survey, the first objective of the study was to pinpoint the differences in perception on various adaptation strategies by these stakeholders.

5.1 Stakeholder preferences for adaptation measures

Table 4 shows that there is quite a large divergence among the stakeholders in terms of which measures they prefer. For example, while only 75 per cent of the structural measures listed in the annex were liked by households, all of them were liked by the government, 63 per cent were liked by the community and only 25 per cent were liked by environmental stakeholders. The same divergence appears among repair and maintenance, managerial and awareness adaptation measures.

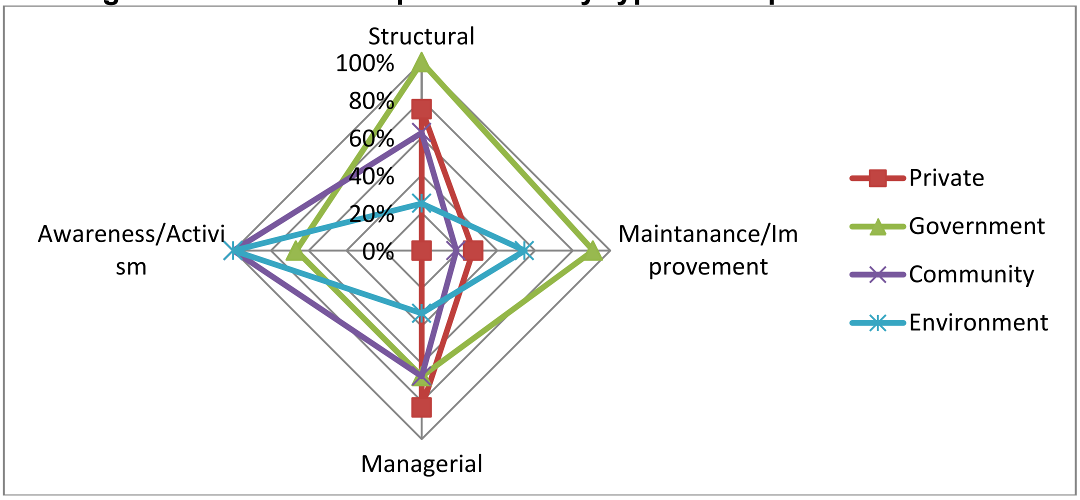
Table 4. Stakeholder preferences for adaptation measures

	Stakeholder groups			
Type of adaptation	Households	Government	Community	Environment
Structural	75%	100%	63%	25%
Repair and maintenance	27%	91%	18%	55%
Managerial	83%	67%	67%	33%
Awareness/activism	0%	67%	100%	100%
Total	46%	81%	62%	53%

Source: FGDs, in-depth interviews, 2010-11

Figure 6 uses a radar diagram to illustrate the agreements and disagreements among the stakeholders. It shows that government stakeholders have special fondness for the structural and repair and maintenance types of adaptations. Community and environment stakeholders seem to prefer the awareness types of adaptation, while households prefer more of a managerial type of adaptation where they also have some say or participation.

Figure 6. Stakeholder preference by type of adaptation measure



Source FGDs, in-depth interviews, 2010-11

The field survey data further showed that stakeholders do not expect all of these adaptation measures to be financed using public funds. Since many of the climate adaptation measures are related to regular seasonal and cyclical natural events (floods are seasonal and severe flooding is also cyclical), individuals often undertake measures voluntarily and so the need for public intervention should be determined using a residual analysis.

5.2 Expansion of adaptation measures

From discussion with different stakeholders the list of adaptation measures was expanded, as shown in Table 5.

Table 5. List of adaptation measures and acceptance by stakeholders

	Who benefits from these adaptations			
Adaptation options	Public	Private	Community	Environ ment
Proper solid waste management	X	X	X	X
Develop drainage system	X	X		X
Construction of new embankment/bridge/dam	X	X		
Repair of existing dam/embankment/bridge	X	X	X	
Repairing drains and dredging of canals/ponds	X	X	X	X
Make water/sanitation canal free from illegal occupation	X	X	X	X
Repair of roads and raise the road level	X	X	X	
Resettle affected people	X		X	X
Pumping of water	X	X	X	X
Widen the sluice gates/clean up the siltation from outlets	X			X
Construction of shelter centre	X	X	X	
Make water/sanitation canal free from illegal occupation	X		X	X
Preserve rain water		X		X
Keep valuables away		X		
Construction of new drains	X	X	X	
Own plinth raising		X		
Repair WASA water pipe	X	X	X	
Arrange campaign/education program to create awareness among people	X		X	X
Redesign city master plan regarding flood situation	X			X
Provide relief/working opportunity among people	X	X	X	
Construction of roads	X	X	X	
Provide sanitation facilitate products			X	X
Redesign of building	X	X		
Migrate during disaster		X		

