ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/322363707

# CLIMATE CHANGE ADAPTATION PROJECTS: INTEGRATING PRIORITIZATION AND EVALUATION

**Article** · January 2012

CITATIONS
0

READS
323

**4 authors:**

Alberto Gianoli
Institute for Housing and Urban Development Studies
15 PUBLICATIONS 53 CITATIONS
SEE PROFILE

Stelios Grafakos
Global Green Growth Institute
52 PUBLICATIONS 485 CITATIONS
SEE PROFILE

Veronica Olivotto
The New School
6 PUBLICATIONS 10 CITATIONS
SEE PROFILE

Anika Nasra Haque
University of Cambridge
9 PUBLICATIONS 70 CITATIONS
SEE PROFILE

**Some of the authors of this publication are also working on these related projects:**

Project Gender and household energy: female participation in designing domestic energy in India's slum rehabilitation housing View project

Project Exploring the use of land value instruments for green resilient infrastructure benefits: A framework applied in Cali, Colombia View project

All content following this page was uploaded by Anika Nasra Haque on 10 January 2018.

The user has requested enhancement of the downloaded file.

# CLIMATE CHANGE ADAPTATION PROJECTS: INTEGRATING PRIORITIZATION AND EVALUATION

A. Gianoli*, S. Grafakos*, V. Olivotto*
A.N Haque**
*Researchers
Institute for Housing and Urban
Development Studies, Erasmus University
Rotterdam, the Netherlands
**Lecturer
School of Architecture
American International University
Dhaka, Bangladesh
gianoli@ihs.nl
grafakos@ihs.nl
olivotto@ihs.nl

**Summary:** The paper analyses the challenges of evaluating climate change adaptation measures and describes a general assessment framework that takes these challenges into consideration. The framework is integrated into an innovative decision making tool, CLIMate ACTions Prioritization (CLIMACT Prio), for the screening, prioritization and evaluation of climate change adaptation measures. CLIMACT Prio applies Multi Criteria Analysis to assist urban decision makers in identifying a wide range of decision criteria and setting priorities among different objectives. The paper concludes with the description of the preliminary application of the CLIMACT Prio to the case of Dhaka, Bangladesh, where the tool was used to prioritise and select alternative adaptation measures aimed at protecting vulnerable areas from flooding.

**Key Words:** Evaluation, climate change adaptation, multi criteria analysis, decision making support tools

# Climate Change Adaptation Projects: Integrating Prioritization and Evaluation

## I. INTRODUCTION: CHALLENGES OF EVALUATING CLIMATE CHANGE ADAPTATION

Global climate is changing at unprecedented rates and the associated risks and impacts are increasingly being felt across a range of urban areas, communities and ecosystems world-wide. The resulting increased demand for adaptation measures calls for robust, reliable and transparent assessment approaches and methods to help decision makers allocate scarce resources efficiently (i.e. how economically resources are converted to results) and effectively (i.e. the extent to which the objectives of the intervention are met). Formal evaluation methods are essential in order for local adaptation planning to develop into an effective and efficient policy response to the challenges posed by climate change (Baker et al 2012).

Adaptation is a concept whose boundaries still need to be clearly defined. Broadly speaking, adaptation can be understood as an action or combination of actions that reduce the vulnerability of an individual, household, population group, infrastructure, or system (e.g. urban area) to the adverse impacts of climate change (IPCC 2007). In order to assess adaptation-specific activities, a counter-factual baseline should be established. However, baseline climatic risks evolve under climate change and shifting baselines constitute a challenge for evaluation as they may constitute confounding factors in the assessment of adaptation interventions. For example, in the case of an intervention directed at reducing the rate of mortality from climate-related events, tracking mortality alone may not be sufficient. A stable mortality rate might suggest that the population's ability to cope with climate change is not improving, whereas the opposite could be true if the deteriorating climate baseline (e.g. higher frequency of climatic extremes) is acknowledged (IIED 2011). Furthermore, adaptation strategies viewed as successful in the short-term might exacerbate longer-term vulnerability. By way of illustration, poorly designed coastal and flood defences can in the short-term lower vulnerability, encouraging population growth and development in otherwise vulnerable locations. In the long-term however, vulnerability can substantially increase if extreme weather events exceed the design threshold of the defences. These complexities need to be considered when designing and implementing evaluations of climate change adaptation measures (OECD 2011).

For a given historical climate baseline, with a certain mean and variability, there is a coping range within which a system such as a community, an economic sector or an ecosystem can cope with climatic variability. The coping range can be considered as a measurement of the resilience of the system and adaptation projects intervene to expand the coping range of the target system by implementing adaptation measures and activities that reduce vulnerability or increase adaptive capacity. But the climate baseline is not the only moving baseline and not the only one affecting the coping range. There is also constant change in terms of socioeconomic conditions, infrastructure, demographics, political context and other variables. Changes along these axes can narrow or expand the coping range of societies. Therefore, the project baseline has to take into account not only forecast in climate and its impacts but also forecasts in socio-economic, environmental and technology indicators when planning and evaluating adaptation interventions. In addition, the scenario conditions in most cases will have not materialized at the time of the project termination (GEF 2008).

In light of the above, it can be stated that evaluating adaptation projects is inherently complex and fraught with difficulties, also because adaptation interventions tend to cut across many sectors, are implemented at different scales, over different timescales, and vary from hard structural adaptation measures to soft policy measures. Even though conventional evaluation methodologies remain applicable to evaluating adaption projects' progress and results, their particular nature and characteristics call for ad hoc approaches. The purpose of the paper is to shed light on how these approaches to the evaluation of climate change adaptations can be developed and applied.

As a starting point, the tables below illustrate some of the general (i.e. shared by all development projects) and specific challenges related to the monitoring and evaluation of adaptation projects (GEF 2011, UKCIP 2011, UNDP 2007, UNFCCC 2010, World Bank 2009, World Bank 2010).

*Table no.1: General challenges*

| | |
|---|---|
| **Capacity** | Low level of capacity and/or financial resources for implementing sound M&E systems. |
| **Data** | Lack of baseline data and historical trends. |
| **Complexity** | Involvement of multiple actors at multiple levels in multiple sectors. |
| **Attribution** | Difficulty of isolating the performance of specific project activities. |

*Source: GEF 2011, UKCIP 2011, UNDP 2007, UNFCCC 2010, World Bank 2009, World Bank 2010*

