Adaptation Decision Making Frameworks and Tools:

Multi-criteria Decision Making tools for Prioritizing Adaptation Actions at Community Level

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ADAPTATION DECISION MAKING FRAMEWORKS AND TOOLS: EMPLOYING MULTI-CRITERIA DECISION MAKING TOOLS FOR PRIORITIZING ADAPTATION ACTIONS AT COMMUNITY LEVEL

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ABBREVIATIONS

AHP	Analytical Hierarchy Process
CBA	Community based adaptation
CCA	Climate change adaptation
IGES	Institute for Global Environmental Strategies
LCA	Local adaptive capacity
MCA	Multi-criteria analysis

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I. Frameworks for Adaptation Decision Making: Advances, Challenges, and Ways Forward

S.V.R.K. Prabhakar, H. Wright and I. Tsurita with contributions from L. Jones, M. Spearman, and P.S. Villannueva

ABSTRACT

There is a lack of holistic frameworks to help climate change adaptation practitioners identify and implement CCA (climate change adaptation) actions. Keeping this in view, several frameworks for CCA decision making have evolved in recent years. Though these frameworks are still at nascent stages and are yet to be field tested, studies of these frameworks indicate that they are a step in right direction and provide ample insights into principles and practices of CCA decision making. This paper identifies various issues to be considered in measuring progress in climate change adaptation metrics, how various monitoring and evaluation (M&E) frameworks have approached the problem of measuring the effectiveness of CCA actions, discusses various prominent M&E frameworks, and provides guidelines and possible ways forward.

1. INTRODUCTION

There has been growing importance for climate change adaptation (CCA) at various levels of developmental agenda, policy decision making and sectoral and geographical scopes, well reflected by an increase in scale and proliferation of funds and institutional resources devoted to climate change adaptation (CCA). Accompanying this increasing investment in CCA is a need for mechanisms to prioritize adaptation actions and to keep track of the progress in the outcomes of these investments in the form an integrated decision making framework. Ways of measuring CCA are needed to ensure the effectiveness and accountability of CCA investments, and to avoid or lessen mal-adaptation. The IPCC has called upon researchers to provide "effective approaches for identifying and evaluating both existing and prospective adaptation measures and strategies" (Carter et al., 2007). Due to gaining interest in community based adaptation (CBA), there is a growing demand from policy makers, practitioners and donor agencies for frameworks and tools for monitoring and evaluation. These stakeholders are keen for reassurance that their investments in CCA will deliver measurable results (Anderson, 2011). The subject of means to measure CCA is termed here as 'adaptation metrics' and defined as "*quantitative, semi-quantitative or qualitative measures for monitoring the effectiveness of adaptation actions by assessing the adaptive capacity of an individual or community or a system as a whole (Authors)*."

The development of adaptation metrics is a relatively new area that has tremendous implications on how various stakeholders approach the problem of adaptation planning, implementation, monitoring, and evaluation of CCA projects. Various stakeholders are already involved at various stages of CCA and they need to understand and accept the methodologies used for designing and implementing these metrics and the meaning of outcomes of using metrics.

Adaptation metrics play an important role in scaling up of community-based adaptation (CBA) interventions. First and foremost, CBA actions are known to be effective at a given location where they are tried and tested and it is often difficult to know which CBA approach may be effective in a new geographical area. This makes it difficult for practitioners to choose a narrow set of options among which to pick for implementation at a new location. With adaptation metrics, the effectiveness of a CBA practice could be relatively and reasonably well judged before its adoption in a new area than a process that involves a combination of technology, social and institutional processes.

Secondly, adaptation metrics are further important to community-based approaches because they are often complex combination of various components and the dynamics among these components depend on pre-existing conditions at a new location. Metrics may be able to help us understand the complexity of CBA practices. The following example may help better visualize this scenario. A zero-tillage machine manufactured in a warehouse and brought to relatively well mechanized location may not require elaborate capacity building as that of introducing the same machine into a location with relatively less mechanization where farmers are not well versed with the concepts of mechanization and advantages of zero tillage. In the later area, there is a greater need for social interaction for external agents introducing zero tillage. Similarly, scaling up successful CBA in new areas is not automatic. Adaptation metrics an help in reducing uncertainties involved in assessing the effectiveness of an action in new area since the metrics can be designed based on a broad set of indicators valid for the broad range of conditions under which adaptation takes place.

Adaptation metrics cannot be standalone and need to be integrated into a decision making framework that enables stakeholders to go through a series of stages or steps for arriving at a suitable adaptation decision for a given location. Projects cannot put considerable resources in monitoring and evaluation that may reduce funds available for the actual project. The developers of frameworks need to consider the practical usage and limited resources under which adaptation projects are implemented. Therefore, frameworks need to be accessible and easy to adopt. Keeping this in view, this paper attempts to discusses adaptation metrics for monitoring and evaluation (M&E) frameworks, an area that has received little attention. First, this paper identifies the challenges involved in defining and identifying adaptation metrics and M&E frameworks, then it assesses some of the M&E frameworks proposed in the literature, and finally, the paper proposes a way forward for unifying adaptation metrics and M&E frameworks. Due to limited work done in this area to date, this paper is a step in the direction of developing M&E frameworks integrating adaptation metrics.

2. CHALLENGES FOR DEFINING ADAPTATION METRICS

Several challenges arise while designing adaptation metrics in the context of CBA. The related discussion is presented in three sub-headings in this section: how is adaptation defined and achieved, how is adaptation measured, and who measures adaptation. All these questions can affect the scaling up of CBA as shown in Table 1.

TABLE 1 QUESTIONS UNDERLINING ADAPTATION METRICS AND THEIR RELEVANCE TO SCALING UP OF CBA

Questions that underline adaptation metrics	How these questions limit scaling up of CBA
How is adaptation defined and achieved?	• Different perceptions of stakeholders affecting their decisions and outcomes • What is valued locally (e.g. process vs outcome) • Cross-scale/location comparisons
How is adaptation measured?	• Constitution of vulnerability • Moving baselines • Relation between the measured outcome and the perceived adaptation
By/for (?) whom are metrics defined?	• The trust among actors across scales and regions • The capacity factor among actors

2.1 How is adaptation defined and achieved?

It is difficult to define adaptation metrics because there is not a clearly agreed definition of adaptation among practitioners, researchers and policy makers. For the purpose of this paper, adaptation to climate change can be framed as a process of choosing the most effective action, and adaptation metrics are then developed to measure the effectiveness of actions (Hinkel, 2008). Framing adaptation involves two methodological challenges (a) the establishment of linkages between actions and outcomes (e.g. through a numerical or statistical model) and (b) a way of objectively comparing the outcomes of different actions. It is important to remember that adaptation decisions are made in a context of uncertainty and change. The establishment of deterministic action-outcome linkages in adaptation is difficult because of inadequate knowledge on the system studied, the evolution of the environment, and the range of possible actions to take in various circumstances. Wide-ranging interpretations of the meaning of adaptation make it difficult for various actors to reach a consensus on what constitutes adaptation.

A recent report from the World Resources Institute reviewed more than 100 initiatives labeled as 'adaptation' in developing countries and found that adaptation and development lie along a continuum from 'development orientated' to 'climate change orientated' (McGray et al., 2007). At the 'development end', efforts overlap almost completely with traditional development practice. This is common for many 'community-based adaptation' (CBA) projects, where activities may take little account of specific climate change impacts and instead increase general resilience. At the opposite end, highly specialized activities exclusively target distinct climate change impacts; for example, reinforcing infrastructure in light of the anticipated increased stresses from climate-change related events (McGray et al., 2007).

Looking at the close connection between development and climate change adaptation (Smit and Pilifosova, 2001), many may wonder if adaptation metrics and related methodology should be different from those for monitoring development effectiveness. However, climate change puts additional stress on communities and adaptation deals with this 'additionality.' While there may be common indicators between monitoring development and monitoring adaptation, adaptation demands supplemental or different indicators to take into consideration the additionality that climate change brings to the system. We consider development as a dynamic and overarching concept and as our understanding of development is still evolving so is the case for adaptation. There may never be a state of 'we have adapted' similar to the case of 'we have developed'. In both the cases, comparison to some 'state' seems to be necessary and so there is a need for comparison against a baseline.

Comparison between CCA and DRR (disaster risk reduction) is also inevitable. If adaptation is closely linked to DRR, metrics for assessing the effectiveness of CCA should benefit from metrics for assessing the effectiveness of DRR. It is thus therefore required to examine the limitations and the extent to which DRR metrics can be applicable or useful to measure progress in CBA (Silva-Villanueva, 2011). DRR also faces a number of evaluation challenges, such us the lack of a counterfactual in most cases to measure success or progress "when nothing happens". The DRR community has addressed such challenges by developing metrics to determine reduction of risk, but this may lead to overemphasis of *indicators/metrics of exposure* in relation to rapid onset disasters. In the context of climate change, there is also the need for attention to slow on-set climate related risks *and* broader set of metrics beyond exposure to risk (Silva-Villanueva, 2011).

2.2 How is adaptation measured?

At what scale do we measure the outcomes of CBA? Selecting a small set of adaptation metrics that are applicable under a wide range of geographical, socio-political domains is a real challenge since capturing the wide diversity in a small number of indices could lead to gross generalization. A good example is Gross Domestic Product (GDP) as an indicator of nation's economic production. Countries differ in the dynamics of adaptation efforts, past and projected economic growth, technological choices, as well as regulatory and policy-making environment. Even within a country, monitoring the progress in adaptation will obviously require an enhanced understanding of what constitutes vulnerability under various circumstances. As shown, CBA takes place through projects, so project-level indicators at the community scale are important. Yet, this book highlights the need to 'scale up' CBA beyond the project level. For CBA to be sustainable, it must be supported by larger scale institutional systems that are critical for enabling adaptive capacity. Therefore successful CBA metrics include indicators beyond the results of project activities at the community scale.

With the possibility of multiple benefits accruing to the system in response to a single adaptation action, it can be difficult to determine appropriate indicators or metrics. For example, an agricultural practice that provides stable income under drought conditions introduced into a community will influence the income of farmers, and their nutritional standard, access to various services and resources. Hence, adaptation metrics should be able to take into consideration the five determinants of adaptive capacity (economic, social, environmental, institutional, and equity) (Smit, 2001; Yohe and Tol, 2002). In a recent review of Community-Based Vulnerability Assessment Tools undertaken by a consortium of NGOs in Nepal, it was found that these approaches vary in the extent that they address vulnerability as a function of exposure, sensitivity and adaptive capacity; in consistency with the IPCC definition of vulnerability to climate impacts (Practical Action *et al.*, 2010).

How do you address moving baselines? M&E has always been about comparing the status of indicators at a certain point of time against a baseline, either set in the beginning or in the future, as a result of external interventions. This is true whether M&E is done for development, DRR or CCA. This understanding necessitates that there is a measure performance against certain 'targets' and 'baselines'. The baseline conditions in a changing climate can be expected to move due to dynamic pressures (such as climate change, economic and political changes) acting on the system, and this poses a challenge for developing adaptation metrics. Static metrics cannot by their very nature reflect changes in underlying drivers such as population growth or the "dynamic nature of livelihood assets" (Practical Action et al., 2010). The dynamic climate-risk baseline can either exacerbate or counteract other trends, and thus it may be more appropriate to focus on successful adaptation as keeping "development on track" (Brooks et al, 2011). There may also be a need to demonstrate additionality against a dynamic baseline. This shows that it is important to look at the context and other risks that might influence the success or failure of CBA, for example market risks and level of institutional support.

Another issue is around the balance of quantitative, qualitative, direct, and proxy indicators. Anderson (2011) suggests that advocates of an econometric approach to impact evaluation often question the validity of qualitative approaches to evaluation with the assumption that "if you can't measure it you're guessing" (Anderson, 2011). Other scholars suggest that qualitative metrics are critical for understanding what constitutes the complexity of CBA (IGES, 2008), suggesting that more useful is a developmental approach to evaluation that emphasizes learning and process rather than measurement. Collection of data is costly and time consuming in many cases whilst qualitative data could be subjective and difficult to re-check. Whilst participatory monitoring tools usually cannot give precise figures, it has been argued that PME (Participatory Monitoring and Evaluation) can also result in "quantified information that can be used for cross-comparisons" (SDC-IC, 2005). Participatory baseline studies can also be viewed as an opportunity to build local analytical capacity to assess climate risk (Brooks et al, 2011.) At different levels of decision making, different types of data may be required; the challenge for M&E/metrics is to find ways for establishing feedback-loops and information systems across these levels and use both qualitative and quantitative indicators.

2.3 Metrics for whom and who measures adaptation?

Metrics have dual purpose, both for the communities and for the external actors (policy makers and project managers). Hence, the questions of who measures adaptation, for whom are the metrics, and how they are used needs careful consideration. Relying upon qualitative and bottom up approaches using participatory processes as point of entry could be more effective than top-down evaluative approaches because it will develop potential for learning, capacity building and ownership in the process. Adaptation decision-making and implementation of adaptation actions involve multiple stakeholders with multiple expectations in terms of outputs and outcomes within a same 'project design document.' Donor agencies may look for more value for money in projects they fund and some other stakeholders engaged in community-based approaches may value the experiences gained in the process of implementing the project.

In summary, some key challenges associated with adaptation metrics that needs to be addressed by any comprehensive M&E framework are:

(a) **Complexity of actions:** Adaptation actions could be different at different scales and hence assessments of effectiveness of such actions may demand different approaches. The same adaptation action could have different degree of outcomes when applied to a different population so the underlying vulnerability factors need to be understood.

(b) **Complexity of indicators:** Adaptation is a broad subject covering a range of ecosystems, sectors, policies and perspectives. No single indicator is likely capture the rich variety of differences in circumstances in adaptation at local, national, regional and international levels.

(c) **Complexity of approaches:** There is a mix of approaches for assessing adaptation. It is important to determine if we are assessing outcomes of adaptation or processes leading to successful adaptation.

(d) **Purpose of assessing effectiveness:** It is often the purpose that drives adaptation choices and their metrics. If we are assessing the effectiveness of learning, we need to check what works and what does not.

In subsequent sections, this paper compares various M&E frameworks, evaluates to what extent they are successful in addressing the above challenges, and finds a way forward for effective utilization of adaptation metrics in scaling up CBA initiatives.

3. FRAMEWORKS FOR M&E OF ADAPTATION

Various institutions and individuals have already proposed several adaptation M&E frameworks, some of which are briefly discussed in this section. These frameworks try to address the challenges discussed in Section 2 of this paper to a certain extent.