5.3 Questionnaire design and training of enumerators

Based on the above list, a questionnaire was developed for a detailed household survey and enumerators were trained to collect household data based on a randomised method of data collection. The questionnaire was pre-tested and revisions were made before the final survey. The survey used a systematic-stratified random sampling method to interview households from 26 wards of the city. Stratification was based on the housing structure of the households in the city.

5.3.1 Sampling Plan

In the KCC area about 42 per cent of houses are pucca houses, 37 per cent are semi-pucca houses and 21 per cent are kaccha/jhupri houses (IWM survey, 2010). Table 6 shows the distribution of our sample in the survey by KCC ward and by housing structure.

Table 6. Household survey – distribution of sample by housing structure and ward

Ward No	Area Name	Pucca	Semi-pucca	Kacha/Jhupri	Total
3	Maheshwar Pasha	5	3	2	10
4	Deana	6	6	4	16
5	Doulatpur	6	6	4	16
6	Pabla, Karigarpara	6	6	4	16
7	S O Cross Road, Khalishpur P.S. Road, Khalispur K. Khana Road	6	6	4	16
9	Rayermohol, Mujgunni, Goalkhali	6	6	4	16
10	Khalishpur Residential area	6	6	2	14
11	Khalispur R/A and Khalispur Housing State	6	6	4	16
12	Khalishpur Thana, Eid Gah	8	4	2	14
13	Charer Hat	6	6	2	14
14	Boyra	8	8	4	20
15	T and T Campus	6	6	4	16
16	Choto Boyra	6	6	4	16
17	Sonadanga, Mujgunni main road	6	6	4	16
18	Banorgati	8	4	2	14
19	Goborchaka	10	6	2	18
20	Sheikhpara, Farajipara	6	6	2	14
23	Kakolibag	6	6	4	16
24	Gollamari, Nirala Residential Area	6	6	4	16
25	Islamabad	6	6	4	16
26	Baniakhamar	6	6	4	16
27	Musolmanpara, Moulavipara, West Tootpara	6	6	2	14
28	West Tootpara, Harintana	6	6	4	16
29	Joshefpara, Rupsha	8	4	2	14
30	Tootpara, Rupsha	6	6	4	16
31	Motiakhali,Labonchora, Mohammodia para	6	6	2	14
		167	**149**	**84**	**400**

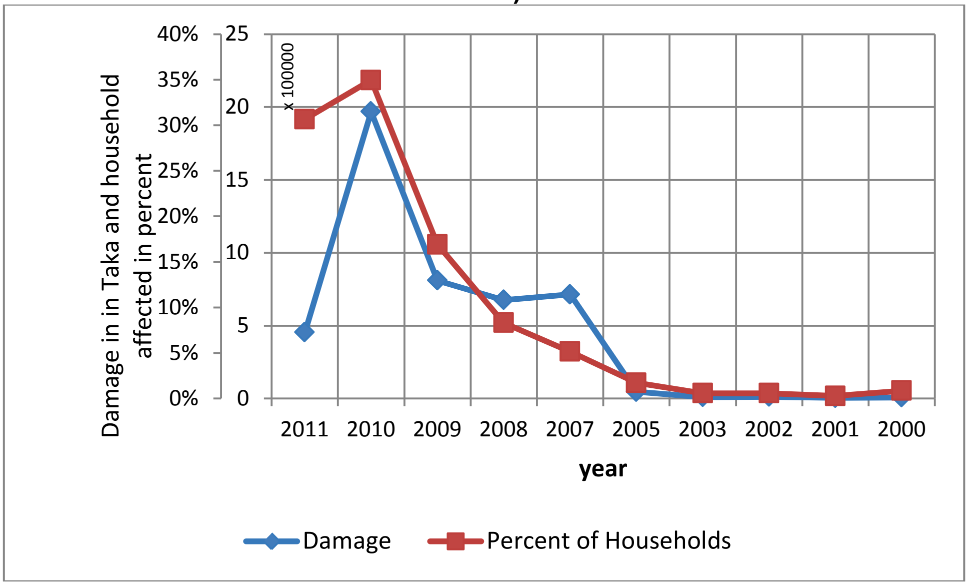
5.3.2 Understanding the project benefits from stakeholders