*Table no.2: Specific challenges*

| | |
|---|---|
| **Uncertainty** | Uncertainty surrounding climate change impacts, including the frequency and intensity of extreme events, and the long-term repercussions of climate change effects. |
| **Indirect effects** | Indirect effects of climate change impacts, such as on health issues. |
| **Co-benefits** | Consideration for the mitigation implications of adaptation options as well as sustainable development synergies. |
| **Infrequent events** | For projects designed to reduce vulnerability to infrequent (extreme) events, the project or activity can be evaluated only if the foreseen event |

| | |
|---|---|
| | occurs before evaluation of the project. If such an event does not occur, it may be difficult to determine if the project or activity was properly implemented. |
| **Time scales** | Significant time lags may exist between interventions and measurable impacts. Furthermore, particularly in the case of projects focusing on long-term time frames, their success will not be apparent for years after the end of the project lifetime. Monitoring and evaluation of interventions designed to deliver long-term benefits must be based on assessments of proxy measures. |
| **Reverse logic** | The adaptation measure is by default successful when no climate-related events occur, thereby rendering the effectiveness of the measure difficult to judge. |
| **Level of risk** | Difficulty of defining a long-term vision of the effects of adaptation and agreeing on levels of acceptable risk. |
| **Shifting baseline** | Adaptation takes place against a backdrop of evolving climate hazards, which may become more frequent and severe, resulting in climate-related losses, or become less pronounced over the timescale of a project. The impacts of adaptation projects must be assessed against changing hazard profiles, meaning that it is not necessarily sufficient to compare losses or damages before and after adaptation interventions. Where trends in climate hazards occur over periods during which assessment of project impacts are taking place, indicators of loss or damage must be 'normalized' to account for changing hazards. |
| **Agreed metrics** | Unlike in climate change mitigation, where carbon dioxide equivalence can be used as a common metric, adaptation lacks an agreed metric to determine effectiveness. |

*Source: GEF 2011, UKCIP 2011, UNDP 2007, UNFCCC 2010, World Bank 2009, World Bank 2010*

The challenges outlined should be taken into consideration when devising evaluation frameworks for adaptation projects. This does not imply that they will be relevant to all adaptation interventions and evaluation approaches. Furthermore, it should be stressed that the paper does not provide universally applicable solutions showing how the challenges should concretely be dealt with regardless of the specificities of each adaptation intervention and related context. What is being argued here is that it is necessary to make the challenges explicit and elaborate evaluation strategies able to deal with the intrinsic complexity that characterises the implementation and evaluation of adaptation projects in the best possible way, given the time and resource constraints that characterise the evaluation of adaptation interventions.

## II. COMPONENTS OF EVALUATION FRAMEWORK FOR CLIMATE CHANGE ADAPATATION

Based on the issues described above, it is proposed that evaluation frameworks for climate change adaptation should be composed of the following three key components:

1. Adaptation Vulnerability Assessment
2. Adaptation Evaluation Criteria
3. Adaptation Logical Framework and Theory of Change

In what follows, the three components are briefly outlined.

### 1. Adaptation Vulnerability Assessment

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as 'the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes' (IPCC 2007, p. 6). The vulnerability of a given system to climate change can vary with the unique characteristics of that system including its exposure, sensitivity, and adaptive capacity (Snover et al 2007). Climate change can impact a system by introducing new stressors, and may also exacerbate existing stressors. The objective is to reduce the risk by informed decision-making based on decision support analysis focusing on probability. The total risk may be decreased by reducing the size of any one or more of the three contributing variables; the hazard, the elements exposed, and/or their vulnerability or by increasing the adaptive capacity.

In general, a vulnerability assessment can be broken into three elements.

Step 1: Assess Current Vulnerability
This element identifies the system's vulnerabilities to existing stressors, including relevant climate conditions that currently affect the system stressors. This assessment provides a roadmap for which climate variables (e.g. temperature, precipitation) are most likely to be of interest. The current vulnerabilities are apt to be affected by a number of elements including environmental, social and economic factors (Mehdi et al 2006).

Step 2: Estimate Future Conditions
The potential changes in climate variables and climate variability are project to a particular future time period to estimate the effects within the assessment area (Mehdi et al 2006). This can be achieved for example by the development of scenarios depending on a range of uncertain factors. Climate projections are a function of the scenarios chosen and the hypothesis made in those scenarios. The scenarios are then used for analysing the impact on social, environmental and economic systems.

Step3: Estimate Future Vulnerabilities
How vulnerable a system is to climate change can be determined by estimating how sensitive and how resilient the system is to change (Turner et al 2003). A system is considered sensitive to climate change if the system is likely to be affected by the projected climate scenarios (Snover et al 2007).

## 2. Adaptation Evaluation Criteria

When evaluating climate change adaptation projects it is proposed to use a modified version of the OECD-DAC criteria for assessing development projects (OECD 1991, 2000), with the addition of equity (UKCIP 2011) and flexibility (Institute of Development Studies 2008). The seven proposed criteria are briefly described below.

*Relevance*

Relevance assesses the extent to which the adaptation intervention activities are consistent with the priorities of the target group and broader stakeholders, and with the relevant policies of the funder. In evaluating the relevance of an adaptation project, the following questions should be considered:

- To what extent are the objectives of the adaptation project still valid?
- Are the activities and outputs of the adaptation project consistent with the overall goal and the attainment of its objectives?
- Are the activities and outputs of the adaptation project consistent with the intended impacts?

*Effectiveness*

Effectiveness measures the extent to which an adaptation intervention attains its objectives. In evaluating the effectiveness of an adaptation project, the following questions should be considered:

- To what extent were the objectives achieved / are likely to be achieved?
- What were the major factors influencing the achievement or non-achievement of the objectives?

*Efficiency*

Efficiency measures the outputs, both qualitative and quantitative, in relation to the inputs. It assesses whether the adaptation intervention has used the least costly resources possible in order to achieve the desired results. This generally requires comparing alternative approaches to achieving the same outputs, to see whether the most efficient process has been adopted. In evaluating the efficiency of an adaptation project, the following questions should be considered:

- Were activities cost-efficient?
- Were objectives achieved on time?
- Was the adaptation project implemented in the most efficient way compared to alternatives?

*Impact*

Impact considers the positive and negative changes produced by an adaptation intervention, directly or indirectly, intended or unintended. This involves the main impacts and effects resulting from the activity on the local social, economic, environmental and other development indicators. The examination should be concerned with both intended and unintended results and must also include the positive and negative impact of external factors. In evaluating the impact of an adaptation project, the following questions should be considered:

- What has happened as a result of the adaptation project?
- What real difference has the adaption project made to the beneficiaries?
- To what extent has the adaptation project reduced vulnerability and/or enhanced adaptive capacity?

*Sustainability*
Sustainability is concerned with assessing whether the stakeholders involved have the ability to prolong the adaptation process beyond the project lifetime and, as a result, whether the benefits of the adaptation activity are likely to continue after external funding has been withdrawn. It is proposed that sustainability should also consider the long-term relation between planned and autonomous adaption, to ensure that they are mutually reinforcing and that there is no crowding out. In evaluating the sustainability of an adaptation project, the following questions should be considered:

- Do the stakeholders have sufficient capacity and endogenous resources to sustain the adaptation process?
- What is the likelihood that the adaptation project's outputs and activities are likely to remain or continue after external funding has ceased?
- Are planned and autonomous adaptation mutually reinforcing?

*Equity*
Equity assess whether the effects of an adaptation intervention may be experienced unevenly, both spatially and temporally, as a result of the differing vulnerability of individuals, households, businesses and communities. In evaluating the equity of an adaptation project, the following questions should be considered:

- Has the adaptation project targeted the expected beneficiaries?
- Are certain individuals, households, businesses or communities exposed to disproportionate risks, bear additional costs or suffer disbenefits as a result of the adaptation project?

*Flexibility*
Flexibility accounts for the uncertainty of climate change and the evolving knowledge base and it assess whether a specific adaptation intervention has the necessary robustness to deal with the complex and variable environment within which it is implemented and with a variety of possible futures. In evaluating the flexibility of an adaptation project, the following questions should be considered:

- Can the scope, size and timing of the adaptation project be modified due to changed circumstances?
- Do the additional costs involved with changing the scope, size and timing affect the financial viability of the adaptation project?