3.1 ODI Local adaptive capacity (LAC) framework

Recognizing the diverse nature of planned interventions aimed at supporting adaptation, the Africa Climate Change Resilience Alliance (ACCRA) contends that many existing development activities are having a strong impact - both positive and negative - on adaptive capacity at the community level (Jones et al., 2010; Jones, 2011). ACCRA's conceptual framework proposes that the capacity to adapt at the community level will be broadly similar in all groups. To date, much of the literature has taken the Sustainable Livelihoods framework (SLF), and its five capitals (natural, social, financial, human, and physical) to be synonymous with adaptive capacity (Brooks et al., 2005; Dulal et al., 2010). However, while useful in helping to understand the resources at the disposal of a system to cope with and adapt to changing environments, asset-oriented approaches typically mask the role of processes and functions in supporting adaptive capacity. ACCRA's Local Adaptive Capacity framework (LAC) tries to incorporate intangible and dynamic dimensions of adaptive capacity, as well as capital and resource-based components, into a more holistic conceptualization of adaptive capacity at the local level. The framework identifies five distinct yet interrelated characteristics with the underlying assumption that positive impacts on these characteristics should enhance the system's adaptive capacity: the asset base;

institutions and entitlements; knowledge and information; innovation; and flexible forward-looking decision-making (Table 2).

TABLE 2 LAC'S CHARACTERISTICS AND ITS FEATURES

Adaptive capacity at the local level	
Characteristic	*Features that reflect a high capacity to adapt*
Asset base	Availability of key assets that allow the system to respond to evolving circumstances
Institutions and entitlements	Existence of an appropriate and evolving institutional environment that allows fair access and entitlement to key assets and capitals
Knowledge and information	The system has the ability to collect, analyse and disseminate knowledge and information in support of adaption activities
Innovation	The system creates an enabling environment to foster innovation, experimentation and the ability to explore niche solutions in order to take advantage of new opportunities
Flexible forward-looking decision-making and governance	The system is able to anticipate, incorporate and respond to changes with regards to its governance structures and future planning

Source: Jones et al. (2010)

The framework is not intended to measure adaptation, or to be used directly as an M&E tool, though it may serve as a starting point for further research and development around both objectives.

3.2 CSDRM Framework

Disaster risk management (DRM) programmes must address changing climatic risks *and* the underlying causes of poverty and vulnerability to ensure DRM effectiveness. The Strengthening Climate Resilience consortium (IDS, Christian Aid and Plan International, funded by DFID) and its partners have developed the Climate Smart Disaster Risk Management approach (CSDRM) to support integration of CCA, DRR and development in both policies and programmes (Mitchell et al., 2010).

Although in its origins planning, monitoring and evaluation where conceptualized as three interlinked processes in the project management cycle, most approaches treat programme planning and implementation and programme monitoring and evaluation as two separate entities, to the detriment of potential feedback loops from learning through M&E that might improve programming during its cycle rather than simply at the end. The planning, monitoring and evaluation (PM&E) framework and methodology that supports the uptake of the CSDRM approach helps governments, DRM and development organizations and their partners to i) assess to what extent policies and programmes already enable integration across sectors and scales; ii) identify integration pathways to support policy and programme planning; iii) and monitor and evaluate the co-benefits, synergies and trade-offs of such processes.

The CSDRM PM&E framework is guided by the ADAPT principles for PM&E in a changing climate (Adaptive, Dynamic, Active, Participatory and Thorough) (Silva-Villanueva, 2011). It is based on seven iterative processes along the programme management cycle. The PM&E framework facilitates ex-ante programme prioritization and planning and robust M&E to deal with and accommodate uncertainty and unexpected events. At the assessment and planning stage, the framework includes a series of guiding questions and indicators that can guide discussions with programme staff and other stakeholders to identify gaps, strengths and opportunities for integration within policies, programmes and projects. It includes an integrated set of indicators that considers environmental, disaster, climate change and developmental processes and domains of decision-making. The indicators are grouped in three pillars – tackling changing disaster risk, building adaptive capacity and addressing the underlying causes of poverty and vulnerability and their structural causes. Although initially developed for disaster risk managers, the CSDRM PM&E framework is also useful for evaluating development programmes with adaptation and risk reduction benefits. In addition, the PM&E *guidance* recognizes that integration processes across different scales are not independent.

The CSDRM PM&E framework does not attempt to evaluate the outcomes of a particular program or policy. It recognizes that the lengthy time scales associated with impacts of climate change limit the extent to which such evaluations provide insights for learning about the adaptation process and progress.

3.3 WRI/GIZ Adaptation M&E Framework

Proposed by the World Resources Institute (WRI), in collaboration with the German Agency for International Cooperation (GIZ) and the German Federal Ministry for Economic Cooperation and Development (BMZ), this framework is a step-wise process for developing adaptation-relevant M&E systems (McGray and Spearman, 2011). The six steps are describe the adaptation context, identify the contribution to adaptation, form an adaptation hypothesis, create an adaptation theory of change, choose indicators and set a baseline, and use the adaptation M&E system. development practitioners can apply these steps either to develop an M&E system for an adaptation project or program, or to identify ways to monitor and evaluate the adaptation components of a development intervention. The steps also can help funders and practitioners to gauge the utility of existing M&E systems for adaptation initiatives.

Each step raises key design and implementation questions for practitioners to address. The steps are organized around three key dimensions of adaptation, and example indicators for each dimension help practitioners identify criteria for defining a given project's contribution to adaptation.

The framework uses M&E as a tool to improve adaptation and development results through the principles of learning, flexibility and results-based management. Based on lessons learned from existing adaptation efforts at the community, project/program and national levels, it proposes that effectiveness be measured across three dimensions of adaptation: adaptive capacity; adaptation actions and sustained development in a changing climate; offering specific examples and types of indicators under each, respectively. This approach highlights ways to "learn by doing" and identifies several areas of further research and practice. This can be treated as a generic framework and not necessarily for CBA.

3.4 Adaptation Monitoring Framework - UNDP

UNDP designed a monitoring framework for adaptation actions (AMF), which includes standard indicators and units for adaptation initiatives across five adaptation processes (capacity building, information management, policymaking and planning, decision making for development, and risk reduction practices/resource management/livelihoods) (Brooks and Frankel-Reed, 2008). This framework is designed for decision making at the national level but contains useful examples of project-level indicators. The framework helps to define outcomes and link project level interventions to measurable indicators of adaptation progress. The indicators are intended to achieve four objectives – coverage, impact, sustainability and replicability. There are a range of quantitative indicators for each of the 'thematic areas' under the IPCC, including agriculture, water resources, public health, disaster risk management, coastal zones and natural resource management (UNDP, 2007). The project-level indicators address "coverage and impact primarily, and sustainability and replicability to a lesser extent" (UNDP, 2007). The project-level output indicators are designed to be "highly specific to project contexts" so that project developers may "formulate their own outputs and associated indicators appropriate to the context and purpose of a project" (ibid).

3.5 Domain based framework

A domain-based framework can be thought as adaptation metrics grouped into three main dimensions of sustainability – social, economic, and environmental (Srinivasan and Prabhakar, 2009). The three-dimensional nature of sustainability and the need to make trade-offs require maintaining all components in a dynamic balance. For example, metrics related to social dimension may include changes in the access of women and minorities to land, water, social services and credit, their participation in training and production activities, and their participation in decision making before and after introducing an adaptation intervention. Likewise, metrics related to economic dimension may include income changes, diversity of income sources and access to credit. On the other hand, metrics related to the environmental dimension may include improvement in soil and water quality, adoption of management practices that protect land and water, and use of local knowledge, capabilities and technologies. In a goal-based metrics system, a nation or region or community may set up specific goals in terms of economic viability, maintenance of natural resource base, and minimizing the impacts of climate change on socioeconomic and biophysical components of ecosystems (Srinivasan and Prabhakar, 2009). Each goal may comprise a number of qualitative or quantitative indicators, which may serve as adaptation metrics. In addition, sector-based, issue-based, cause and effect-based, and combination frameworks may be used to select adaptation metrics.

4. COMPARISON OF FRAMEWORKS

Using several key elements, a comparison of major frameworks discussed in this section is presented in Table 3. These key elements were chosen for two reasons: a) ability to identify commonalities and differences among the frameworks, and b) relevance to questions addressing scaling up of CBA (Table 1). Further, these key elements are closely connected with the underlying questions determining adaptation metrics and scaling up of CBA (Table 3).

TABLE 3 RELATION BETWEEN QUESTIONS UNDERLYING ADAPTATION METRICS AND KEY ELEMENTS FOR COMPARING M&E FRAMEWORKS

Questions that underline adaptation metrics	How these questions limit scaling up of CBA	Related key elements for comparing M&E frameworks
How is adaptation defined and achieved?	• Different perceptions of stakeholders affecting their decisions and outcomes • What is valued locally (e.g. process vs outcome) • Cross-scale/location comparisons	• Scope and application, criteria, characteristics and determinants. • Uncertainties
How is adaptation measured?	• Constitution of vulnerability • Moving baselines • Relation between the measured outcome and the perceived adaptation	• Use of Indicators (Qualitative/Quantitative). • Comparability • Compatibility with other decision making

Questions that underline adaptation metrics	How these questions limit scaling up of CBA	Related key elements for comparing M&E frameworks
		tools (existing project management cycles, economic evaluations)
Metrics for whom and who measures adaptation?	• The trust among actors across scales and regions • The capacity factor among actors	• Participation at local level • Cross-scale integration, target decision making scale

The following broad conclusions can be drawn in comparing the frameworks which are important for stakeholders to note.

a) Most frameworks propose participatory processes as essential for implementing M&E because it builds capacity, accountability and ownership.

b) Frameworks find the different tools they propose to use are already available and just need to be adapted for the purpose of M&E for adaptation.

c) Uncertainty is considered at two levels: uncertainty about the impacts of climate change; and uncertainty about how data is gathered and analyzed in M&E. While uncertainty related to climate change impacts are considered when designing adaptation interventions, the uncertainty about how data is collected and interpreted within M&E is dealt with by proper learning and capacity building of stakeholders in the process.

d) All frameworks either discuss or consider in one or other form different determinants of adaptive capacity proposed by Yohe and Richard, 2002 (i.e. technology, economic resources, institutions, equity, information and skills, social capital) and all use an indicator-based approach (quantitative and or qualitative) to measure/consider these determinants within the framework. Some of them do not necessarily provide specific indicators but allow participants to identify them themselves since they do not intend to be prescriptive.

e) UNDP and CARE have both suggested a range of metrics and indicators which can be used in project-specific settings (UNDP, 2007; CARE, 2011). These indicators are “highly specific to project context” (UNDP, 2007) are therefore it is suggested these can be selected according to the needs of the specific CBA project incorporating what the community feels is important.

f) None of the frameworks attempt to quantify adaptation or provide a detailed means of quantification, but provide sufficient room for actors to use adaptation metrics in M&E.

g) All frameworks examined claim to be able to coexist/compatible with existing project management cycles and economic evaluations. However, most have not yet been tested in practice.

h) Though none provide a tool to do so specifically, they encourage cross-scale integration and hence provide an opportunity to compare and summarize results across scales.

5. GUIDELINES FOR FACILITATING M&E OF ADAPTATION

From the foregone discussion in sections 3 and 4, some broad and specific guidelines emerge for the users of the frameworks compared in this paper. The essential steps to be involved in M&E are shown in Figure 1.

Broad guidelines

i) The importance of Monitoring and Evaluation (M&E) in the field of Climate Change Adaptation (CCA) is to improve the project and to ensure the project outcomes are successful in enhancing adaptive capacity.

j) M&E for CCA is ideal to clarify what needs to be done in the process of planning, implementing, finalizing, and following up the project. It will assess and review the project at different stages to make project outcomes more resilient and sustainable under the impacts of climate change.

k) To make M&E effective at the local level, identifying the characteristics of adaptive capacity is the key to designing M&E.

l) If M&E for CCA is implemented in a holistic manner, it could reduce the duplication of other M&E activities and enable us to comprehensively assess the effectiveness of each project.

m) In the stage of implementing M&E at the local level, identification of indicators is essential in order to make effective, efficient, and ideal measurement. One needs to be aware of the variety of interventions that can be taken considering that climate change is uncertain and complex.

n) M&E should be done to enhance incentives for individuals who conduct adaptation actions. In other words, it is desirable to expand individuals' adaptive capacity and to minimize practitioner's efforts on monitoring.

o) Certain uncertainties and costs are associated with implementation of M&E. Make sure that these uncertainties are understood and costs are accounted for smooth implementation of the M&E.

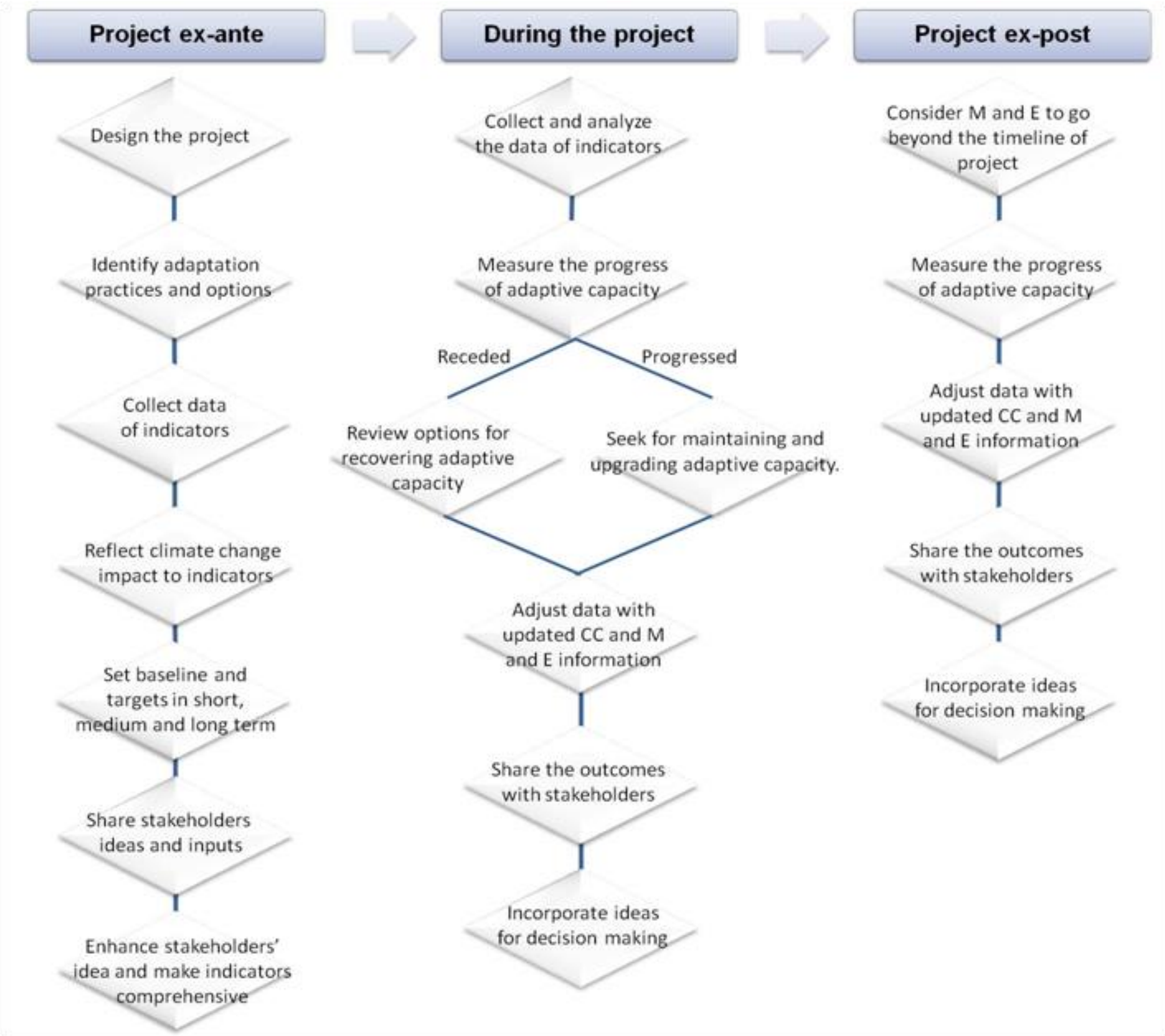

FIGURE 1 STEPS FOR MONITORING AND EVALUATION OF ADAPTATION ACTIONS

Specific stage-wise guidelines

Pre-project (ex-ante)

1. Design the project with setting targets and timelines for the project.
2. Identify adaptation practices and options to be implemented.
3. Extract and prioritize indicators of adaptive capacity, adaptation, and risk reduction for the activities to be conducted using frameworks such as the Local Adaptive Capacity framework.
4. Collect data for respective indicators including economic, social, political, institutional, ecological, and geographical indicators.
5. Reflect direct and indirect impact by climate change for such indicators.
6. Set baseline and individual targets in short, medium and long term.
7. Share the ideas and inputs of the stakeholders including local community.
8. Obtain mutual agreement among stakeholders' on the M&E indicators.
9. Try to identify incentives for stakeholders to pursue adaptation activities.
10. Anticipate possible obstacles for M&E.