In order to understand the benefit from a climate adaptation project, it is important to find out the benefit of the project. These benefits should be the ‘additional’ benefit accruing to stakeholders due to taking adaptation measures. Typically, benefits from climate adaptation activities refer to the ‘value of avoided damages’ for each stakeholder.

In case of the Khulna City drainage project, the field survey data from households, which covers both private households and businesses, show that in the past 10 years, the cost of damages due to waterlogging is around Taka (৳) 13,469 per household per year, or (US$195)The total damage over 10 years for 400 households was around ৳ 369.23 million. The value for the whole population of the city (about a million) is around ৳ 92.31 billion every 10 years.

The field survey also shows that 70 per cent of the households in the city area were directly or indirectly affected by waterlogging. Assuming that a large volume of damages are indirect and perhaps non-monetary, such as individual suffering in terms of cooking, transportation, loss of power, loss of trees, damage to houses, and diseases. It is also important to note that the amount of damage is increasing exponentially, as is the number of households over the years. This suggests that the extent of damage is likely to go up over the future years and it will further go as the general income level of people increases. Consequently, the cost of 'avoided damage' is likely to go up significantly.

Figure 7. Trends in damage and percent of households affected by year (2000-2011)



Source: Field Survey 2011

Estimating the benefits of adaptation measures to government or public stakeholders, the community and the environment would require a more elaborate survey strategy it was not done during this study due to financial and time constraints. The 'additional benefits' from climate adaptation measures could be determined for government from budget analysis the government offices such as the KCC, KDA and KWASA and other public utility services. This would provide the cost of repair and maintenance of roads, public buildings and other infrastructure due to waterlogging in the past 10 years. Estimating the value of avoided damage from community and environmental stakeholders point of view would need a complete set of valuation studies, which could not be done in this phase of study.

5.4 Weights and impact on project costs

The field survey of households and discussions at the stakeholders' workshop were used to derive the relative weights for the extended list of adaptation measures given the climate scenarios and its impacts on the Khulna city drainage infrastructure and on its people. The result is shown in Table 7. It shows that the preliminary preference pattern shown in Table 3 has been revised and the weights are different from the initial list of preferences. This is mainly due to the fact that the consultation process refined the initial list and finally produced the W matrix of Equation 1.

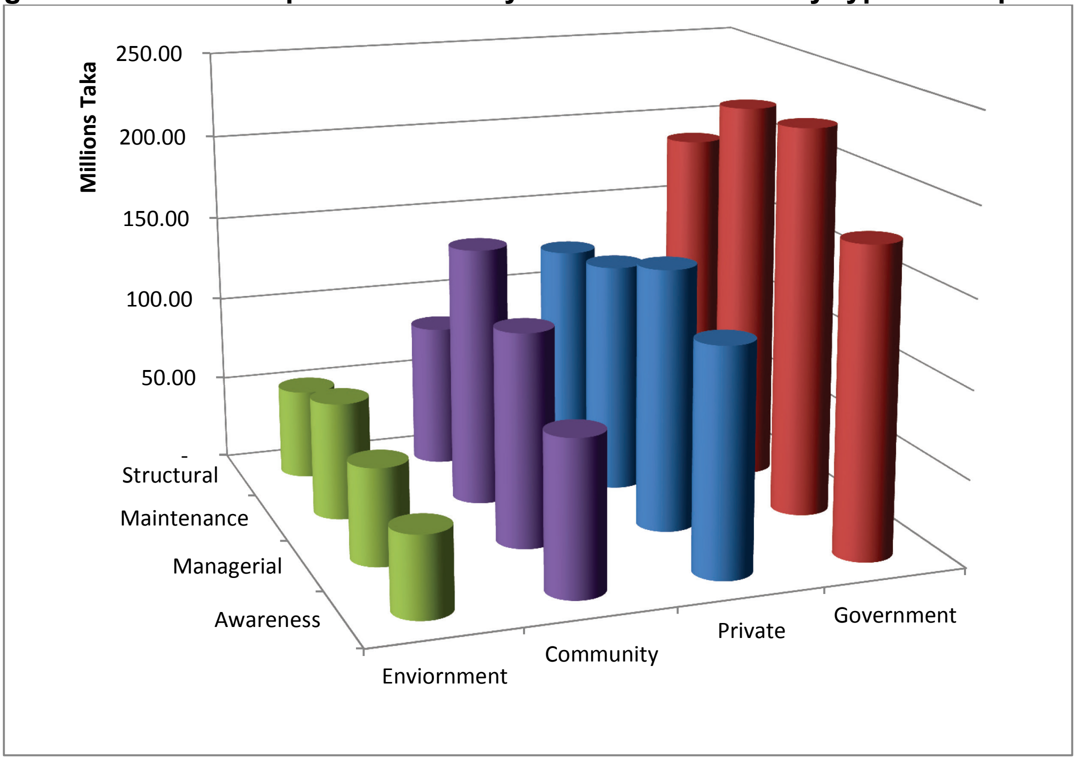
Table 7. Distribution of weights by type of adaptation measures by stakeholders