### 3. Adaptation Logical Framework and Theory of Change

The adaptation logical framework is the key analytical tool to be used in the evaluation of adaptation projects. It graphically conceptualises the hypothesised cause-and-effect relationships of how project resources and activities will contribute to the achievement of objectives and results. The underlying logic is that inputs are used to undertake project activities that entail the delivery of outputs (goods and services), that lead to the achievement of the project outcomes (first level or primary outcomes, second level or secondary outcomes, and so on) that contribute to the project impacts. Based on the logical framework it is possible to configure indicators, baselines, milestones, targets, identify data sources and techniques, and assess assumptions and risks for monitoring and evaluating implementation and results around this structure (AFB 2011). A matrix detailing how the general (i.e. Capacity, Data, Complexity, Attribution) and specific (i.e. Uncertainty, Indirect effects, Co-benefits, Infrequent events, Time scales, Reverse logic, Level of risk, Shifting baseline, Agreed metrics) challenges related to the evaluation of climate change adaptation projects will be dealt with should be added to the adaptation logical framework.

The adaptation logical framework should be complemented by an adaptation theory of change. Broadly speaking, development policies and interventions are typically aimed at changing the behaviour or knowledge of households, individuals, and organizations. Underlying the design of the intervention is an explicit or implicit theory of change, with social, behavioural, and institutional assumptions indicating why a particular policy will work to address a given development challenge (NONIE 2009). Any theory of change requires certain assumptions to be made about how inputs can generate activities that will result in the desired outputs, outcomes and impacts. The evaluation must explore and challenge these assumptions. This is particularly true in the case of climate adaptation where there can be considerable uncertainty (UKCIP 2011).

Annex 1 shows the template of the proposed adaptation logical framework in relation to a concrete adaptation measure currently being implemented in Phobjika Geog, Bhutan.

## III. CLIMACT PRIO: SCREENING, PRIORITIZING AND EVALUATING CLIMATE CHANGE ADAPTATION PROJECTS

After having outlined a general methodology specifically developed to evaluate climate change adaptation projects, based on an adaptation logical framework which includes specific assessment criteria and challenges as outlined above, the paper will describe how this can be integrated into a decision support tool developed by the authors to screen, prioritise and evaluate adaptation measures. This will emphasise how the phases of screening, prioritizing and evaluating climate change adaptation measures should be considered as strictly related and can therefore be encompassed within a single coherent and consistent decision making framework. After having outlined the technical characteristics of the framework, in the next section the paper will describe its application to the choice of flood protection measures in Dhaka, Bangladesh.

CLIMate ACTions Prioritization (CLIMACT Prio) is a decision support tool for the screening, prioritization and evaluation of climate adaptation projects. CLIMACT Prio applies a multi-criteria approach to assist decision makers at the urban level to identify a wide range of decision criteria and set priorities among different objectives. This approach does not necessarily identify an 'optimal' adaptation option, but rather requires the decision maker to draw conclusions by taking into account different components of the assessment problem. In addition, by following this approach, other objectives such as local development benefits can be included in the decision making process.

CLIMACT Prio provides an interactive platform to help decision makers to structure and define the decisions under consideration. The Excel-based software asks the decision makers to enter information through a guided menu of instructions and utilises a menu-driven graphic representation of results for the evaluation of climate change adaptation options. The user selects specific adaptation options and criteria and then assigns scores (qualitative and quantitative) to describe how each option meets each criterion. CLIMACT Prio is based on Multi Criteria Analysis (MCA). MCA is a multi-step analysis based on the synthesis of already existing vulnerability assessment studies. The results from this analysis assist the decision-making process in choosing priority adaptation actions.

The CLIMACT Prio tool is structured around five sequential phases:

1. Vulnerability profile
2. Identification of adaptation actions and selection of criteria
3. Impact assessment matrix, normalization of scores, weighting of criteria
4. Final ranking and sensitivity analysis
5. Adaptation logical framework

These stages are described in more detail below (see also Annex 2):

Phase 1: Vulnerability profile
The decision maker is requested to provide information on the different components of vulnerability, namely exposure, sensitivity and adaptive capacity. Given the technical nature of these measurements, the support of climate change vulnerability specialists is recommended. After considering the three components of vulnerability by developing different indices, the vulnerability index is calculated, based on data on 1) the level of Physical Exposure to Climate Change Risks (including both extreme weather events recurrence and mean level for rainfall, temperatures, and sea level rise), a predominantly quantitative analysis, which produces an Exposure Factor, 2) the Sensitivity Analysis of the given area (qualitative and quantitative), which produces a Sensitivity Index, and 3) the level of Adaptive Capacity of the same given area (qualitative analysis). The Vulnerability Index is expressed as the Exposure Factor multiplied by the Sensitivity Index and divided by the Adaptive Capacity:

Phase 2: Identification of adaptation actions and selection of criteria
Based on the city's vulnerability profile, which identifies sectors that have the highest vulnerability index, the decision maker can develop an initial list of alternative adaptation measures. These can be differentiated between adaptive capacity and adaptation action. Adaptive capacity is the ability or potential of a system to respond successfully to climate variability and change. Building the capacity for a population to adapt provides a foundation for anticipating and adjusting to climatic conditions that will continue to change over a long period of time. An

intervention's aim falls within this adaptation dimension if it seeks to improve the quality and availability of resources needed to adapt, or if it addresses the capability to use those resources effectively. Adaptive capacity includes adjustments in behaviour, resources and technologies. A high adaptive capacity does not necessarily translate into actual adaptation measures. To address specific climate change risks, adaptive capacity must be applied to specific decisions and actions. These actions may directly reduce or manage the biophysical impacts of climate change, or they may address non-climatic factors contributing to vulnerability.

Decision makers should identify adaptation measures that can contribute to the reduction of vulnerability but also identify their contribution to the achievement of other city's development objectives. The sectors where these measures will be implemented should be indicated by the decision makers, along with the relevant implementation time frame. Costs and benefits for each adaptation measure should be described and if possible quantified in monetary terms.

Phase 3: Impact assessment matrix, normalization of scores, weighting of criteria
The decision maker should define the criteria that will be used in the CLIMACT Prio to prioritize the actions. It is advisable to involve all relevant stakeholders in the selection of the criteria. Scores are then assigned for each adaptation action against the selected criteria to complete the so called impact assessment matrix. CLIMACT Prio also includes spreadsheets to carry out a rapid cost-benefit analysis and cost-effectiveness analysis. Usually, this step is based either on economic, social, environmental and adaptation impact studies, on experts' judgments, or on modelling exercises. To minimize ambiguity and subjectivity, scoring should be done based on a clearly understood and agreed upon scale. If the selected criteria do not all use the same scoring scale, the values should be standardised in order to be able to compare the scores. Standardization can be done on a 0 to 1 or to a 0 to 100 scale. In CLIMACT Prio standardization is done by linear interpolation. Last but not least, all stakeholders should decide if any of the criteria should be given a higher or lower weight with respect to others. Weighting of criteria may change the final ranking of the climate change adaptation measures.