During the project

1. Identify difficulties and obstacles to conduct monitoring.
2. Collect and analyze the data.
3. Measure the progress of adaptive capacity, adaptation, and risk reduction in respective stages according to the designed indicators and reflect third party view by involving different stakeholders.
    - 3.1. If progressed, seek practice for maintaining and system for upgrading the adaptive capacity.
    - 3.2. If gaps are identified, review options for improving adaptive capacity and to improve progress.
4. Adjust the project strategy (if permissible) keeping in view the outcomes of the evaluation.
5. Identify incentives for stakeholders regarding the activities and adjust efforts of monitoring.
6. Share the outcomes with stakeholders including local community.

7. Incorporate different ideas from stakeholders for decision making.

Post-project (ex-post)

1. Consider M&E to go beyond the timeline of project completion and constantly monitor the changes so that there is valuable data to measure different scales of the success or failure of the project under the changing climatic and socio-economic environment.
2. Collect data and measure the progress in adaptation by involving different stakeholders. Improve the M&E framework based on the lessons learned from the project (e.g. how the uncertainty aspect could be better handled).
3. Analyze stakeholders' incentives to conduct adaptation activities and adjust M&E.
4. Adjust with the changing and updated information in relation to climate forecast as well as M&E framework to screen the form of analyzing and identifying the measures.
5. Share the outcomes with stakeholders including the local community and incorporate their ideas into the possible step for future decision making processes.
6. Continually conduct M&E as much as possible to see if the project is feasible in long term; some projects are successful in short term but not in long term which means it could eventually lead to mal-adaptation.

6. CONCLUSION

Adaptation metrics will be vital for prioritizing and incentivizing adaptation actions, as well as evaluating the performance of activities and funding streams. Keeping the importance of measuring adaptation in view, considerable efforts have gone into developing several model frameworks. Most of these efforts focused on integrating the 'adaptation metric' aspects into some kind of single monitoring and evaluation (M&E) framework. Such integration makes sense because most of the current ongoing CBA interventions are being implemented in the form of small and medium scale projects that the donor agencies, local implementing agencies and governments would like to monitor and evaluate for their effectiveness. Since these agencies have their own internal M&E systems in place, if not CCA-specific, it is more efficient to integrate 'adaptation metrics' into existing M&E frameworks rather than to create new frameworks. However, as discussed in Section II of this paper, it appears that such integration is not as simple as one would expect. Overcoming these challenges will be essential for scaling up CBA in a way that brings measurable results. Dynamic baselines and uncertainties demonstrate the need for qualitative participatory indicators in which communities themselves track progress.

In comparing these frameworks, we found that most of the M&E frameworks converge at certain points, such as identifying the principles upon which adaptation is planned and implemented, determining ways to assess underlying adaptive capacity, building an M&E system based on the principles of adaptive management, and making sure that there is multi-scale and cross-sectoral interaction. More importantly, it has been found that is very difficult to develop a M&E framework that integrates adaptation metrics considering diverse context/expectations from stakeholders discussed under which adaptation takes place. M&E for CCA should clarify what needs to be done in the process of planning, implementing, finalizing, and following up the project. It will assess and review the project at different stages to make project outcomes more resilient and sustainable under the impacts of climate change. Identification of indicators is essential in order to make effective, efficient, and ideal measurement. One needs to be aware of the variety of interventions that can be taken considering that climate change is uncertain and complex, and that external risks may change.

Frameworks need to be a 'guide post' with built-in flexibility rather than being a rigid evaluation that may limit capturing the diverse impacts of adaptation actions. There is also consensus among the authors that the frameworks need to capture complementarities that exist among different domains of decision-making such as CCA, development, and DRR. These frameworks suggest moving beyond a rigid asset-based approach towards social and institutional approaches that instill a sense of learning as understanding on climate change impacts and adaptation strategies continues to emerge. Existing frameworks tend to merge in terms of employing a participatory process, and the need for capturing overall change as a goal. M&E then becomes part of a learning process as well as capturing results.

TABLE 4 SHOWING THE COMPARISON AMONG THE PROPOSED FRAMEWORKS FOR MEASURING ADAPTATION

	LAC	CSDRM	WRI/GTZ	UNDP
Underlying principles				
Scope and application	Identifying the characteristics of adaptive capacity. Future use in the development of indicators and metrics of adaptation.	Integrate CCA, development and DRR assessments into a single framework.	The framework revolves around three principles for M&E of adaptation: Learning; Results (RBM); Flexibility	Generic framework with applicability to wide variety of stakeholders.
Criteria, characteristics and determinants	The asset base; knowledge and information; innovation; institutions and entitlements; flexible forward looking governance	ADAPT principles and frameworks, identifying and measuring interlink ages between disasters, adaptation and development, avoiding mal-adaptation, robustness under uncertainty.	The framework breaks down adaptation into three dimensions for M&E: Adaptive capacity; Adaptation Actions; and Sustained development in a changing climate.	Project-level indicators focus on impact and coverage. Split into IPCC thematic areas (TA's)
Processes				
Use of Indicators (Qualitative/Quantitative)	Assessments using the LAC can include both qualitative and quantitative based variables	Both quantitative and qualitative	Both quantitative and qualitative	Standard indicators and specific project-level indicators. Some are quantifiable; others are based on QBS (qualitative based surveys)
Cross-scale	Yes	The framework includes a set	Can work at a single or	Yes

	LAC	CSDRM	WRI/GTZ	UNDP
integration		of indicators to measure integration across sectors and scales	multiple scales; strongly favors integration of bottom-up decision-making.	
Target decision making scale	Yes	The framework aims to be applicable across scales.	Project/program.	Yes
Participation at local level	Yes	Yes. The framework is an organizational PM&E tool but input from local communities is of upmost importance for the success of CSDRM.	Participation is an integral part of the planning process.	VRA can be included.
Outcomes				
Comparability	Effectiveness and impact across the five characteristics is comparable, either quantitatively or qualitatively.	The framework proposes a set of standardized, though flexible, indicators - than can be compared across countries, context and scales.	This framing is applicable at multiple scales and with multiple sectors.	'Standard' indicators are more comparable than the project-specific indicators for TA's.
Compatibility with other decision making tools (existing project management cycles, economic evaluations)	-NA-	Follows programme management cycles to aid its integration into ongoing decision-making tools. Is meant to complement ongoing M&E frameworks and facilitate programme planning and design, identify desired outcomes and M&E co-benefits and trade-offs.	It is intended to create linearity in measurable/ trackable outcome indicators that complement or enhance existing M&E systems.	Yes, because it provides example indicators that could be complementary to the existing M&E frameworks.

	LAC	CSDRM	WRI/GTZ	UNDP
Uncertainties	Uncertainties around where the characteristics of adaptive capacity are broadly common across all contexts- particularly in the context of rural and urban locales.	Acknowledges high degree of uncertainty in both climate and socio-economic scenarios, and addresses by identifying mutually reinforcing (supportive) relationships between planning and monitoring.	Firstly, considers a vulnerability/and or risk assessment is completed as an input to the M&E system and uncertainty is part and parcel of the VA/RAs. Secondly, deals with it by enabling actors to identify and track assumptions under which decisions are made.	Recognizes that the adaptation 'baseline' is moving and indicators of loss or damage must be 'normalized' to account for changing hazards; assessment of this may be qualitative.
Simplicity/ease of use by practitioners	Difficult to say, because they have not been tested and practiced as yet.			
Prescriptive or reflective	Reflective	Reflective	Reflective	prescriptive

Source: Compiled by authors

Since most M&E frameworks discussed in this paper are not widely adapted, there is little evidence on their practicality and their suitability under diverse conditions in which adaptation takes place. As a next step, these frameworks need to be tested and implemented in practice to find out which approach is most effective. The following faulty assumptions should be avoided in formulating M&E frameworks: a. characteristics of adaptive capacity are known and agreed upon; b. it is easy to estimate baselines and establish adaptation targets at levels where adaptation is important; c. tools exist for measuring adaptation and M&E and that they just need to be brought together; d. local actors are capable of choosing what is right and wrong and they have information to do so, and; e. integration across scales is simple and straightforward.

Practitioners often face a steep learning curve in using existing CCA M&E frameworks, and require additional institutional or academic support in doing so. Evolving frameworks should therefore provide donor agencies with a means to compare adaptation actions and their effectiveness across different geographical scales, and should help in deciding how much money and other resources need to be invested before projects are implemented. Such integration of adaptation metrics in M&E frameworks can help in evaluating and scaling up pilot projects to regions with similar socio-economic and climatic characteristics and provide an useful tool for early prioritization of actions even before CCA project is initiated on the ground (ex-ante), such that adaptation actions are identified and implemented without fear of maladaptation. Indicators are likely to vary between projects, but developing an integrated M&E framework that considers environmental, disaster, climate change and developmental domains of decision making would go a long way to the practicality and usefulness of emerging adaptation metrics and practice in adaptation M&E. In summary, more time is needed for these frameworks to evolve and to be useful in practice. The key take-home messages emerge are: a. The monitoring and evaluation (M&E) in the field of climate change adaptation (CCA) is to improve the project and to ensure the project outcomes are successful in enhancing adaptive capacity. B. M&E for CCA should clarify what needs to be done in the process of planning, implementing, finalizing, and following up the project. It will assess and review the project at different stages to make project outcomes more resilient and sustainable under the impacts of climate change. C. To make M&E effective at the local level, identifying the characteristics of adaptive capacity is the key to designing M&E. d. If M&E for CCA is implemented in a holistic manner, it could reduce the duplication of other M&E activities and enable us to comprehensively assess the effectiveness of each project. E. In the stage of implementing M&E at the local level, identification of indicators is essential in order to make effective, efficient, and ideal measurement. One needs to be aware of the variety of interventions that can be taken considering that climate change is uncertain and complex. F. M&E should be done to enhance incentives for individuals who conduct adaptation actions. In other words, it is desirable to expand individuals' adaptive capacity and to minimize practitioner's efforts on monitoring. G. Certain uncertainties and costs are associated with implementation of M&E. Make sure that these uncertainties are understood and costs are accounted for smooth implementation of the M&E.

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II. Adaptation as a problem of decision making: Application of multi-criteria techniques in adaptation decision making

C. Ilori and S.V.R.K. Prabhakar

ABSTRACT

Adaptation involves decision making at various levels involving multiple stakeholders who often have different criteria to prioritize adaptation actions. Hence, reconciling the adaptation decision making using simple techniques that accommodate one or two criteria may not ideally represent the complexity under which adaptation decision are often have to be made and multi-criteria analysis techniques provide one of the best tools for decision making. Multi-criteria analysis techniques are diverse and it is often challenging to prioritize one tool against other in absence of a specific question to be answered. Keeping this challenge in view, this chapter reviews various multi-criteria analysis tools at disposal to decision makers, lays out advantages and challenges involved in using them for adaptation decision making and identifies the best options that practitioners could use. The review indicated that Analytical Hierarchy Process (AHP) could provide a good tool if the stakeholders are well educated about the complexity involved in using it since AHP can provide good opportunity to engage in a group setup where several stakeholders come together and take decisions. The subsequent chapter of this report demonstrates the use of AHP in prioritizing criteria, indicators and adaptation practices in drought and flood-prone areas of the Gangetic Basin in South Asia.

1. INTRODUCTION

The objective of this chapter is to review the currently available tools for prioritizing adaptation actions based on the current experiences from the published literature. In order to achieve this objective, the paper sets the discourse by differentiating vulnerability and adaptation so as to make an impression on the reader on the need for adaptation based approach and the need for prioritizing adaptation actions. While trying to clarify the approaches adopted in other developmental areas, the chapter subsequently compares various multi-criteria decision making tools available and their pros and cons.

Vulnerability, resilience and adaptation are three fundamental concepts that cannot be over-emphasized in climate change adaptation discussion. Adaptation in the context of climate change is any effort or action towards reducing the negative impacts of climate change (Keithley and Bleier, 2008). The concept of adaptation cannot be conceived for designing and implementing projects alone, it is about reducing vulnerability and building resilience. As a matter of fact, when addressing the issue of climate change adaptation, the idea of vulnerability comes into the forefront of discussion (SPREP, 2003). According to Waterwiki (2009), "prioritization of adaptation measures should be based on the results of vulnerability assessments". Vulnerability arises as a result of loss of resilience in a system. Resilience is about people's capacity far beyond the minimum of being able to cope. A resilient community is able to bounce back or return from a shock and remain unchanged. The concept of resilience helps to obtain a complete understanding of vulnerability. The good understanding of vulnerability and resilience is very crucial to the development of sustainable adaption strategies (Harley et al., 2008). The actual impacts of climate change can be reduced by: (1) promoting resilience so as to reduce system sensitivities; (2) increasing adaptation capacity and effectiveness of adaptation responses and (3) improving the adaptation-planning processes (Grafton, 2009). The graphs below illustrate vulnerability, resilience and adaptation.

The graphs are simple examples of vulnerability, resilience and adaptation within the context of climate change (Figure 2). A drought occurrence (for example) could decrease the wellbeing of a poor household or community at large. In some cases, it makes no difference (e.g graph 3) and in some others, for example to survive the drought, some assets might be sold and as a result they might not return to their original wellbeing level (graph 1). This is what occurs in absence of resilience. A resilient community will be able to bounce back from the unexpected climate disaster (graph 2). The first graph is typical of a vulnerable household or community that is prone to the risk of climate change. Any perturbation in the climate system would lead to a decline in the overall wellbeing. In the second graph, a resilient household or community is observed where there are adaptation measures after a disaster. The household or community could return more quickly to the original wellbeing level. This resilience is an important asset as climate changes. An occurrence of drought only leads to a temporal decline. The system is able to adjust after some time and return to normal. This type of situation is an illustration of reactive adaptation.