	Structural	Maintenance	Managerial	Awareness
Private stakeholders	60%	60%	40%	46%
Public stakeholders	100%	91%	67%	67%
Environment stakeholders	29%	50%	33%	100%
Community stakeholders	57%	25%	67%	100%

Source: field survey, 2011; and stakeholders' workshop, 2012.

Using the cost of adaptations provided in the ADB study and Equation 1, the total cost of adaptation is shown in Figures 8 and 9. Figure 8 shows the breakdown of the costs of adaptations by stakeholders. It shows that the government prefers the most costly options while environmental stakeholders prefer the least costly adaptation options. It also shows how the set of adaptation options differs by stakeholders, a piece of information which was not expected at the initial phase of research. This clearly justifies use of stakeholder-based CBA for climate-related adaptation projects.

Figure 8. Climate adaptation costs by stakeholders and by type of adaptation

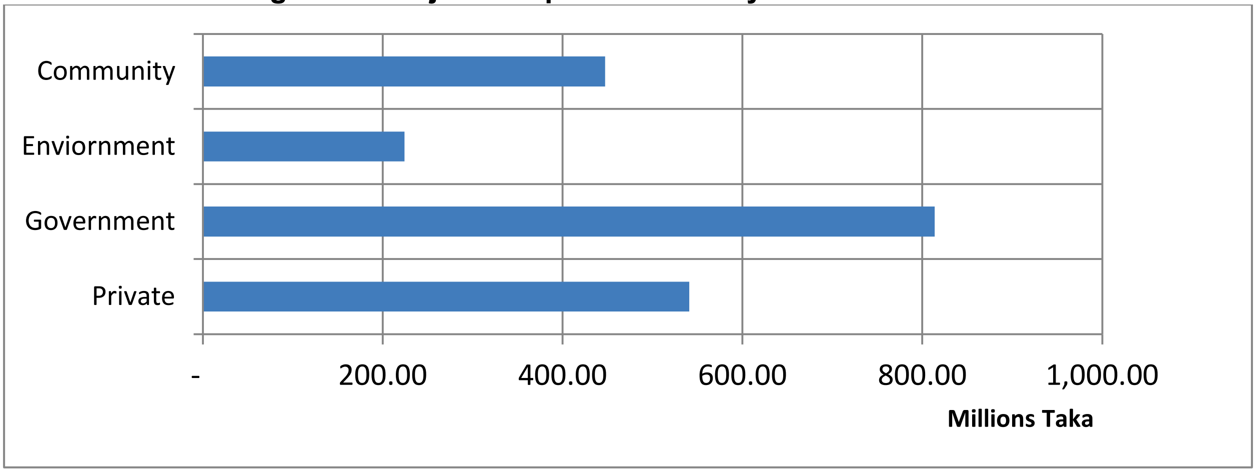


Source: Author's calculation.