Phase 4: Final ranking and sensitivity analysis
The final ranking of priorities based on the impact assessment matrix and on the weighting of criteria is presented for discussion. Sensitivity analysis is carried out to measure the robustness of the final ranking.

Phase 5: Adaptation logical framework
A detailed adaptation logical framework is developed for each of the adaptation options selected based on the final ranking. This will be used as a basis to evaluate each adaptation measure against a number of criteria (i.e. relevance, effectiveness, efficiency, impact, sustainability, equity, flexibility). The specific and general challenges related to the evaluation of adaptation projects are also defined for each selected option.

The last section of the paper illustrates a concrete application of the CLIMACT Prio decision support tool in Dhaka, Bangladesh. As a limitation, it should be pointed out that the project is still ongoing and that only the first four stages around which the tool is structured have been completed.

## IV. FLOOD PROTECTION MEASURES FOR CLIMATE CHANGE ADAPTATION IN DHAKA

Dhaka is one of the largest megacities in the world and its population is growing rapidly. Due to its location on a deltaic plain, the city is extremely prone to detrimental flooding, and risks associated with this are expected to increase further in the coming years due to global climate change impacts as well as the high rate of urbanization the city is facing. The lowest-lying part of Dhaka, namely Dhaka East, is facing the most severe risk of flooding. In the past, the lowlands and water bodies acted as water retention areas and also helped to sustain the natural ecosystem. The fast-growing population combined with a scarcity of land in that part of the city has resulted in encroachment of the water retention areas. The city's drainage system has not improved with the rapid growth in the rate of urbanization and most of the city's canals have either been entirely or partially filled over the last two decades. Consequently, these low-lying areas suffer from inundation. The Dhaka Integrated Flood Protection project brought major changes to the flooding system and land use, and protected the western part of the city from flooding. However, the eastern part remains unprotected. This increases the urgency for the need to adapt to current climate variability and future climate change and also to create the tools for assessing different adaptation measures.

After the catastrophic floods of 1987 and 1988, the government of Bangladesh envisaged a Flood Action Plan (FAP) to protect the country from flood damage. Since then, various proposals have been developed to protect Dhaka East from flooding, and the 1992 Japan International Corporation Agency Flood Action Plan (JICA FAP) 8A was the first study that attempted to address this under the Dhaka Integrated Flood Control Embankment Eastern Bypass Road Multi-purpose Project. The project proposed a series of flood protection measures such as embankments, flood walls, raised roads, canal improvement, regulators and pumping stations. However, there are various challenges regarding implementation, including a lack of technical capacity and expertise and limited resources. In addition, measures cannot be implemented simultaneously. As a consequence, nothing is being done regarding flooding in the area and there is a clear gap between project proposal and project implementation. There is a need, therefore, to prioritize the proposed measures and assess which must be implemented in the first instance in order to reduce risk and the vulnerability of the area, while simultaneously meeting local goals.

### 1. Application of CLIMACT Prio in Dhaka

CLIMACT Prio was applied to the Dhaka case following six steps:

Step 1: Selection of potential adaptation options. All the adaptation options for the study area proposed by the government were included for assessment. Furthermore, additional adaptation options were selected for assessment based on the analysis of cases with a similar context.

Step 2: Stakeholder criteria selection. In order to assess the adaptation measures, criteria were identified and selected in a participatory manner. Focus group discussions involving stakeholders were organized at an early stage of the decision-making process, to identify stakeholder s' objectives and for the final selection of criteria. The criteria had to fulfil some qualitative attributes such as value relevance, operationality, reliability, measurability, decomposability, non-redundancy, minimum size, preferential independence, completeness, and understandability.

Step 3: Experts' impact judgements: scoring of adaptation options. The next step involved the scoring of each adaptation option against the selected evaluation criteria. This was conducted by the selected experts, who scored each option based on their expertise. This step ensured the inclusion of technical expertise in the process.

Step 4: Stakeholder focus group discussions on weighting of criteria. All the scores were standardized to a common scale based on the min–max standardization technique. Since different units of measurement were used to score the criteria, by using the standardization technique all measurement scales were converted to a single common one. Stakeholders' preferences regarding the relative importance of criteria were determined during a consensus-building focus group discussion.

Step 5: Prioritization of options. This step aimed at prioritising the most efficient and effective adaptation measures for the study area. Based on the weighted summation formula (combining criteria weights and scores for different adaptation measures), the final ranking for different measures was obtained.

Step 6: Sensitivity analysis. The sensitivity analysis was conducted in order to investigate how sensitive the result of the final ranking is to the input variable of criteria weights, and to incorporate the uncertainty and range of stakeholder preferences.

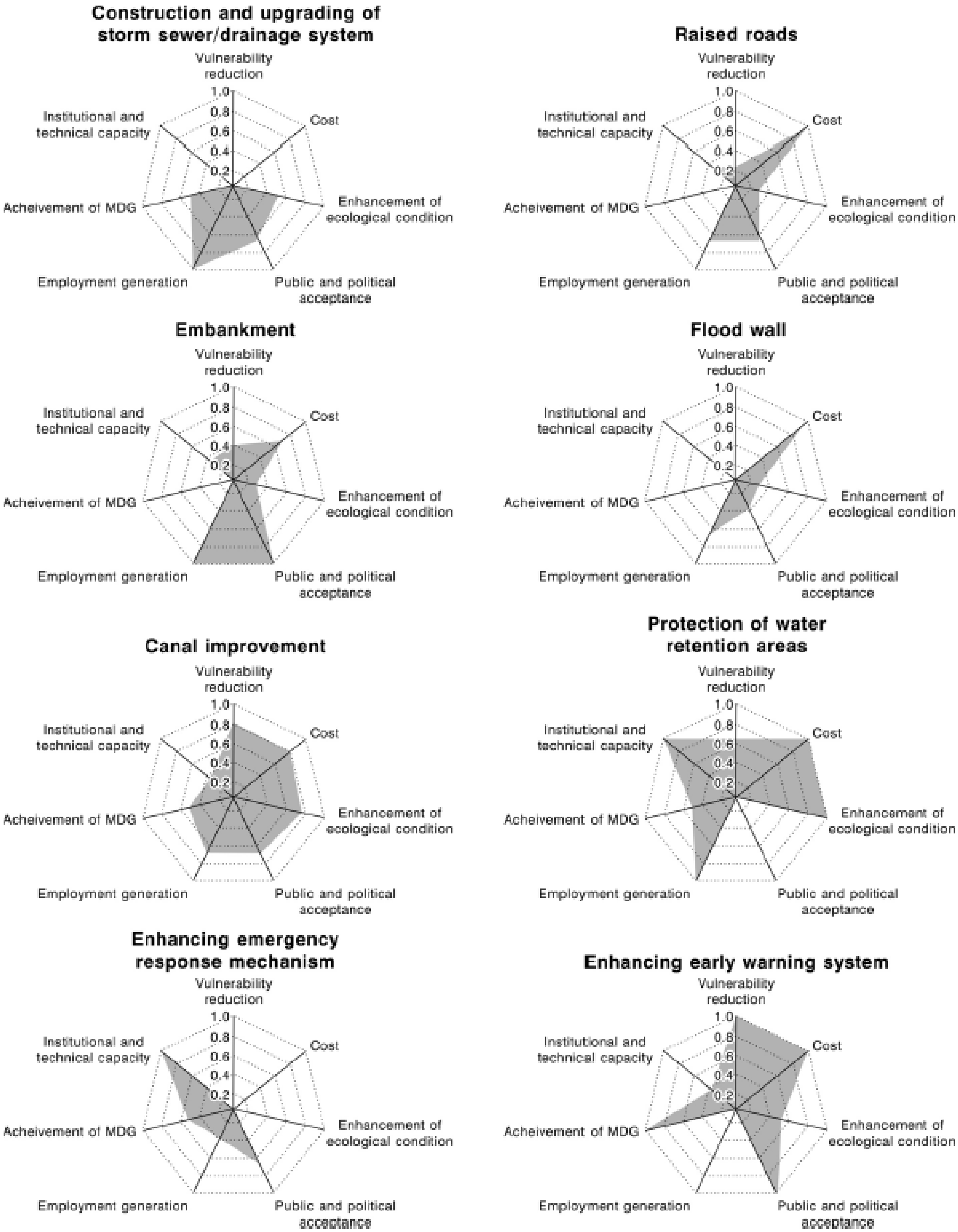
The evaluation stage is in the process of being carried out.