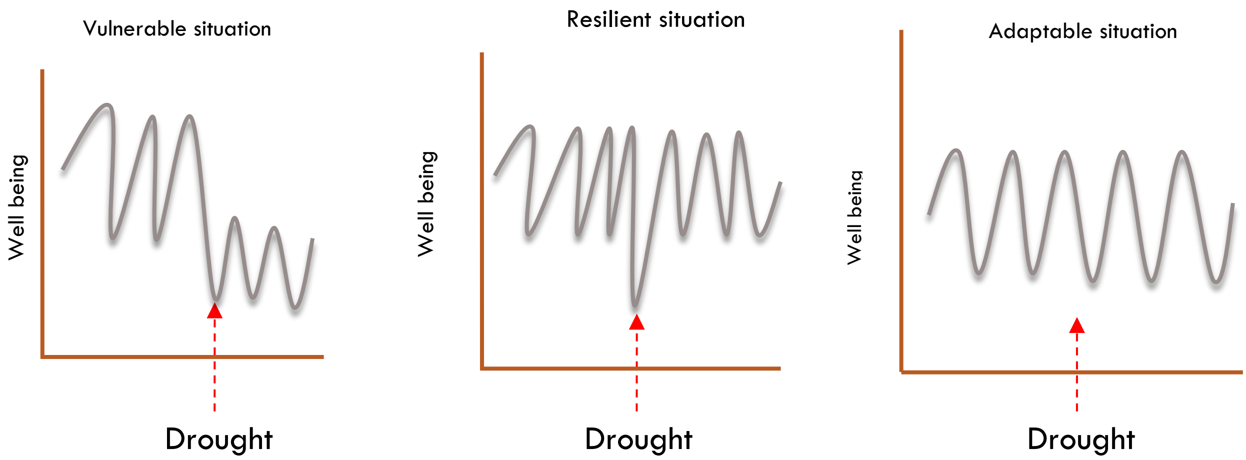

FIGURE 2 VULNERABILITY, RESILIENCE AND ADAPTATION

Source: Authors

The third graph is typical of a household or community that has moved beyond resilience to being able to adapt fully to a new climate. The wellbeing does not change in the course of the drought. The drought is perceived for a second as a normal event. They are fully adapted to the drought perhaps through the use of drought-resisting crops for farming or through early warning system that would alert them that drought is coming so they can prepare for it. The above scenario can be observed within communities of most developed countries of the world. This typifies an example of anticipatory adaptation.

2. ADAPTATION AND DEVELOPMENT

After assessing vulnerability level and analyzing potential measures to make communities resilient, activities must be formulated to ensure that a community is fully adapted to the changing climate. This thus poses an interesting question: *are these adaptation efforts the same as development activities that have been going on for ages and are the same tool for* *development will be effective and adequate to prioritize adaptation options?* Climate change adaptation is an emerging issue which is just been explored whereas development has been going on for ages. Some adaptation scholars believe that there is an overlap between climate change adaptation and development (Huq and Ayers 2008; Ayers and Huq, 2008, Hedger et al., 2008; McGray et al., 2007; OECD, 2009). Huq and Ayers (2008) and McGray et al. (2007) maintain that activities that are taken to ensure adaptation to climate change are synonymous with development activities. In the words of Huq and Ayers (2008), *"Good (or sustainable) development (policies and practice) can (and often does) lead to building adaptive capacity. Doing adaptation to climate change often also means doing good (or sustainable) development"*. Many adaptation activities practically fall within the two extremes of addressing drivers of vulnerability to actions to confront or address the severe impacts posed by climate change (McGray et al., 2007). Overlap between adaptation and development can also be established by the fact that vulnerability to climate change is determined by socioeconomic indicators (Brown et al., 2010). For this simple reason, a number of development organizations are soliciting for the integration of 'mainstreaming of adaptation into ODA (Official Development Assistance) activities. McGraw et al. (2007) posit that there may not be a clear cut difference between efforts towards climate change adaptation and efforts geared toward sustainable development for a number of reasons. These reasons are in terms of objective, methodological approach and the complexity inherent in the climate system.

In this context, how to differentiate tools employed for assessing effectiveness of development actions from that of tools for assessing adaptation actions is a relevant question. Scholars believe that key tools, approaches and methods to measure development effectiveness can also play important role in climate change adaptation intervention evaluation (Hedger et al., 2008; McGraw, 2007) (see table 5). The question on the overlap between climate adaptation and development has resulted in another question in the climate adaptation community: does the new challenge of adaptation call for additional funding, especially when the work in it is in no way different from the normal development?

TABLE 5 SOME TOOLS AND METHODS FOR EVALUATING CLIMATE CHANGE ADAPTATION AND DEVELOPMENT

Method	Description	Further description	Pros	Cons
Logical framework approach (Logframe)	It helps to clarify projects objectives or policy and assists in the identification of expected casual links (the program logic) between inputs, processes, outputs, outcomes and impact. **It leads to the identification of performance indicators** at each of the above stage (input, processes,…). It reveals the risks which might impede objectives attainment. It is a vehicle for engaging partners in objectives clarification and activity design. It helps in reviewing progress and taking corrective action during implementation.	It improves project quality and program designs. It summarizes design of complex activities. Provides objective basis for activity review, monitoring and evaluation	It ensures that decision-makers ask fundamental questions and analyze assumptions and risks. It full engages stakeholders in the planning and monitoring process. It is an effective management tool to guide in project implementation monitoring and evaluation.	It can be a static tool that does not reflect changing conditions if not updated during implementation. It can stifles creativity and innovation if managed rigidly. It requires regular training and follow-up.
Performance indicators	These are measures of inputs, process, outputs, outcomes, and impacts for development projects or strategies. They help in tracking progress and taking corrective action to improve service delivery.	It sets performance targets and assesses progress towards achieving them. Indicates whether an in-depth evaluation or review is needed.	Effective means to measure progress toward objectives. Facilitate benchmarking comparisons between different organizational units.	Poorly defined indicators result in bad measures of success. Tendency to define too many indicators making system costly and impractical. There is a trade- off between picking optimal or desired indicators and having to accept the indicators which can be

Method	Description	Further description	Pros	Cons
				measured using existing data.
Rapid appraisal methods	These are quick. Low-cost ways to gather the views and feedback of stakeholders and beneficiaries to respond to decision –makers' need for information.	Provides rapid information for management decision-making, especially at project level. Provides context and interpretation for quantitative data collected. Provides qualitative understanding of complex socioeconomic changes, people's values, motivations and reactions.	It saves time. It provides avenues to explore new ideas	Findings are usually related to specific communities-thus making generalization from findings impossible. It is less valid, credible and reliable than formal surveys.
Participatory methods	They provide active involvement in decision-making for people with a stake in a project, program or strategy and generate a sense of ownership in the M&E results and recommendations. Common tools include *stakeholders' analysis, participatory rural appraisal, beneficiary assessment, participatory monitoring and evaluation.*	Useful in learning about local conditions and local people's perspectives and priorities to design more responsive and sustainable interventions. Good for problem identification and trouble- shooting during implementation. Good project, program of policy evaluation tool. Provides knowledge and skills for poor people's empowerment	Relevant issues can be examined by involving key players in the design process. Enhancement of local learning, management capacity and skills. Provision of timely, reliable information for management decision-making.	Sometimes regarded as less objective. Can be time-consuming if key stakeholders are not engaged meaningfully.

Method	Description	Further description	Pros	Cons
Impact evaluation	It is the systematic identification of the effects-positive or negative, intended or not-on individual households, institutions and the environment caused by a given development activity such as a project. It helps understand the extent to which activities reach the poor and the magnitude of their effects on people's welfare.	It measures outcomes and impacts of an activity. Helps to clarify whether costs for an activity are justified. Informs decision on whether to expand, modify or eliminate projects or policies. Comparing the effectiveness of alternative interventions.	It provides answers to some of the most central development questions. It provides estimates of the magnitude of outcomes and impacts for different demographic groups, regions or over time.	Some approaches can be expensive and time-consuming. Utility is reduced when decision-makers need information quickly.
Adaptation tools				
Geographic analogs	A qualitative tool for evaluating the effectiveness of potential adaptation strategies.	Applicable in all sectors of adaptation. It makes comparison with observed adaptations to past climate extremes in different geographic locations, sectors or time periods. It points out how well actual adaptation response would or not work. Provides insights into how adaptation process may work. Used in U.S. EPA-supported project, fisheries evaluation in Poland and Mexico.	Relatively easy to use. It narrows the list of feasible options. Helps in avoiding duplication of research.	Used with other quantitative evaluation options. Does not provide a means to weigh trade-offs among different options. Needs engagement of multi-disciplinary panel of experts (climatologist, meteorologists, epidemiologists, etc.). Needs knowledge of situations being

Method	Description	Further description	Pros	Cons
				compared
VANDACLIM	A window-based tool that provides steps to complete a vulnerability and adaptation assessment.	Used in agriculture, water resources, coastal environment and human health sectors. Creates a model of climate change impacts on biophysical factors and human health for a selected area. Applied by ten countries in the Pacific Island Climate Change Assistance Program	Easy to use. Menu-driven. Produces results in both map and chart forms.	Requires site-specific data input. Requires knowledge about site's geography, land-use, population and economy. May not be suitable for community-based adaptation.
Tool for Environmental Assessment and Management (TEAM)	It creates graphs and tables that allow experts to compare the relative strengths of adaptation strategies using both quantitative and qualitative criteria.	Applicable in coastal zones, water resources, agriculture. Gives the relative effectiveness of alternative adaptation measures across a range of criteria.	Easy to use. Useful when it is important to consider a wide range of criteria.	More rigorous results require more analysis. Used in conjunction with other decision-making tools (e.g CBA). Strategies' relative strengths and weaknesses are revealed.

Compiled by authors from: Kumar, 1993; GTZ, 1997; Guljt and Gaventa, 1998; Hatry, 1999; Roche, 1999; Sapsford, 1999; Stratus Consulting Inc., 1999; Baker, 2000; World Bank, 2000 ; UNFCCC, 2004; World Bank, 2004; Garg et al., 2007; Hedger et al., 2008; USAID, 2007.

As mentioned previously, many authors have justified the relationship between adaptation and development; however there are criticisms at the international climate negotiation that not all adaptation is development and not all development reduces vulnerability to climate change adaptation (Ayers and Huq, 2008). A good example of this difference is found in adaptation interventions adopted by donors for developing countries' adaptation efforts. Adaptation interventions do not at all time equate with the priorities set for development by recipient countries (Ayers and Huq, 2008). In another vein, the new challenges from climate change have called for the modification of the existing tools and methodologies that have been employed in development activities for better adaptation actions (Mitchel et al., 2010, McGraw et al., 2007). In fact UNFCCC (2002), in its guidelines for the preparation of NAPA for least developed countries maintains that adaptation differs from usual development and that "what is setting adaptation apart from the usual development project would seem to be the increase in frequency and intensity of extreme events and the uncertainty that goes with it, and the fact that adaptation projects normally try to achieve multiple objectives". As a result of this, additional tools may be needed to enhance adaptation decision- making.

3. ASSESSING ADAPTATION ACTIONS

The new problems that the changing climate is bringing have called for new research approaches and tools useful to evaluate different adaptation actions. The IPCC (2001) advocates for methodology development to link impact assessment with sustainability evaluation assisted by multi-criteria policy analysis and multi-stakeholder consultation. According to a statement in the same publication, there are a number of tools available for understanding climate change adaptation and researching ways in which society can adapt. These tools are also helpful for rightful adaptation decision-making and policy formulation. Major ones include Multi-criteria analysis (MCA) or multi-criteria decision making (MCDM), cost benefit analysis, cost effectiveness analysis (CEA) (UNFCCC, 2002; Ministry of Environment and Agriculture, 2007). The MCA was extensively used as key decision making tools in the UK adaptation actions (DTLR, 2001). MCA approach can be applied in adaptation actions for the following reasons: MCA approaches can be a very useful tool in communicating awareness about the challenges of climate change adaptation and suggesting list of available options in achieving an efficient adaptation (de Briun et al., 2009). The MCA has been proved to be more effective in ranking adaptation options which could be possibly useful in deciding on the best adaptation strategy.

A careful look into the literature confirms that Multi-Criteria Analysis (MCA), Cost-Benefit Analysis (CBA) and Cost-Effectiveness Analysis (CEA) are often applied in adaptation decision making. Employing the MCA in preparing NAPA document (2008-2012) for the Republic of Cape Verde (Ministry of Environment and Agriculture, 2007), it was concluded that MCA is preferred to CEA and CBA for a number of reasons: In the environment sector, several elements that are needed for informed analysis are often on variables which cannot be quantified, but these are also important in the decision making process; costs quantification and evaluation and/or benefits in monetary terms were considered very difficult; and it is possible to combine objectives and subjective assessment.

3.1. Nature of adaptation decision making and need for prioritization

Adaptation to climate change will require making decision in the face of many actors. Certain things are common in decision-making: policy formulation (in some cases), sharing of different views and reaching a consensus and engagement of people decision will directly affect. Adaptation to climate change follows a step-by-step procedure that any decision-making endeavor may take. In discussing issues surrounding adaptation to climate change, several parties are brought into scene: planners, policy makers, researchers, people that are affected by the impact of climate change and other stakeholders as occasion may warrant it. Decisions about actions or plans for effective adaptation may incorporate several criteria owing to the nature of adaptation itself. Decision in adaptation also necessitates the interplay of experts in different fields-climatology, economist, scientist, meteorologist, political science, engineering, etc.

There are several tools that are used in decision making. One which fully takes into account the above mentioned scenarios is the Multi-criteria Analysis (MCA). Given a wide spectrum of adaptation options, the careful selection of specific adaptation actions based on adaptation objectives and criteria is essential. *Most often a multi-criteria analysis of adaptation options is needed* (Prutsch et al., 2010). The analysis can include, but not limited to effectiveness, importance, urgency, sustainability, co-benefits, side-effects, resilience, importance, political and cultural acceptability (Prutsch et al., 2010). Adaptation options need to be prioritized for the following reasons: Prioritization of adaptation options is needed in some circumstances where available resources (human, financial) are limited or scarce (Julius et al., 2008). This will ensure that the most cost-effective options are chosen (Waterwiki, 2009): adaptation is costly, adaptation has long term implication, and prioritization helps to avoid mal-adaptation.

Another pivotal theme in adaptation prioritization is evaluation. It measures the progress achieved in the cycle of a project. Adaptation is an ongoing process which requires periodic evaluation (Prutsch et al., 2010). The main aim of evaluation in any project or program is to improve the effectiveness and efficiency of projects by using the results for better planning. Two concepts are important: ex-ante and ex-post evaluation. Ex-ante evaluation is an assessment of the relevance, effectiveness and impact of a project performed before. Ex-post evaluation on the other hand is performed after implementation of a project or development. This may be directly after or long after completion. This type of evaluation is performed to identify factors that are responsible for project success or failure, assess the sustainability of results and impacts of project and subsequently arrive at conclusions.