Figure 9 shows the total cost of the project based on Equation 1. It shows that the project cost would be highest if we followed the preference of the public (government) stakeholders. If we follow the preference of the private stakeholders the project cost reduces and if we follow the environmental stakeholders, the project cost is the least. This is because not all the adaptation measures were agreed by all the stakeholders.

Evidently, public authorities favour the most extensive measures, followed by private, community and the environmental stakeholders in that order. It is also evident that while structural adaptation measures are preferred by the government or public agencies, community and environmental groups preferred the awareness type of adaptation measures.

Figure 9. Project adaptation cost by stakeholders



Source: Author's calculation

6 Concluding observations

Climate change poses risks to the life and livelihood of people in a locality. The adaptation measures suggested in a project designed are supposed to mitigate such risks. A full-proof measure represents a case where all risks are mitigated and could be a very costly option. On the other hand, since climate risks are never 100 per cent predicted, it is possible to use the preferences of stakeholders to redesign the project to significantly reduce the cost of adaptation. Such strategy will also significantly improve the efficiency of resource allocation. It is therefore recommended that, while dealing with adaptations to climate change, stakeholder-based project design might be more efficient and effective.

In terms of the cost of adaptation, the adaptation measures preferred by community stakeholders cost about two times more than those of the environmental stakeholders, who preferred a low-intervention strategy. The preferred cost is 2.41 times greater for private stakeholders and 3.63 times greater for government stakeholders. Given this disparity, the strategy of stakeholder-based CBA is justified for climate adaptation projects on the grounds that it will require the balancing of benefits across stakeholders and probably reduce the cost of adaptation and ensure a sustainable development path.

References

Asian Development Bank, 2011. Adapting to climate change strengthening the climate resilience of the water sector infrastructure in Khulna, Bangladesh. Mandaluyong City, Philippines.

IWM and Alterra 2010. Bangladesh: Strengthening the Resilience of the Water Sector in Khulna to Climate Change, Final Report, Local Government Division, Ministry of Local Government, Rural Development & Cooperatives, Asian Development Bank (ADB).

Annex 1: List of adaptation measures suggested for the Khulna study by stakeholders

Type of adaptation	Adaptation measures	Private	Governme nt	Communit y	Environm ent
Structural	Construction of new roads	1	1	1	0
	Construction of culvert/bridge	0	1	0	1
	Construction of temporary embankment	1	1	1	0
	Construction of new surface drains	1	1	1	1
	Construction of shelters	1	1	1	0
	Construction of road and embankment	0	1	0	0
	Construction of flood embankment	1	1	1	0
	Redesign of building	1	1	0	0
Maintanance/ improvement	Maintenance of own pond/canal/drains	1	0	0	1
	Raise the plinth of land/earth filling	1	1	1	0
	Repair of roads and raise the road level	1	1	1	0
	Repair of own house/Redesign of building	1	0	0	0
	Fill up dead ponds/canals	1	1	1	1
	Sluice gates improvement and clean up the siltation from outlets	0	1	0	1
	Raising of road cum embankment level	0	1	0	0
	Re-excavation of drain with lining	0	1	0	1
	Re-excavation of Moyur river	0	1	0	1
	Re-excavation of canals/drainage channel	0	1	0	1
	Widen the canals	0	1	1	0
	Widen the drains	1	1	0	0
	Repair of existing dam/ embankment/bridge	0	1	0	1
	Repair of culvert	0	1	0	0
Managerial	Resettlement of affected people	0	1	1	1
	Pumping of water	1	1	1	1
	Preserve rain water	1	0	0	1
	Keeping valuables away	1	0	0	0
	Migrate during disaster	1	0	0	0
	Proper solid waste management	1	1	1	1

Type of adaptation	Adaptation measures	Private	Governme nt	Communit y	Environm ent
	Make water/sanitation canal free from illegal occupation	0	1	1	1
	Provide relief/working opportunity among people	1	1	1	0
	Upgrade of flood embankment	1	1	1	0
Awareness/activism	Arrange campaign/education program to create awareness among people	0	1	1	1
	Inform people before disaster	0	1	1	1
	Provide sanitation facilitation products	0	0	1	1

Source: ADB report (2011), FGD, In-depth interview and face-to-face questionnaire survey by IIED research team (2011).