## 2. Preliminary results

The proposed flood protection project for the study area, named the Dhaka Integrated Flood Control Embankment Eastern Bypass Road Multi-purpose Project, includes the following suggested interventions: flood embankment; pumping stations; regulators/sluices; retention basins; construction and upgrading of the road network; flood walls; and canal improvement. So far, none of the listed interventions have been implemented, although successive governments have declared it to be a priority project. The project was originally approved in 1998. All the adaptation options listed above were included in the assessment, and a further two were proposed, given their relevance based on the analysis of cases facing similar challenges: an emergency response mechanism and an early warning system.

The following criteria, derived from stakeholders' opinions, were used: vulnerability reduction, cost, enhancement of ecological conditions, public and political acceptance, employment generation, achievement of millennium development goals, and institutional and technical capacity. The figure below depicts the normalized scores illustrated by radar graphs.

*Figure no.1: Normalized scores adaptation options*




*Source: Authors' analysis*

The weighting values were elicited through a consensus-building discussion. The scores given by the experts were combined with the weights agreed upon by the stakeholders in order to estimate the weighted scores. This calculation resulted in a final score for each option, on which basis the ranking of adaptation options was determined. The three highest ranking adaptation options were: protection of water retention areas, enhanced early warning system and canal improvement.

## V. CONCLUSION

After having illustrated the challenges related to the evaluation of climate change adaption projects, the paper has presented a general approach based on a vulnerability assessment, evaluation criteria and a logical framework that explicitly takes into consideration the difficulties of evaluating adaptation measures. The framework has been incorporated into CLIMACT Prio, a decision-making tool for the screening, prioritization and evaluation of adaptation projects at the urban level. The prioritization component of the tool was used in the context of Dhaka, where local stakeholders were guided in the selection of priority adaptation options to already identified climate change vulnerabilities. Though further research is needed to evaluate the effectiveness of selected climate change adaption projects in Dhaka, it can be stated that the proposed approach shows the potential, opportunities and value of using MCA as well as a specifically developed framework to select and evaluate climate change adaptation measures. Also further research is needed to identify the usability and added value of using the other components of the CLIMACT Prio namely the vulnerability profile (not object of this specific study) and the adaptation logical framework, once the prioritized projects are implemented and relevant data are available.

## VI. BIBLIOGRAPHY

AFB (2009), Results Based Management Framework, Adaptation Fund Board, Ethics and Finance Committee

AFB (2011), Project Level Result Frameworks and Baseline Guidance Document, Adaptation Fund Board, Ethics and Finance Committee

Baker, I., Peterson, A., Brown, G., McAlpine C. (2012), Local government response to the impacts of climate change: An evaluation of local climate adaptation plans, Landscape and Urban Planning 107, 127-136

Downing, T.E., Patwardhan, A. (2005), Vulnerability Assessment for Climate Adaptation. Adaptation Planning Framework, Technical Paper 3 in Bo Lim, Erika Spanger-Siegfried, Ian Burton, Elizabeth Malone and Saleemul Huq, eds. Adaptation Policy Frameworks for Climate Change, Cambridge: Cambridge University Press, 67-89.

Füssel, H.M., Klein, R.J.T. (2003), Climate Change Vulnerability Assessments: An Evolution of Conceptual Thinking, Climatic Change 75(3), 301-329

GEF (2008), Background and Elements for a GEF Monitoring and Evaluation Framework on Adaptation, Global Environmental Fund

GEF (2011), A Framework for Monitoring and Evaluating Adaptation to Climate Change, Global Environmental Fund

GIZ (2011), Making Adaptation Count - Concepts and Options for Monitoring and Evaluation of Climate Change Adaptation

Institute of Development Studies (2008), Evaluation of Adaptation to Climate Change from a Development Perspective

IIED (2011), Tracking adaptation and measuring development, Climate Change Working Paper No. 1

IPCC (2007), Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Mehdi, B., C. Mrena, and A. Douglas, (2006), Adapting to Climate Change: An Introduction for Canadian Municipalities, Canadian Climate Impacts and Adaptation Research Network

Næss, O.L.,Norland, I.T., Lafferty, W.M, Aall, C (2006), Data and process linking vulnerability assessment to adaptation decision-making on climate change in Norway, Global Environmental Change 16, 221-233

NONIE (2009), Impact Evaluations and Development, NONIE Guidance on Impact Evaluation

OECD (1991), DAC Principles for the Evaluation of Development Assistance

OECD (2000), Glossary of Evaluation and Results Based Management (RBM) Terms

OECD (2011), Monitoring and Evaluation for Adaptation: Lessons from Development Cooperation Agencies, OECD Environment Working Papers No. 38

Schroter, D., Polsky, C., Patt, A.G, (2005), Assessing Vulnerabilities to the effects of global change: an eight step approach, Mitigation and Adaptation Strategies for Global Change 10(4), 573-595

Snover, A.K., L. Whitely Binder, J. Lopez, E. Willmott , J. Kay, D. Howell and J. Simmonds, (2007), Preparing for Climate Change: A Guidebook for Local, Regional and State Governments, In association with and published by ICLEI - Local Governments for Sustainability, Oakland, CA

Turner, B.L., Kasperson R.E., Matson, P.A., McCarthy, J.J., Corell, R.W., Christensen, L., Eckley, N.,Kasperson, J.X., Luers, A., Martello, M.L., Polsky, C.,Pulsipher, A., Schiller, A., (2003), A framework for Vulnerability Analysis in Sustainable Science, PNAS Vol. 100(14), 8074-8079

UNDP (2007), Monitoring and Evaluation Framework for Adaptation to Climate Change, Draft

UNDP (2008), Proposed Framework for Monitoring Adaptation to Climate Change, Draft

UNDP (2009), Handbook on Planning, Monitoring and Evaluating for Development Results

UNFCCC (2010), Synthesis report on efforts undertaken to monitor and evaluate the implementation of adaptation projects, policies and programmes and the costs and effectiveness of completed projects, policies and programmes, and views on lessons learned, good practices, gaps and needs, United Nations Framework Convention on Climate Change

UKCIP (2011), AdaptME toolkit - Adaptation Monitoring and Evaluation

Word Bank (2009), Mainstreaming Adaptation to Climate Change in Agriculture and Natural Resources Management Projects, Guidance Note 8