In effectively evaluating adaptation projects, it is important to use relevant indicators at both ex-ante and ex-post stages. These indicators help to measure progress and provide useful guidance in future applications. According to JICA's evaluation report, the indicators used for ex-ante evaluation are those that will also be used for post-ante evaluation. Below is a table (Table 6) that lists some projects in Asia showing the indicators used at the two evaluation stages.

TABLE 6 INDICATORS EMPLOYED FOR EX-ANTE AND EX-POST EVALUATION OF PROJECTS

Project	Geographical focus	Indicator	
		Ex-ante	Ex-post
Ho chi Minh City Water Environment Improvement – Vietnam	National	Populated treated (person)	Same as ex-ante
		Amount of wastewater treated (m^3/day)	Same as ex-ante
		BOD concentration (mg/1) in wastage treatment plants (influents and effluents)	Same as ex-ante
		Area inundated by 5-year probable rainfall (ha)	Same as ex-ante
Integrated water resources and flood management project for Semarang - Indonesia	Local	Annual highest water level (m)	Same as ex-ante
		Inundated area by levee breach	Same as ex-ante
		Number of inundated houses by levee breach of overflow (houses (at 50-year floods)	Same as ex-ante
		Amount of water supply (m^3/s)	Same as ex-ante

Project	Geographical focus	Indicator	
		Ex-ante	Ex-post
		Discharge capacity at river mouth (m^3/s)	Same as ex-ante
		Inundated area due to poor drainage (km^2) (at 5-year-floods)	Same as ex-ante
		Number of inundated houses due to poor drainage (at 5-year floods)	Same as ex-ante
Support program to respond to climate change – Vietnam		Domestic energy consumption	Same as ex-ante
		Forest coverage (%)	Same as ex-ante
		The number of local ministries that have formulated a disaster control plan	Same as ex-ante
Sikkim Biodiversity Conservation and Forest Management Project - India	Local	Total protected area (km^2)	Same as ex-ante
		Total Number of Protected Areas	Same as ex-ante
		Afforestation and Regeneration Area (ha)	Same as ex-ante
		Number of Self Help Groups (SHGs) Formed	Same as ex-ante
		Number of Trainees of Forest Department Staff	Same as ex-ante
Eighth Bangkok Water Supply Improvement Project – Thailand	Regional	Average Daily Water Production (10	Same as ex-ante
		Maximum Daily Water Production (10,000 m3 /day)	Same as ex-ante
		Water Production Capacity (10,000 m3 /day)	Same as ex-ante
		Beneficial Population (persons)	Same as ex-ante
		Internal Rate of Return EIRR(%)、FIRR(%)	Same as ex-ante
Urban Flood Control System Improvement in Selected Cities-Indonesia	Regional	Maximum channel capacity (m3/s) at the water-level measurement point or the initially scheduled construction section	Same as ex-ante
		Maximum flood inundation area caused by dike break or overflow (km2)	Same as ex-ante
		Maximum number of inundated households caused by dike break or overflow	Same as ex-ante
		Economic Internal Rate of Return (EIRR) (%)	Same as ex-ante
Sihanoukville Port Special Economic Zone Development Project - Cambodia	National	Amount of direct investment	Same as ex-ante
		Number of relocating companies	Same as ex-ante
		Number of relocating companies	Same as ex-ante
		Amount of exports	Same as ex-ante
		Volume of containers handled (additional volume)	Same as ex-ante
		Internal Rate of Return	Same as ex-ante
Qinghai Ecological Environmental Improvement Project - China	Regional	Area (ha) Rate of vegetation cover after 2 years (%)	Same as ex-ante
		Area (ha) Reduction rate of burrows after implementation (%)	Same as ex-ante
		Area (ha) Reduction rate of pests after	Same as ex-ante

Project	Geographical focus	Indicator	
		Ex-ante	Ex-post
		implementation (%)	
		Afforested area (ha) Survival rate after 1 year (%) Survival rate after 3 years (%)	Same as ex-ante
		Afforested area (ha) Survival rate after 1 year (%)	Same as ex-ante
Second Poverty Reduction Support Operation (PRSO2) – Lao Peoples Democratic Republic	National	Percentage of loss making SOE	Same as ex-ante
		Reduction of annual loss of loss-making SOEs (state-owned enterprises)	Same as ex-ante
		Reduction of combined loss for the first phase of SOEs (four SOEs)	Same as ex-ante
		Percentage of rural population with access to electricity	Same as ex-ante
Agra water supple project	Regional	Total population served (per 1000 persons)	Same as ex-ante
		Amount of water supply (m^3/day)	Same as ex-ante
		Non-revenue water rate (%)	Same as ex-ante
		Ratio of population using pipe water for drinking (%)	Same as ex-ante

Source: Japan International Cooperation Agency Project. 2010. Evaluation Report. Available at http://www.jica.go.jp/english/our_work/evaluation/oda_loan/economic_cooperation/c8h0vm000001rdjt-att/vie100527_02.pdf.

3.2. Methods for prioritizing and selecting adaptation options

As discussed previously, adaptation options need careful selection. There are several tools that are useful in prioritizing adaptation options. These tools are collectively referred to as decision making tools in adaptation (see UNFCCC, 2004; Stratus Consulting Inc., 1999; Bosch, 2002). Four major tools are often used to prioritize and select adaptation options -cost benefit analysis, multi-criteria analysis (MCA), cost-effectiveness analysis (CEA), and expert judgment (OECD, 2009, Isabelle and Bosch, 2004). Table 7 presents pros and cons of various tools employed in adaptation decision making.

TABLE 7 PROS AND CONS OF TOOLS EMPLOYED FOR ADAPTATION DECISION MAKING

Method	Pros	Cons	References
Cost-benefit analysis	Allows comparison between sectors	Heavy on quantitative data	Bosch, 2002
	Provides project specific assessment	Extensive data and analysis	Garg et al., 2007
	Proven economic tool	Difficult to get cost and benefit data for social parameters.	

Method	Pros	Cons	References
	Easy quantitative comparison across alternative adaptation options	Generally performed from a project/policy-perspective and not from user (e.g community needing adaptation measures) perspective	
Cost-effectiveness analysis (CEA)	Provides budget estimate	Provides ranking only	Bosch, 2002
	Could provide economy-wide policy assessment	Requires macro-level assumptions which could be distant from micro-level adaptation needs and realities	Garg et al., 2007
	Good to compare costs of adaptation across regions with similar circumstances and objectives	Arriving at a common discount rate for different communities could be tricky	
	Good to provide indicative comparison of national adaptation costs with national mitigation costs (worked out from different models)	Requires extensive data and analysis	
		Defining objective function could become subjective for adaptation policy	
Multi-criteria analysis (MCA)	More criteria possible	Manipulation easy	Bosch, 2002,
	Participatory approach	Provides ranking only	
	Proven modelling concept	Needs trained human resources	Garg et al., 2007, Niang-Diop and Bosch, 2004
	Broader approach and could include economic social, environmental, technical and financial criteria	Requires extensive data and analysis	
	Could rank different adaptation options on considering multiple criteria	Defining multiple criteria and preferences for policy outcomes could become subjective for adaptation policy	
	Could generate environmental and social indicators	Requires macro-level assumptions, which could be distant from micro level adaptation needs and realities	
Policy exercise	Policymaker's involvement is easier	May need separate economic analysis for weighting alternative adaptation	Garg et al., 2007
	Ease of use	Experience may drive commonsense, which may both be inadequate in the climate change context	
	No training required for participants	Inexperience facilitators could diminish the tremendous possibilities	
	Scope, coverage and involvement of relevant policymakers can be identified based on adaptation problems being analyzed		
	Very useful for developing countries and LDCs		

Method	Pros	Cons	References
Expert judgment	Flexible to choose on specific problem to investigate	It is Subjective	Bosch, 2002, Garg et al., 2007
	Widely used and established tool		
	Saves time vis-a-vis full scale study		
Tool for environment	Easy comprehending output for policymakers	Needs trained human resources	Garg et al., 2007
	Visual comparison of alternative adaptation policy options through graphs and charts	Needs data to set up for specific area.	
	Useful for developing countries LDCs		
Adaptation decision matrix (ADM)	Could be considered as a simplified	Users have to be knowledgeable about various adaptation options, criteria used to evaluate and the relative weightage of these criteria	Garg et al., 2007
	No training required for participants	The coordinator has to be especially knowledgeable in cross-cutting and cross-sectoral issues	
	Ease of use	Defining multiple criteria preferences for policy outcomes could become subjective for adaptation policy	
	Policymakers' involvement is easier		
	Promising for developing countries		
	Broader approach and could include economic, environment, social, technical and financial criteria		
	Could rank different adaptations on the above multiple criteria		

Source: Compiled by authors

Multi-Criteria Analysis

Multi-criteria Analysis: Multi-criteria analysis is useful in dealing with problems where benefits and/or costs cannot be measured in non-monetary units. It proves effective when benefits cannot be quantified and valued (e.g. preservation of biodiversity) (UNFCCC, 2002). MCA according to the UNFCCC is the most applicable and suitable tool for prioritizing adaptation. Using an MCA process, adaptation options can be scored against selected criteria depending on consensus. The scores can either be quantitative or qualitative (based on the judgment of a multidisciplinary team or various stakeholders and expressed in a variety of scoring scales). The scores can then be standardized and weighted to allow the options to be compared by expressing the value of each score in the same measuring unit on a common scale, and to allow the scores to be ranked by taking into account the relative weight of each criterion.

Cost Benefit Analysis

Cost Benefit Analysis is another tool which has been extensively used for adaptation selection and prioritization. Cost Benefit Analysis can be extremely valuable in community-based adaptation by helping communities and program staff to think through the costs and benefits of different program options, and targeting resources towards achieving "outcomes", rather than "outputs" (Chadburn et al., 2010). It offers a useful framework for organizing information about the consequences of alternative actions for addressing climate change (Munasinghe, 2007).

In addressing problems associated nature conservation policy, Diez and Etxano (2008) suggest that MCA is a better tool than Cost Benefit Analysis. Ananda and Herath (2003) also argue in favor of MCA against Cost Benefit Analysis after a critical evaluating of its application in forest decision Based on Phillips and Stock's (2003) study, the following are listed as the attributes of MCA: MCA can capture any set of criteria, monetary and non-monetary, MCA combines social and technical processes, MCA provides an analytical structure for comparing monetary and non-monetary outputs, In MCA, human judgement is required to establish relative weights of the criteria, MCA graphs, which are typical outputs, aid understanding, MCA provides methods for discovering the key advantages and disadvantages of an option, and the important ways it differs from other options. While Cost Benefit Analysis focuses on efficiency, MCA does not impose limits on the forms of criteria, allowing for consideration of social equity (Munansinghe, 2007). In many cases, paucity of data makes the use of MCA a more realistic and practicable option. To allow for application prices Cost Benefit Analysis requires effects to be measured quantitatively but MCA can be broken into three steps (van Pelt, 1993): One that requires quantitative data, one that uses only qualitative data and a third that handles both simultaneously.

Cost Effectiveness Analysis

Cost-effectiveness is generally more applicable to individual project decisions that are applying decision rules or procedures which have already been determined in policy, strategic, or program decisions. Cost-effectiveness on the adaptation side might be used when, under different climate change scenarios, a required minimum level of a public good or service (e.g., flood protection) is specified and the option to deliver this good at the lowest cost is sought (Boardman et al., 1996). The main target of CEA is to find the lowest cost option to achieve a specified objective.

4. MULTI-CRITERIA ANALYSIS

Multi-criteria analysis (MCA) is now been adopted as an efficient decision-making tool in different areas, notably where there is a choice to be made between competing options. In policy formulation, it provides an option for policy makers to have a detailed and structured list of negative and positive effects of program or policy through the use of different techniques. Its main goal is to aid decision making in selecting the 'best' alternative from the number of feasible choice-alternatives under the presence of many criteria and diverse criterion priorities' (Jankowski, 1995). Every MCA technique has common procedures, which are called a general model (Jankowski, 1995). This procedure includes the following actions: deriving a set of alternatives; deriving a set of criteria; estimating impact of each alternative on every criterion to get criterion scores; formulating the decision table with use of the discrete alternatives, criteria and criterion scores; specifying decision-makers preferences in the form of criterion weights; aggregating the data from the decision table in order to rank the alternatives ; making the final recommendation in the form of either one alternative, reduced number of several 'good alternatives', or a ranking of alternatives from best to worst.

MCA as a decision support technique aids decision-makers to evaluate resource allocation issues. It is now increasingly being used in the policy arena, often as an alternative for cost-benefit analysis and cost-effectiveness analysis (CEA) (Brouwer and van Ek, 2004). According to Perez-Soba et al. (2008), it has three key components: a number of alternative plans or options that require evaluation; a set of criteria by which the alternatives are to be judged; and a method for ranking the alternatives based on how well they satisfy the criteria.

There are many MCA techniques (Table 8) but a key feature of all is the emphasis on judgment of the decision making team in establishing objectives and criteria and judging the contribution of each option to each performance criterion. MCA techniques can be used to identify a single most preferred option, rank options, short-list a limited number of options for subsequent detailed appraisal, or simply distinguish acceptable from unacceptable possibilities.

TABLE 8 EXAMPLES OF MCA TECHNIQUES

MCA technique	Strength	Weakness
Analytic Hierarchy Process (AHP)	Most reliable MCA method. Easy to interpret. Efficient for project and policy evaluation (Macharis et al., 2004). Intuitive and flexible over other methods. Helps evaluates measures and alternatives. Helps capturing both subjective and objective evaluation measures and alternatives. Pair-wise comparison is easy to understand. Group decision is supported through consensus by calculating geometric mean of the individual pair-wise comparisons (Zahir, 1999). Reduces bias in decision-making. Offers effective means in situations of uncertainty and risk through derivation of scale where measures do not exist (Millet and Wedley, 2002).	Irregularities can occur in ranking. Compensation between good scores on some criteria and bad scores on other criteria can occur. Pair-wise comparison may become so large (n(n-1)/2) that it becomes a lengthy task (Macharis et al., 2004). Difficult to implement with many criteria.
Goal programming	Simple and easy to use. Handles large number of variables, constraints and objectives.	Use of software may be difficult to understand.
PROMETHEE	Provides a complete ranking from best to worst (Macharis et al., 2004). Unlike in AHP, loss of important information which occurs through aggregation does not occur.	It is complicated as it involves three steps- the PROMETHEE 1, the PROMETHEE II and the GAIA (Geometrical Analysis for Interactive Aid) plane. Different types of farming techniques. It does not provide decomposition of problem and building of hierarchy. Evaluation becomes possible when criteria are more than seven. No specific guidelines to determine weight (Macharis et al., 2004)
TOPSIS	Relatively simple, gives cardinal ranking, rational	
ELECTRE	Use of pair-wise comparisons of alternatives	Only expresses preferred alternative but not by how much.

Sources: Modified from Malczewski et al. 1997.

4.1 Conditions for selecting MCA techniques

According to DCLG (2009) and Stewart (2009) the criteria to take into consideration in selecting MCA techniques are: (1) Transparency, (2) Internal consistency and logical soundness, (3) Ease of use, (4) Data requirements, (5) Software availability, where needed (6) Realistic time and manpower resource requirements for the analysis. Table 9 presents the application of multi-criteria techniques in various fields showing its versatility and robustness.

TABLE 9: MULTI-CRITERIA ANALYSIS APPLICATION IN VARIOUS FIELDS

MCA Method	Criteria	Region	Decision problem	Field of application	Reference
Analytic Hierarchy Process (AHP)	Maximization of net benefit, maximization of area, resources availability	Thailand	Selection of the best irrigation plan	Irrigation management	Mainuddin et al., 1997
AHP	Environmental performance, Political acceptability, Feasibility of implementation (sub-criteria, direction contribution to GHG emissions, indirect environmental effects, cost efficiency, competitiveness, equity, flexibility, stringency, implementation network capacity, administrative feasibility, financial feasibility,	Trinidad and Tobago	Finding the most appropriate policy instrument for GHG-emission mitigation	Climate change	Blechinger and Shah, 2010
AHP, PROMETHEE	Cost, economic, social, environmental factors.	Greece	Selection of the best water project	Water management	Anagnostopoulos, 2005
Multi-Attribute Value Theory (MAVT)	Yield, canopy opening, species composition	Malaysia	Determining the most efficient method in forest management	Forest management	Huth et al., 2004
AHP	Rainfall, elevation, water network, road network, nectar, pollen	Malaysia	Determining land suitability of bee zones.	Agriculture/land suitability	Maris et al., 2008
AHP	Number of duck species, wader species, passerine species	Sweden	Conservation site selection	Ecological evaluation	Anselin et al., 1989
AHP	Local inhabitants' resource requirements, tourism and scientific research, environmental quality, accessibility	China	Buffer zone design for protecting endangered bird species.	Nature reserve	Li et al., 1999
AHP	Climate impact in 5 years, climate impact in 10 years,	Iran	Identification of the most	Water resources	Al-Zubi,

MCA Method	Criteria	Region	Decision problem	Field of application	Reference
	climate impact in 20 years		impacted area(local, national and regional) when hit by climate change	management (climate change impact)	2009
MAVT	Area, species representation, boundary length, protects imperiled local-scale species, vulnerable and declining bird species, coarse-scale and regional-scale aquatic species, plant communities, vegetation types, geoclimatic classes, aquatic habitats, focal species	USA	Site selection for selected animals and determination of site vulnerability	Conservation	Noss et al., 2002
MAVT	Biodiversity, habitat loss, exposure to human activities, endemism and conservation status of bird species	Ecuador	Prioritizing ecosystem for conservation	Conservation planning	Sierra et al., 2002
AHP	Natural value of coastal environment, value for commercial exploitation, recreational value, accessibility and potential disturbance, natural value of marine environment	Italy	Suitability of marine areas for different uses and levels of protection	Marine area protection	Villa et al., 2002
MAVT, NDS, computation, TOPSIS (Technique for Order Preference by Similarity to Ideal Solution	Number of species, total species rarity, total site richness, total site rarity	Crete	Identification of the best reserve among a set of alternatives.	Nature reserve	Memtsas, 2003
AHP	Conservation value, business investment, recreation visitor days, extent of river red gum, number of bird species	Australia	Identification of the best planning option in wetland management	Wetland management	Herath, 2004
MAVT	Keepers jobs, conservation jobs, other jobs, tourism, hunting, grants, taxes, protected species, protected areas, access regulations, education, research, community viability, management, tradition, enjoyment by owner, enjoyment by others, heather	UK	Evaluating stakeholders preferences in human-wildlife management	Wildlife management	Redpath et al. 2004

MCA Method	Criteria	Region	Decision problem	Field of application	Reference
	cover, heather burns, access routes, tree cover, grazed area, appearance, vegetation, vertebrates, invertebrates, red grouse, raptors, fox, corvid and stoats, hares, sheep, dear, waders and other birds				
AHP	Population, housing, socio-economic status, physical distance	Iran	Identification of level of contribution of selected indicators to people's vulnerability	Natural hazard management	Bronowicz and Maita, 2007
Compromising programming	Cost, public appraisal, political impact quantity of water, health impact, flexibility, water demand control, time of water shortage, population impact	Iran	Selecting water and wastewater management options	Water management	Abrishamchi et al., 2005

Source: Compiled by authors

No matter what type of MCA technique is applied, they tend to give feedback about judgments made by different stakeholders involved in a decision-making process. They are also capable of handling judgment or decisions that involve many criteria. In terms of weaknesses, since judgment is based on individual opinions, result may be subjective. There is tendency for the general opinion of people not to have been represented well by the stakeholders. There is inconsistency in value judgments. For example, CO2- cost trade-offs might be expressed in various ways by different agencies consequently resulting in contradiction or difficulty when comparing the different views (Hobbs and Horn, 1997).

4.2 The Analytic Hierarchy Process (AHP)

AHP, one of the MCA methodologies is the widely used (Teknomo, 2006). It was developed by Thomas Saaty (1990) and has been applied to situations that involve decision-making in both the private and public sector. It is very straightforward and comprehensive, making the decision evaluation easy to communicate to relevant stakeholders. The AHP models a decision making problem and allows the inclusion of tangible and intangible objects (Mu, 2005). The top element of the hierarchy is the goal for the decision model (Figure 3). This makes possible the structuring of a multi-dimensional problem into a hierarchical tree with criteria and alternatives. Opinion is extracted during the evaluation process using pair-wise comparisons. In a simple term, AHP process is an approach to decision-making that involves structuring multiple choice criteria into hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining the overall ranking of the alternatives (DSS Glossary, 2010). By organizing and assessing alternatives against a hierarchy of multifaceted objectives, AHP provides a proven, effective means to deal with complex decision making. AHP offers an avenue to efficiently identify and select criteria, and provide weight.

4.3. Application of AHP in selecting alternatives

The AHP has been widely applied in the literature. While some if its advantages are extensively discussed in the literature (e.g Vreeker et al., 2002), Yin et al. (2007) employed it in evaluating adaptation options for the water sector in the Heihe River basin of north-western China to make judgments about how effective different options are with respect to four decision criteria and to determine the relative importance of the selected criteria. The criteria selected for the study include water use efficiency, economic returns to water use, environmental effects and cost. From the results, intuitional options were ranked above engineering measures to increase water supply. Options that were preferred include economic reforms and water consumer.

In Mongolia, herders, scientific experts and authorities from local, provincial and national offices were asked to participate in evaluating adaptation options for livestock sector (Batima et al., 2007). Options that promote adaptation and developmental goals, consistency with government policies and environmental impacts were screened against some selected criteria. The options that were selected in the initial screening were then evaluated against a second choice of six additional criteria – capacity to implement, importance of climate as a source of risk, near term benefits, long-term benefits, cost and barriers. Adaptation strategies that were chosen as priorities are measures that general near- term benefit by improving capabilities for reducing the impacts of droughts and harsh winters as well as measure that produce long-term benefits through improving and sustaining pasture yields. Recommendations were made that there should be improved pasture management through traditional system of seasonal movement of herds, animals' winter survival capacity should be increased by modifying grazing schedules and there should be an increase in the use of supplemental feeds. All these examples, AHP was able to provide useful tool in prioritizing adaptation options displaying its robustness and relevance for employing it in adaptation decision making.

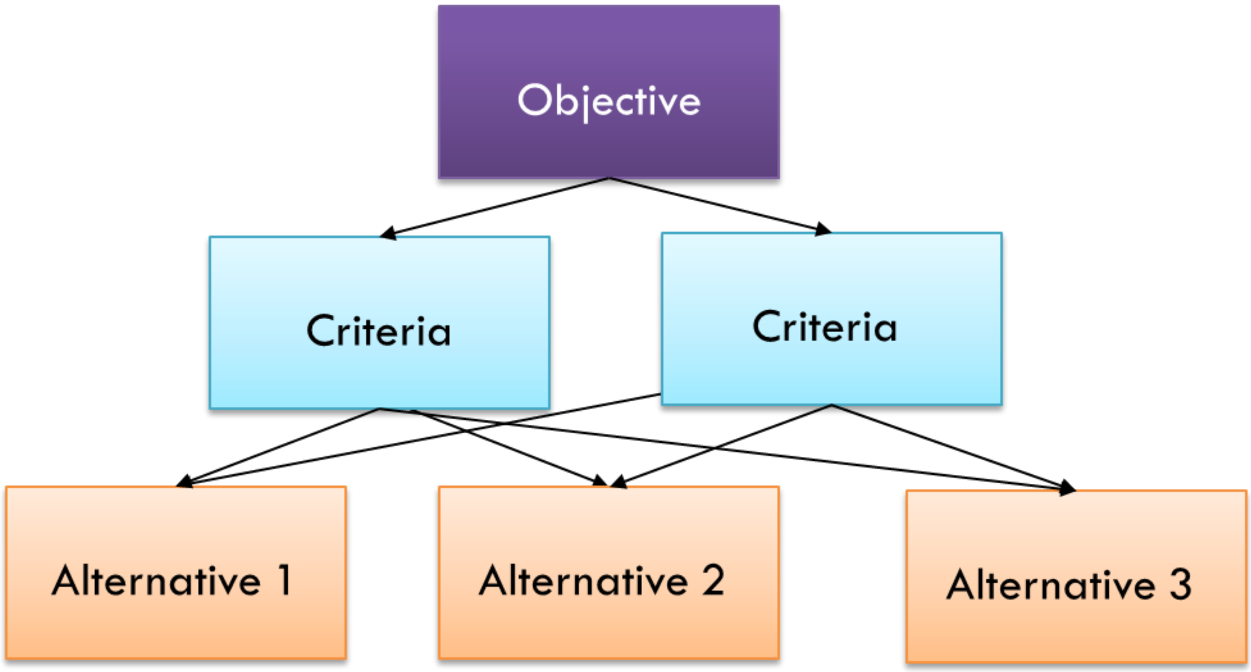

FIGURE 3 DECISION HIERARCHY

5. CONCLUSION

In this chapter, we made efforts to review various tools that are being employed for prioritizing adaptation decision making. Among all the tools, as demonstrated in this chapter, MCA has the capabilities to contribute to prioritization of adaptation actions. It has been widely used in various fields and its application hopes to continue to grow. The use of MCA is now gaining attention in climate change studies. For example, the government of Netherland recently used it to rank adaptation options in the country.

If effectively used in the Asia-Pacific region, stakeholders will find its application very robust and easy to communicate in the face of multiple options. This paper draws majority of its evaluation and conclusions from the literature. In establishing and investigation the robustness of this tool, efforts have been made in the ongoing research to use tools such as AHP in practical implementation. To this effect, the following paper in this report will employ AHP in prioritizing adaptation actions, criteria and indicators in the drought and flood-prone areas of

Gangetic Basin. From the existing literature and applications among different scholars in the field of sustainable development and climate change adaptation, it can be concluded that MCA will be a robust technique offering solution to prioritizing adaptation actions in the face of multiple alternatives and options.

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III. Prioritizing Local Adaptation Actions Using Analytical Hierarchy Process: A Case Study in the Gangetic Basin

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ABSTRACT

The research carried out in the drought and flood-prone areas of Gangetic Basin employed Analytical Hierarchical Process (AHP) to evaluate adaptation practices being practiced by communities. The methodology involved bottom-up identification of criteria employed by communities to prioritize adaptation effectiveness indicators and identification of indicators themselves through using participatory rural appraisal methods. The experience suggested that the use of AHP requires careful consideration at the local level for the reasons that the methodology, especially the pairwise rankings of criteria, indicators and practices, could be time consuming and could be difficult to comprehend by the focus group participants comprising of farming community. However, the ease of employing the method varied across the study locations. For example, community members relatively well educated, as in case of Uttaranchal state of India, could be able to better comprehend the method when compared to other locations. In terms of results, the study has indicated slight differences between male and female focus groups in the prioritization of criteria, indicators and practices. The differences between study locations could be attributed to the location specific conditions such as nature of the hazard in question, vulnerability and socio-economic condition of the respondents which determined the nature of adaptation practices being selected.

1. INTRODUCTION

Adaptation decisions taken at local level are often outputs of processing multiple criteria and objectives that local communities face day to day and hence a simple ranking procedure will not be able to capture the complex nature of adaptation decisions made at the local level. The previous chapter has clearly laid out various benefits and difficulties involved in employing multi-criteria methods and it was clear that Analytical Hierarchy Process could be a good tool to map out all the complex decisions making that goes into participatory decision making as in climate change adaptation. Despite the ability to capture complex decisions that goes into prioritizing adaptation decisions, there are not many efforts to fully utilize the robustness of AHP methodologies at the local level and especially in adaptation decision making. In order to find out the feasibility of employing AHP in local adaptation decision making, the authors have made efforts to conduct focused group discussions (FGDs) using AHP process in selected locations of the Gangetic Basin and the results are presented in this paper.

2. METHODOLOGY

During the first phase of this project, several structured questionnaire surveys were conducted to prioritize adaptation effectiveness indicators in Bangladesh, Nepal and India. The study, results of which were published as IGES publication,[1] was done entirely based on indicators and criteria identified from the literature review and expert consultations at the national level and communities were consulted at the end of the prioritization process. In FY 2013, the study team aimed to identify the adaptation effectiveness indicators in a complete bottom up manner in the Gangetic Basin. The indicators and criteria for prioritizing indicators and adaptation practices were identified from a clean slate by engaging farming communities at each study location through facilitative discussion of identifying a set of indicators and criteria without researchers influencing the decision making process of the participating group. The overall process involved in the study is depicted in Figure 4.

2.1 Survey locations

The surveys were carried out in drought- and flood-prone areas by selecting a representative location in each hazard zone. In each hazard zone, two villages were surveyed in each country through a set of focus group discussions (See the Table 10). The survey locations for drought-prone areas were the same villages where the structured questionnaire surveys were

[1] Prabhakar et al., Adaptation effectiveness indicators for agriculture in the Gangetic basin, IGES, 2013. Available at http://pub.iges.or.jp/modules/envirolib/view.php?docid=4550.

carried out in FY 2012 (please refer to the IGES report)[2]. For flood-prone areas, the villages were identified in consultation with the district administration where floods have regular recurrence. Efforts were made to identify areas where hazards are largely climatic vagaries and are free from human interventions as much as possible (for e.g., droughts and floods due to uncoordinated retention/release of water at head end of the river). Selection of FGD participants followed stratified random sampling to make sure that the group largely consisted of farming communities representing various socio-economic strata of sampled villages. The FGDs were carried out in separate gender groups in each village to avoid undue interference from other gender group as often women folks tend to support male counterparts in a public process and it is often difficult to bring out their own priorities and preferences. In each gender group, a purposive sample of economic and educational classes was ensured. The italicized numbers in parenthesis of Table 10 indicate the number of FGD participants at each study location and Table 11 spells out the names of locations in the study countries. The number of female participants was either limited or could not be accessed due to socio-cultural environment in Indian villages and due to preoccupation of the village folks.