World Bank (2010), Economic Evaluation of Climate Change Adaptation Projects

## ANNEX 1

| | | | | | | |
|---|---|---|---|---|---|---|
| **PROJECT NAME** | **Construction of reinforced concrete bridge in Phobjika Geog, Bhutan** | | | | | |
| | | | | | | |
| **PROJECT FOCUS** | ADAPTATIVE CAPACITY | | | **ADAPTATION ACTION (related to climate change hazard: increased rainfall)** | | |
| | | | | | | |
| **THEORY OF CHANGE** | | | | | | |
| | | | | | | |
| **SPECIFIC OBJECTIVES** | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | **Assumptions and Risks** The intervention is sufficient to reduce the vulnerability of the bridge so that it withstands increased rainfall. Extreme and unexpected weather conditions will damage the bridge despite the intervention to reduce its vulnerability. The fast growing species and indigenous species planted on the river banks are able to reduce the eroding force of the river and to stabilize the soils. |
| Reduced vulnerability of the existing wooden bridge in Phobjika Geog to increased rainfall (the bridge is climate proof). | The existing wooden bridge is able to withstand increased rainfall without being damaged. | Wooden bridge is damaged 1 to 3 times a year. | - | - | Wooden bridge is damaged 0 times a year. | |
| | | **Source** | | | | |
| **OUTPUTS** | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | **Assumptions and Risks** All construction materials to build the reinforced bridge are easily available in the surrounding areas. Workers are able to build the reinforced bridge in accordance with standard |
| Construction of 13 meters long, 4 meters high and 5 meter wide reinforced concrete bridge. | Reinforced concrete bridge built. | No reinforced bridge. | Plan for reinforced bridge ready by July 2012 | Reinforced bridge started in August 2012 | Reinforced bridge ready by January 2013 | |
| | | **Source** | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | engineering guidelines. The weather conditions will not delay the construction of the concrete reinforcement. The weather conditions in the area may not allow for the growth of the trees species planted. Wildlife may undermine the growth of the trees species planted. |
| | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | |
| Undertake embankment plantations with fast growing species and indigenous trees. | Number of fast growing species and indigenous trees planted. | To be defined. | To be defined. | To be defined. | To be defined. | |
| | | **Source** | | | | |
| **OUTCOMES** | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | **Assumptions and Risks** |
| The river embankments are more resistant in the face of heavy downpours. | Frequency of erosions. | To be defined. | To be defined. | To be defined. | To be defined. | Good river bed maintenance prevents debris from accumulating in the future. |
| | | **Source** | | | | |
| | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | |
| The new reinforced concrete bridge is safe to cross all year round. | Number of days per year in which the bridge is not safe to cross. | To be defined. | - | - | Number of days per year in which the bridge is not safe to cross equals 0. | |
| | | **Source** | | | | |

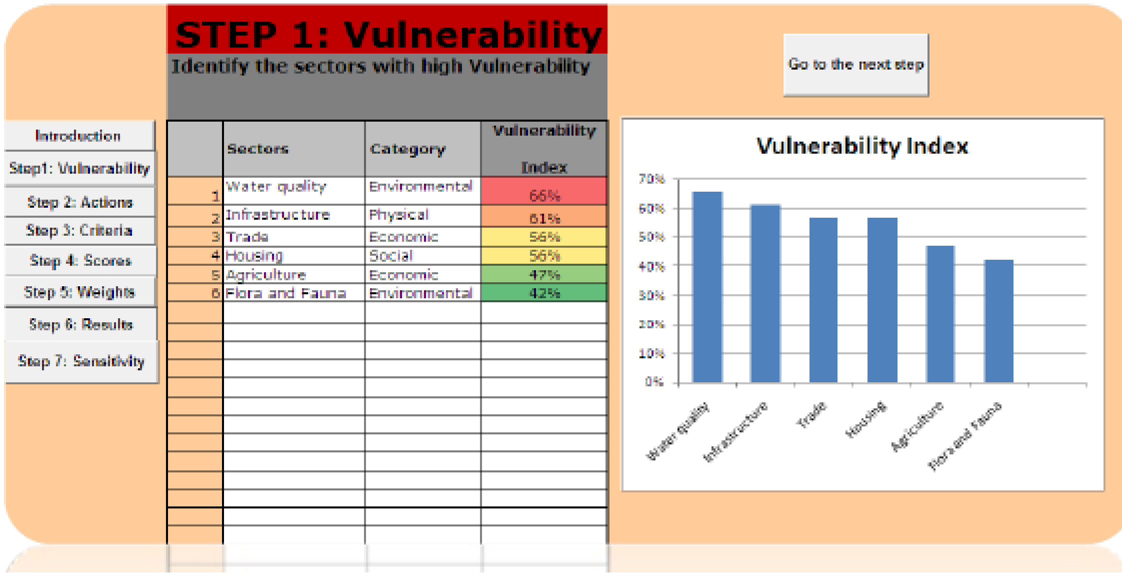
| **IMPACTS** | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | **Assumptions and Risks** |
|---|---|---|---|---|---|---|
| Villages are no longer cut off from local markets. | Number of days per year the villagers are isolated from local markets. | To be defined. | - | - | Number of days per year in which the villagers are isolated from local markets equals 0. | See all the above. |
| | | **Source** | | | | |
| | | | | | | |
| | **Indicator** | **Baseline 2012** | **Milestone 1 2012** | **Milestone 2 2012** | **Target 2013** | |
| Students have uninterrupted access to school. | Number of schooldays per year lost due to the unavailability of the bridge. | To be defined. | - | - | Number of schooldays per year lost due to the unavailability of the bridge equals 0. | |
| | | **Source** | | | | |
| | | | | | | |

| **INPUTS (USD)** | | **2011** | **2012** | **2013** | **2014** | **Total** |
|---|---|---|---|---|---|---|
| | **National/Regional Government** | 88.888 (BTN 4.000.000) | | | | |
| | **Local Government** | | | | | |
| | **External (UNCDF)** | 22.00 (BTN 1.000) | | | | |
| | **Other** | | | | | |
| **INPUTS (HR)** | | **2011** | **2012** | **2013** | **2014** | **Total** |