2.2 FGD Process

The FGDs were organized in such a way that the farming community participants are able to identify indicators, criteria and practices on their own with minimum suggestive inputs from the facilitators as much as possible. The flow of the process followed is show in Figure. Each FGD consisted of two phases. In Phase I, the participants were explained about the background and purpose of the exercise and explained them the concepts involved including vulnerability, adaptive capacity, exposure, adaptation practices, effectiveness indicators, and criteria. This was followed by discussion on the demographic background of the participants. Subsequently, the participants discussed listing past climate related events, their impacts and practices that may have helped them to alleviate the impacts or the practices that they thought would have helped them to alleviate the impacts of the climatic events. By end of the phase, the group members have enlisted and ranked practices, indicators and criteria. In the Phase II, the group was taken through the detailed process of Analytical Hierarchy Process (AHP) i.e. pair-wise

[2] Adaptation effectiveness indicators for agriculture in the Gangetic basin, IGES, 2013. Available at http://pub.iges.or.jp/modules/envirolib/view.php?docid=4550.

comparison of criteria, pairwise comparison of indicators by prioritized criteria and pairwise comparison of adaptation practices by prioritized indicators.

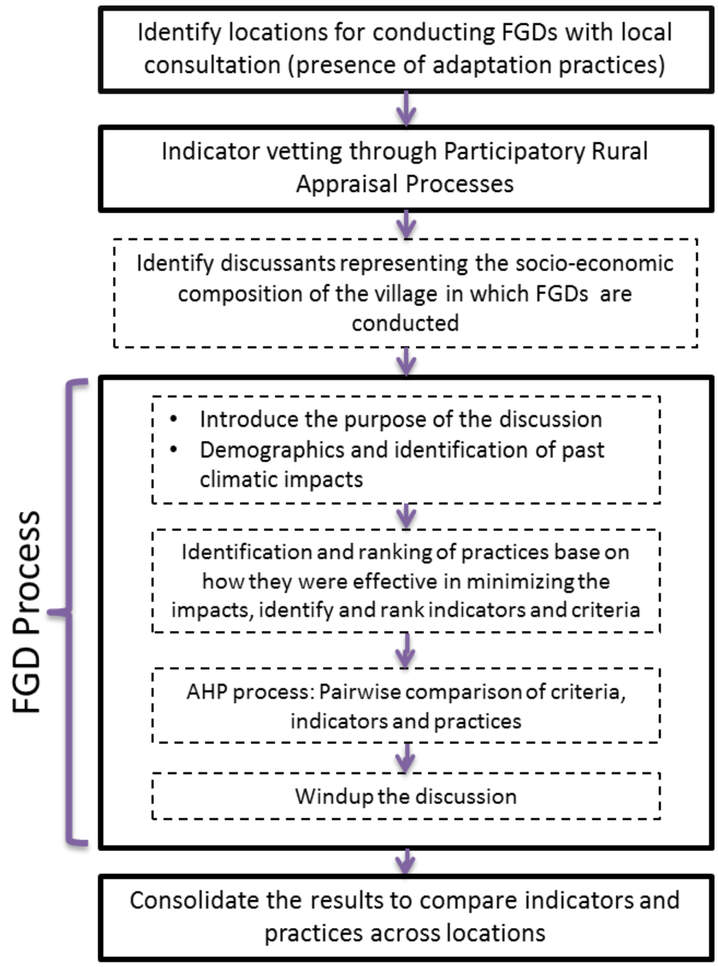

FIGURE 4 FLOW OF STEPS IN THE SURVEY METHODOLOGY

TABLE 10 DETAILS OF FOCUS GROUP DISCUSSIONS IN EACH STUDY LOCATION

Item	Details
Sampled villages	Two villages in drought-prone area and two villages in flood-prone area of Bangladesh, India and Nepal
FGD Sub-groups	One male and one female FGD per village
Number of participants per FGD	10-28 depending on the size of the village following a thumb-rule of 10% of households to be sampled.
Characteristics and respondent selection	Participants of each gender based sub-group is selected in a stratified random sample i.e. representing economic and educational classes representing each village

FIGURE 5 FOCUSED GROUP DISCUSSIONS IN PROGRESS USING AHP METHODOLOGY

Though an exhaustive list of criteria, indicators and practices were identified in the phase I of the exercise, only top ranked criteria, indicators and practices were used for AHP exercise to keep the exercise short and interesting. The results were written on a white chart posted on the wall as group members discuss pairwise rankings. The pairwise comparisons were done using Saaty's fundamental scale of judgment (See Table 12, Saaty's scale of judgment). The pairwise comparisons were done by asking the respondent to choose one level among 9 levels of strength the respondent feels the criteria/indicators/practice are related to each other in contributing to the superior objective. All the pairwise rankings were decided after the group reaches a consensus and hence represent the collective opinion of the group. The individual

FGD responses were then subjected to aggregation of individual judgment analysis that gave the collective consensus and helped identifying which groups or sections tend to prioritize what.

TABLE 11 STUDY LOCATIONS FOR CONDUCTING FGD IN DROUGHT- AND FLOOD-PRONE AREAS

Country	Drought-prone area		Flood-prone area	
Bangladesh	Maktapur, Chapainawabganj district *(10 male and female)*	Soankandi, Chapainawabganj district *(10 male and female)*	Ganganandapur, Rajbari district *(10 male and female)*	Bil Nuruddinpur, Rajbari district *(10 male and female)*
India	Selhupur, Kanpur Dehat district *(11 male and female)*	Salarpur, Kanpur Dehat district *(8 male)*	Jogipura, Udham Singh Nagar district *(21 male and 12 female)*	Gobra, Udham Singh Nagar district (9 male)
Nepal	Fattepur, Birganj district (23 male and 25 female)	Bageshwori, Birganj district (28 male and 25 female)	Manau, Bardiya district (17 male and 30 female)	Fattepur, Bardiya district (13 male and female)

TABLE 12 SAATY'S FUNDAMENTAL SCALE OF JUDGMENT

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Judgment slightly favors one criteria over another
5	Strong importance	Judgment strongly favors one criteria over another
7	Very strong importance	A criteria is favored very strongly over another
9	Extreme importance	Judgment favoring a criteria is of the highest possible order of affirmation

Demographic background of the FGD participants: All FGDs were organized among the farming communities and were organized separate for male and female groups.

3. RESULTS AND DISCUSSION

The results are discussed in the order of adaptation practices identified in each hazard zone followed by adaptation effectiveness indicators and criteria used for identifying the indicators in the same order as that of the focus group discussion proceeded. The results for this step are presented after combining the two village samples. The results from the pairwise comparison followed in the reverse order i.e. criteria for identifying the indicators, indicators themselves followed by adaptation practices for the reason that the group has already gone through the initial identification of practices, indicators and criteria and became familiar with the process.

3.1 Adaptation practices

Several adaptation practices were identified during the focused group discussions which are a mix of those already been practiced by communities for several decades and those have been introduced by external interventions. The results are presented in Table 13. Across the study locations, bore wells were preferred over surface water sources and other efficient water use options for the reason that bore wells provided reliable source of water over surface water and the water was available when it was needed. In drought-prone areas of Bangladesh, most practices were those that provide communities greater access to the available ground and surface water resources. Among the practices that will enable efficient use of water, change in cropping pattern and organic farming appeared to be the most desirable options. While male group preferred change of cropping pattern, female group preferred access to ground and surface water resources. Establishing small ponds appeared to be one of the favorable options and the group thought there is a need for greater government intervention in promoting mini ponds.

TABLE 13 ADAPTATION PRACTICES TO MITIGATE THE IMPACTS OF DROUGHT

Country	Male group	Female group
Bangladesh	Change of cropping pattern Bore well Mini ponds	Bore well Canals irrigation system Change of cropping systems Organic farming
India	Bore well Contour bunds Land leveling Drought tolerant varieties Organic manures	Bore well Land levelling Drought resistant varieties Contour bunds Road connectivity
Nepal	Bore well Pest control Alternative cropping systems Drought resistant crop varieties Zero and minimum tillage Early maturing crop varieties	Bore well Organic manures Fertilizer management Pest control Alternative cropping systems

In India, the emphasis appeared to be more on efficient use of available water though greater access to groundwater was also preferred. Options such as contour bunds, land levelling and drought tolerant varieties appeared prominently. There were negligible differences in preferences between male and female groups. However, female group tend to prefer greater access through better road connectivity which they believed would help them in seeking employment during drought. In Nepal, other than the greater access to groundwater, the communities preferred to implement several practices that increase the water use efficiency (alternative cropping systems, drought tolerant crop varieties, prudent pest and fertilizer management practices etc.). Female groups preferred organic manures and were not comfortable with changing cropping systems which was not the case with the male groups.

Among the adaptation practices in the flood-prone areas, strengthening embankments, homestead raising, early warning, flood preparedness and evacuation of assets were the most commonly preferred adaptation options (Table 14). There were very few agriculture practices identified which were limited to flood tolerant varieties and modern agriculture practices in Bangladesh and in other places the communities were of the opinion that there are no agriculture practices that could help reduce the impact of floods. In Bangladesh, the homestead raising, embankment, modern agriculture practices (e.g. flood tolerant varieties) and diversification of income during flood periods were most preferred. Here, farming is possible only for six months and for rest of the year the land is inundated by floods leading to limited income generation opportunities. Hence, seasonal migration is the major option for the male members to keep the income levels stable while women folk prefer engaging in small income generation activities in the village. However, it also becomes common that the entire family migrates for extended periods during floods. In India, where change of river course due to sand mining was a major problem, river embankment, bringing river to original course, planned de-silting of river and drainage to agriculture fields were chosen. Male groups preferred a stronger river embankment followed by changing the course of the river while the female group preferred planned desilting followed by embankment and drainage of agriculture fields.

TABLE 14 ADAPTATION PRACTICES TO MITIGATE THE IMPACTS OF FLOODS

Country	Male group	Female group
Bangladesh	Embankment Homestead raising Seasonal migration Flood tolerant varieties Women employment Income diversification	Modern agriculture practices Homestead raising Embankment Income diversification
India	Embankment with road Bringing river to the original course	Planned desilting of rivers Embankment with pitching

Country	Male group	Female group
	Drainage for agriculture fields Planned desilting of rivers Improved early warning Post-flood relief	Drainage of agriculture fields Bringing river to original course Post-flood relief
Nepal	Early warning River embankment Flood preparedness (boats, shelters etc.) Temporary embankment at local level Forest conservation and afforestation Evacuation of assets	Embankment Early warning Temporary local embankment Evacuation of assets

In Nepal, the male group preferred early warning, river embankment and flood preparedness while the female groups preferred embankment, early warning and temporary local embankment that can protect the village from low level floods and provide additional time for evacuation. Members were not aware about any specific agriculture practices that could help them reduce the impact of floods.

3.2 Adaptation effectiveness indicators

Identifying indicators was easy part for the FGD participants as the process made them think why certain practices can be evaluated as effective over others. The results are presented in Tables 15 and 16. In drought-prone areas, the major choice for adaptation effectiveness indicators was the increased availability of water. This is related to the adaptation practices chosen by the focus groups that are related to establishing infrastructure to access more ground and surface water sources. Other common indicators chosen were increase in crop production, food security, reduction in cost of production and access to services such as health and education. However, the increase in income was not the first ranked indicator as communities believe that increase in income is inevitable if all other indicators are taken care off. In a way, the focus groups thought indicators in a hierarchical fashion and the first indicator was always the most important one and sets precedence to and determines the next indicator.

There were no significant differences between male and female focus groups in Bangladesh. In India, where soil erosion is a predominant problem, the reduction in soil erosion appeared as second important option by both the gender groups. In Nepal, while the top two indicators were similar to the ones prioritized by other groups, the social indicators such as access to health and education, options for income diversification including avenues for off-season crop production were found to be preferred indicators.

TABLE 15 ADAPTATION EFFECTIVENESS INDICATORS IN DROUGHT-PRONE AREAS

Country	Male group	Female group
Bangladesh	Availability of irrigation water Reduction in cost of production Crop production Food security Number of crop production choices Increase in income Independency from loans	Availability of irrigation water Reduction in cost of production Choice of crops Food security Increase in income
India	Availability of water Reduction in soil erosion Increase in crop yield Increase in income Increase in water retention Increase in soil fertility Access to services	Availability of water Reduction in soil erosion Increase in land area (land leveling) Increase in crop yield Access to services
Nepal	Availability of water Increase in crop yield Improved health and education Reduction in cost of production Reduction in pest and diseases Off-season crop production	Availability of water Increase in crop yield Better access to services Off-season crop production Increase in soil fertility Reduction in pest and diseases Increased income level

In the flood-prone areas (Table 16), indicators such as stable living standards, reduced property loss and improved health and nutrition found significant place. Indicators reflected the nature of impacts felt at the study locations. For example, loss of land due to river erosion was a major issue which has resulted in loss of fertile cultivable land and assets such as houses along the river course at localized places along the river Kosi in the state of Uttaranchal in India. Here, floods are sporadic depending on the amount of rainfall received in the upper catchments. In the case of Bangladesh, the floods are recurrent and annual phenomenon impacting the livelihoods on regular basis continuously impacting the income and livelihoods and hence stabilizing the living standards and greater mobility for women which could help in finding employment during floods were found important. In case of Nepal, the heavy rainfall events have resulted in flash floods and landslides leading to significant loss of lives and property in 2013.[3] As a result, focus groups here have identified the lives and property saved as important indicators. In terms of gender differences, most top ranked indicators were similar between male and female groups with variations in subsequent ranked indicators.

[3] IFRC. 2013. Situation Report, Available at http://www.ifrc.org/docs/Appeals/rpts13/IBfINP19071301.pdf

For example, female groups preferred improved communication facilities and increased feeling of safety as second ranked indicators in Bangladesh and India while these indicators were given less importance by the male counterparts.