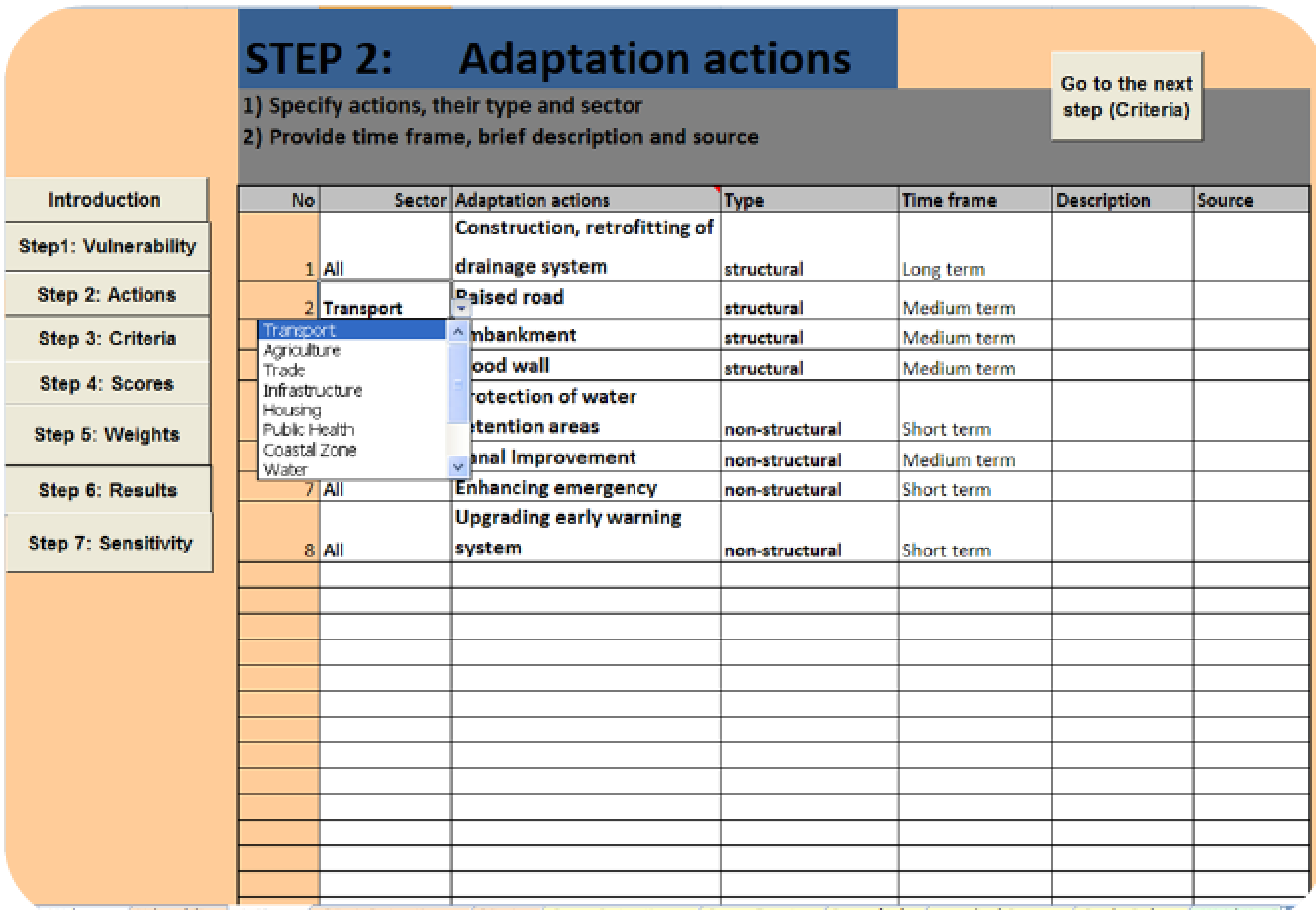
| | | | | | | |
|---|---|---|---|---|---|---|
| | **National/Regional Government**<br><br>**Local Government**<br><br>**External**<br><br>**Other** | | | | | |
| **ACTIVITIES** | | **2011** | **2012** | **2013** | **2014** | **Assumptions and Risks** |
| | **National/Regional Government** | Release of CCAG | | | | |
| | **Local Government** | | Constructi on of bridge<br>Tree plantation | | | |
| | **External** | | | | | |
| | **Other** | | | | | |
| | | | | | | |
| **CHALLENGES** | | **Proposed strategy** | | | | **Comments** |
| | **Capacity**<br>**Data**<br>**Complexity**<br>**Attribution**<br>**Uncertainty**<br>**Indirect effects**<br>**Co-benefits**<br>**Infrequent events**<br>**Time scales**<br>**Reverse logic**<br>**Level of risk**<br>**Shifting baseline**<br>**Agreed metrics** | | | | | |

## ANNEX 2

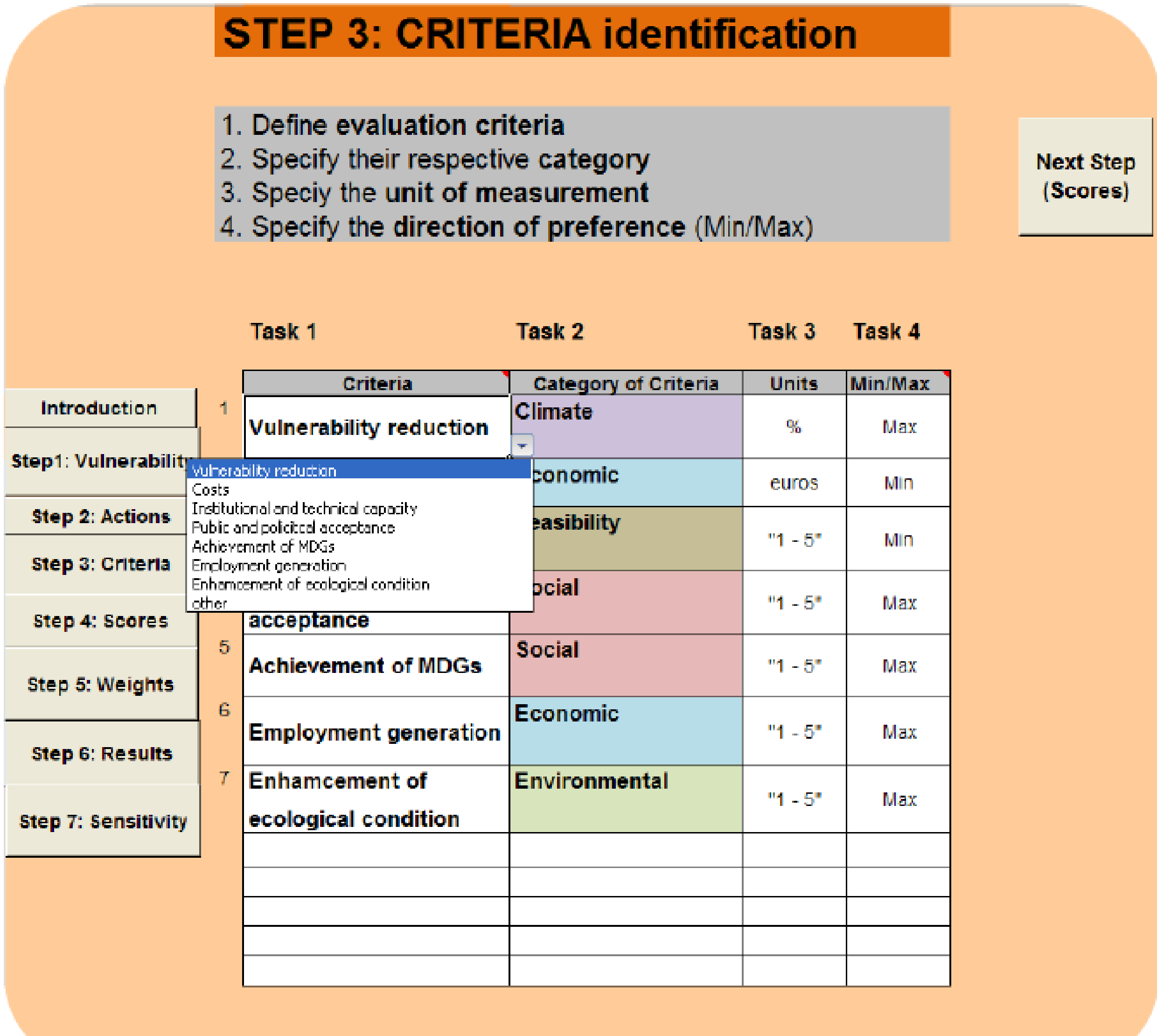
Vulnerability index showing the level of vulnerability by sector:



Identification of adaptation actions:



Identification of selection criteria:



Impact assessment matrix:

**STEP 4: SCORING - Impact Assessment Matrix**

Next Step (Normalized Scores)

Indicate the scores for each alternative on every criterion

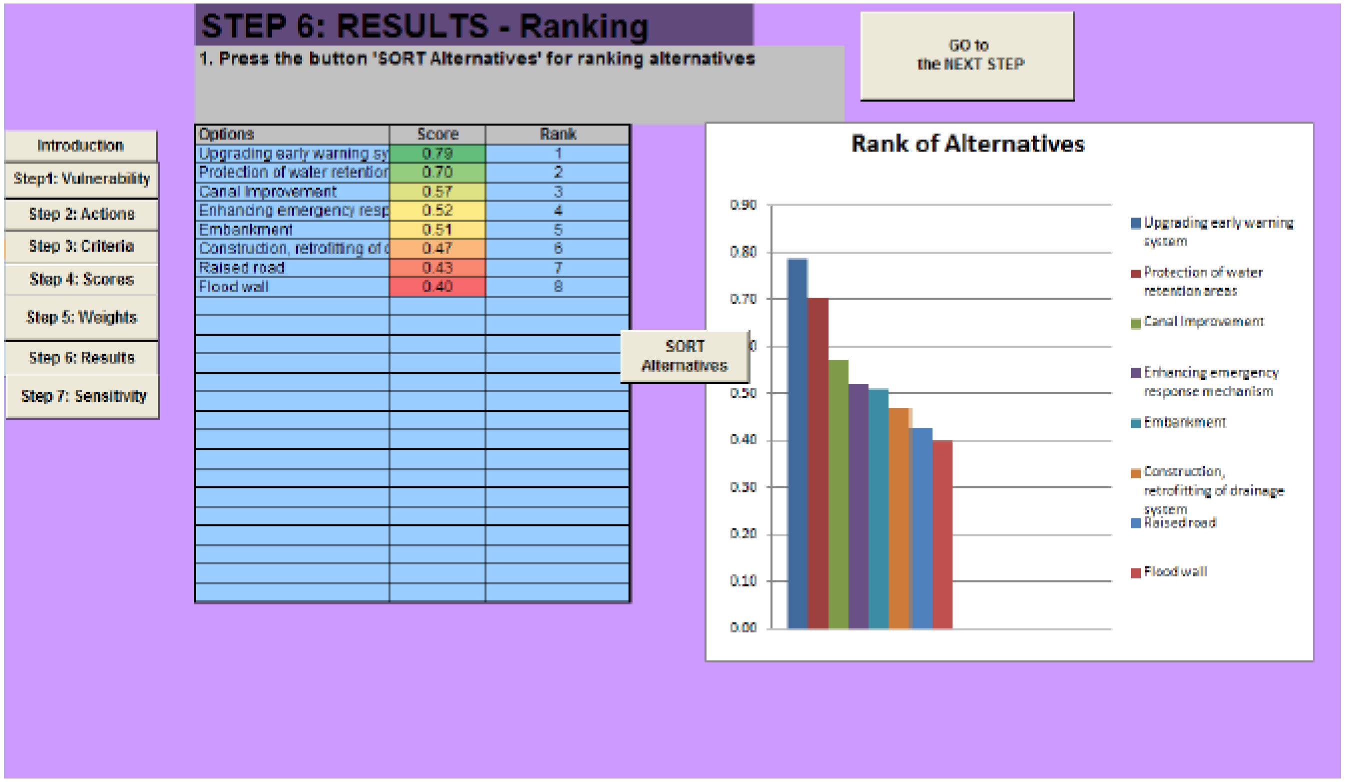
| Options/Criteria | Vulnerability reduction | Costs | Institutional and technical capacity | Public and policitcal acceptance | Achievement of MDGs | Employment generation | Enhamcement of ecological condition |
|---|---|---|---|---|---|---|---|
| Scale units | % | euros | "1-5" | "1-5" | "1-5" | "1-5" | "1-5" |
| | 1 | -1 | -1 | 1 | 1 | 1 | 1 |
| | Max | Min | Min | Max | Max | Max | Max |
| Construction, retrofitting of drainage system | 79 | -64 | -4,7 | 3,9 | 4,0 | 3,6 | 2,9 |
| Raised road | 64 | -4 | -4,0 | 3,7 | 3,4 | 3,0 | 2,4 |
| Embankment | 69 | -20 | -3,7 | 4,4 | 3,4 | 3,6 | 1,6 |
| Flood wall | 61 | -6 | -3,1 | 3,0 | 3,3 | 3,3 | 2,3 |
| Protection of water retention areas | 74 | -1 | -2,6 | 2,4 | 3,9 | 4,0 | 4,6 |
| Canal Improvement | 71 | -14 | -3,7 | 3,7 | 3,6 | 3,1 | 3,9 |
| Enhancing emergency response mechanism | 63 | -1 | -2,4 | 3,6 | 4,0 | 2,1 | 2,3 |
| Upgrading early warning | 81 | -2 | -3,7 | 4,4 | 4,6 | 2,4 | 3,1 |

Weighting of criteria:

1. Examine carefully the criteria and indicate the level of importance of criteria verbally from "very low" to "very high"
2. Examine carefully the criteria and assign a value denoting difference in importance
(100 is assigned to the most important criterion)

| | | | | | Stakeholder 1 | | | | Stakeholder 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Task 1 | Task 2 | Task 3 | | Task 1 | Task 2 | Task 3 | |
| | Category of Criteria | Criteria | Units | Impact Range | Rank | Importance | Values | Weights | Rank | Importance | Values | Weights |
| 1 | Climate | Vulnerability reduction | % | 19,3 | 2 | Very High | 100 | 22,7% | 1 | Very High | 100 | 21,3% |
| 2 | Economic | Costs | euros | 63,7 | 6 | Very High<br>High<br>Moderate | 80 | 18,2% | 3 | Very High | 90 | 19,1% |
| 3 | Feasiblity | Institutional and technical capacity | "1-5" | 2,3 | 7 | Low<br>Very Low | 60 | 13,6% | 5 | High | 80 | 17,0% |
| 4 | Social | Public and policitcal | "1-5" | 2,0 | 1 | Moderate | 60 | 13,6% | 2 | High | 80 | 17,0% |
| 5 | Social | Achievement of MDGs | "1-5" | 1,3 | 3 | Low | 30 | 6,8% | 4 | Moderate | 60 | 12,8% |
| 6 | Economic | Employment generation | "1-5" | 1,9 | 5 | Low | 40 | 9,1% | 7 | Low | 40 | 8,5% |
| 7 | Environmental | Enhancement of ecological | "1-5" | 3,0 | 4 | High | 70 | 15,9% | 6 | Very Low | 20 | 4,3% |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Final ranking:






View publication stats