TABLE 16 ADAPTATION EFFECTIVENESS INDICATORS IN FLOOD-PRONE AREAS

Country	Male group	Female group
Bangladesh	Increase in income Stable living standard Increase in crop yield Improved communication facilities Improved women mobility Improved nutrition	Increase in crop yield Improved communication facilities Stable living standard Increase in income Improved nutrition
India	Reduction in land erosion Reduced loss of property Relief from stress Stable income Reduction in evacuation Access to drinking water	Reduction in land erosion Increased feeling of safety Reduction in loss of property Access to drinking water Safe access to school
Nepal	Lives saved Reduction in loss of property Increased awareness on floods Improved road access Stable livelihoods	Lives saved Reduction in loss of property Reduction in loss of yield Stable livelihoods Improved health

3.3 Criteria

The most difficult process in the entire exercise was in making understand the FGD participants about the meaning of criteria and in listing the criteria for prioritizing the indicators (Tables 17 and 18). This was despite adapting the sequence of identifying adaptation practices followed by effectiveness indicators and criteria. As a result, the number of criteria identified in the study locations was limited. The wording used during the group discussion was subsequently standardized while writing the paper which helped in bringing out similarity for comparison purposes across the villages and gender groups. The FGDs have indicated that the criteria for identifying adaptation effectiveness indicators could be similar across gender and hazard backgrounds though subtle differences could be found in terms of relative ranking of the criteria. The most common criteria for prioritizing indicators appeared to be easy to understand and communicate to the fellow community members. For these criteria to be met, the FGD participants felt that the indicators would have to have direct relationship with the problem that the farmers are facing so that they are able to see what is happening in the field or in their economic status. Criterion for indicators being relevant to large and diverse geographical areas and ability to bring effect on policy processes were also chosen however with less frequency. In terms of gender differences in criteria, female group tend to prefer criteria relating to ability to see and understand the impact of the adaptation practices followed by the relevance to economic wellbeing. Similar criteria were observed in both drought- and flood-prone areas.

TABLE 17 CRITERIA FOR PRIORITIZING ADAPTATION EFFECTIVENESS INDICATORS IN DROUGHT-PRONE AREAS

Country	Male group	Female group
Bangladesh	Cost effectiveness Relevant to crop production Relationship with income and economic wellbeing	Cost effectiveness Relationship with economic wellbeing Relevant to crop production
India	Relevance to the problem Easy to understand Easy to see the benefit	Easy to see the benefit Easy to understand
Nepal	Bring effect on policy Relevant to diverse areas Easy to see the benefit Easy to understand Easy to communicate	Easy to see the benefit Easy to communicate Easy to see the benefit Easy to measure Relevant to diverse areas

TABLE 18 CRITERIA FOR PRIORITIZING ADAPTATION EFFECTIVENESS INDICATORS IN FLOOD-PRONE AREAS

Country	Male group	Female group
Bangladesh	Cost effectiveness Easy to communicate Relevant to alternative income generation Relevant to crop production Relevant to stabilizing income	Cost effectiveness Relevant to crop production Easy to communicate
India	Easy to observe Prior experience	Easy to observe Prior experience
Nepal	Relevant to raising community awareness Easy to understand Easy to communicate Relevant to diverse areas	Easy to observe Easy to communicate Easy to understand

4. MULTI-CRITERIA ANALYSIS

From the previous section, it is evident that the community members had multiple criteria for prioritizing adaptation effectiveness indicators and in turn several indicators for prioritizing effective adaptation options. The methodology of Analytical Hierarchy Process (AHP) was employed to reconcile criteria and how criteria influenced the relative ranking of indicators and how practices were ranked considering multiple indicators. The hierarchical nature of criteria, indicators and practices are shown in Figure 6. Here, the ultimate goal was to identify appropriate adaptation options for drought and flood-prone areas in the study countries.

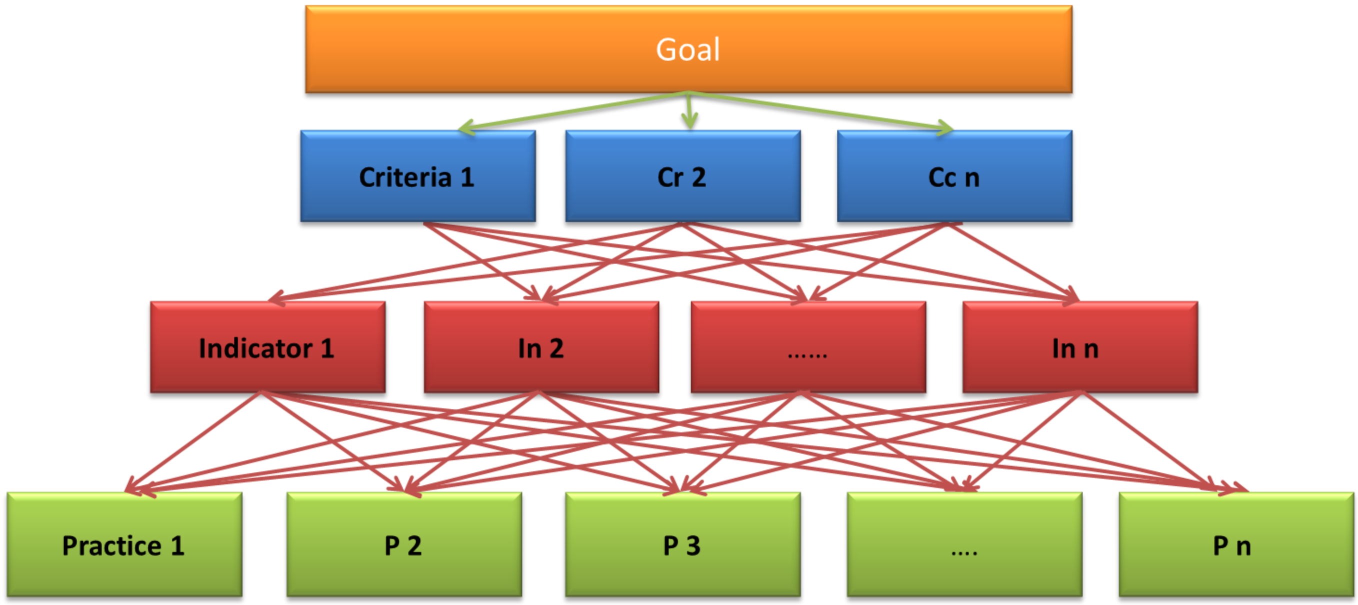

FIGURE 6 HIERARCHICAL CRITERIA AND INDICATORS INFLUENCING THE ULTIMATE ADAPTATION CHOICE MADE BY COMMUNITIES

An evaluation copy of SuperDecisions software was used for analyzing the pairwise comparisons. The software uses the AHP methodology developed by Prof Saaty (2008)[4] and it provides priority values by normalizing measurements. The software provides facility to arrange goal, criteria, indicators and practices as alternatives in hierarchical manner. For the purpose of this study, the goal was defined as identifying the most effective adaptation practice that will reduce the drought and flood impacts for agriculture communities. In the software, each hierarchy is denoted as cluster and each criteria/indicator/practice in a cluster as node. The entire set of clusters and nodes arranged in a hierarchical fashion is denoted as network (for example the entire elements depicted in Figure 6). The pairwise comparisons were made using the Saaty's relative importance scale. Keeping in view the limited time that communities could provide for focus group discussions, only a prioritized criteria, indicators and practices were put through the exercise of pairwise comparisons.

4.1 India

[4] Saaty, T.L. 2008. Decision making with the analytic hierarchy process.

In the drought-prone areas of the study location in India, the male group has prioritized two criteria (easy to understand and easy to observe), three indicators (water availability, reduction in soil erosion and increase in crop yield) and three practices (bore well, road and land levelling) for pairwise comparisons. The results of pairwise comparisons are provided in Table 19. The computed normal priority values (refers to normalized priorities for all the nodes in a cluster) for the pairwise comparison among the two criteria were 0.5 and 0.5 respectively since both were chosen as equal in importance (the limiting priority values, which refers to the entire network, for these were 0.166667 for both). Two important observations to be made here: Reduction in soil erosion was the most preferred indicator with a high priority value normalized among indicators and the practice of land leveling was found to be most effective adaptation option, as indicated by highest idealized overall priority, followed by the water availability. Interestingly, water availability was only 83% as effective as land leveling which was mainly due to the higher importance given to the reduction in soil erosion. The female focus groups have selected slightly different indicator and practice for the third choice (Table 20). For female group, the most effective adaptation practice was installation of a bore well followed by land leveling and drought resistant varieties. For them, land leveling is 47% as good as installing a bore well. The difference was due to relatively low priority given to the reduction in soil erosion compared to the male focus group.

TABLE 19 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY MALE FOCUS GROUPS IN DROUGHT-PRONE AREAS OF INDIA

Indicators	Water availability	Reduction in soil erosion	Increase in crop yield	Priorities normalized by cluster
Criteria				
Easy to understand	0.33255	0.36161	0.30583	**0.50000**
Easy to observe	0.33255	0.36161	0.30583	**0.50000**
Practices	**Bore well**	**Road**	**Land levelling**	
Water availability	0.49008	0.05875	0.71881	**0.33256**
Reduction in soil erosion	0.05921	0.19398	0.05784	**0.36161**
Increase in crop yield	0.45071	0.74727	0.22335	**0.30583**
Priorities normalized by cluster	0.40406	0.10753	0.48841	
Idealized overall priorities	**0.827290**	**0.220152**	1.0	

TABLE 20 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY FEMALE FOCUS GROUPS IN DROUGHT-PRONE AREAS OF INDIA

Indicators	Water availability	Reduction in soil erosion	Increase in land area	Priorities normalized by cluster
Criteria				
Easy to understand	0.75111	0.04363	0.20526	**0.50000**
Easy to observe	0.75111	0.04363	0.20526	**0.50000**
Practices	**Bore well**	**Land levelling**	**Drought resistant varieties**	
Water availability	0.77849	0.17993	0.04158	**0.75111**
Reduction in soil erosion	0.14457	0.30231	0.55312	**0.04363**
Increase in land area	0.21099	0.74236	0.04664	**0.20526**
Priorities normalized by cluster	0.63435	0.30071	0.06494	
Idealized overall priorities	**1.000000**	**0.474046**	**0.102372**	

The Table 21 provides the priority values from the flood-prone areas for male focus groups in India. In flood-prone areas, the number of practices chosen by the focus groups was relatively higher than in drought-prone areas partly due to the relatively higher education levels and economic status of focus groups with higher awareness levels on flood risk reduction. However, the authors could not access female folks in the flood-prone areas and hence only the results from the male focus groups were presented. Here, the focus groups have chosen prior experience as important criteria followed by easy to observe. The pairwise comparisons indicate higher preference to the criteria of prior experience, reduction in river bank erosion among the indicators and constructing permanent river embankment among the practices. Followed by river embankment, planned de-silting was 39% as good as river bank erosion. The main contributing factor to higher preference came from the higher preference given to the reduced erosion.

TABLE 21 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY MALE FOCUS GROUPS IN FLOOD-PRONE AREAS OF INDIA

Indicators	Reduction in erosion	Relief from stress	Reduced evacuation	Property saved	Stable income	Priorities normalized by cluster
Criteria						
Prior	0.62346	0.05296	0.14355	0.16000	0.02003	**0.90000**

Indicators	Reduction in erosion	Relief from stress	Reduced evacuation	Property saved	Stable income	Priorities normalized by cluster
experience						
Easy to observe	0.37205	0.26438	0.05652	0.29217	0.01488	**0.10000**
Practices	**River embankment**	**Improved drainage**	**Planned desilting**	**Early warning**	**Flood relief**	
Reduction in erosion	0.65051	0.14736	0.14736	0.02738	0.02738	**0.59832**
Relief from stress	0.60442	0.09274	0.24361	0.01873	0.04050	**0.07410**
Reduced evacuation	0.40240	0.12852	0.40240	0.04614	0.02055	**0.13484**
Property saved	0.45960	0.13609	0.33867	0.02980	0.03585	**0.17322**
Stable income	0.44780	0.13919	0.35197	0.03680	0.02424	**0.01952**
Priorities normalized by cluster	0.57661	0.13866	0.22601	0.02987	0.02884	
Idealized overall priorities	**1.000000**	**0.240479**	**0.391973**	**0.051808**	**0.050016**	

4.2 Nepal

The chosen criteria, indicators and practices for pairwise comparison are presented in Table 22. For the male focus groups, the results indicated that the installation of pump set for pumping groundwater was the most effective adaptation option and harvesting surface water was 98% as effective as installing a groundwater pump and hence is considered as equal as the first option. Since surface water availability is sporadic, the harvesting was found to be not as reliable as dependency on the groundwater; however, the surface water harvesting required less investment than pumping groundwater. In terms of indicators, availability of water was chosen as most important followed by the increase in crop yield. Among the criteria, interestingly, being able to bring impact on policy came prominent followed by other criteria.

TABLE 22 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY MALE FOCUS GROUPS IN DROUGHT-PRONE AREAS OF NEPAL

Indicators	Availability of water	Increase in crop yield	Escape drought	Cost effectiveness	Less investment	Priorities normalized by cluster
Criteria						
Bring effect on policy	0.65025	0.17192	0.09684	0.03228	0.04870	**0.77778**

Indicators	Availability of water	Increase in crop yield	Escape drought	Cost effectiveness	Less investment	Priorities normalized by cluster
Replicable	0.62720	0.23506	0.08583	0.02597	0.02594	**0.11111**
Easy to see the benefit	0.65260	0.20489	0.06511	0.03319	0.04421	**0.11111**
Practices	**Pump for groundwater**	**Harvesting surface water**	**Pest control**	**Alternative crops**	**Drought resistant varieties**	
Availability of water	0.40747	0.37738	0.02239	0.05954	0.13322	**0.64795**
Increase in crop yield	0.36449	0.42792	0.09860	0.03772	0.07126	**0.18260**
Escape drought	0.40262	0.32979	0.08745	0.09113	0.08901	**0.09209**
Cost effectiveness	0.27410	0.19745	0.17222	0.11314	0.24308	**0.03168**
Less investment	0.19451	0.39396	0.20999	0.01780	0.18375	**0.04568**
Priorities normalized by cluster	0.38522	0.37729	0.05561	0.05826	0.12362	
Idealized priorities	**1.0000**	**0.979396**	**0.144369**	**0.151234**	**0.320907**	

Among the female focus group (Table 23), the indicators such as easy access to water, ability to produce off-season crops and cost effectiveness followed the first two ranked indicators, which differed from the male focus groups. Among the indicators, availability of water has satisfied most criteria followed by easy access to water and ability to produce off-season crops. The installation of groundwater pump remains the most popular choice among the community members. However, women focus groups tend to evaluate the adaptation practices close to each other compared to men where the choices were clear. As a result, the differences between top three practices were less. Harvesting surface water was 94% as good as installation of bore well pump, green manures are 84% as good as groundwater pump followed by modern fertilizer and pest management strategies.

TABLE 23 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY FEMALE FOCUS GROUPS IN DROUGHT-PRONE AREAS OF NEPAL

Indicators	Availability of water	Increase in crop yield	Easy access to water	Off-season crop production	Cost effectiveness	Priorities normalized by cluster
Criteria						
Easy to see benefits	0.50687	0.10542	0.17918	0.10489	0.10363	**0.71471**
Easy to	0.60946	0.06847	0.12842	0.15266	0.04100	**0.06680**

Indicators	**Availability of water**	**Increase in crop yield**	**Easy access to water**	**Off-season crop production**	**Cost effectiveness**	**Priorities normalized by cluster**
communicate						
Easy to understand	0.52380	0.10330	0.13923	0.10278	0.13089	**0.21849**
Practices	**Pump for groundwater**	**Harvesting surface water**	**Green manures**	**Fertilizer management**	**Pest management**	
Availability of water	0.34621	0.34621	0.10412	0.15708	0.04638	**0.51742**
Increase in crop yield	0.42824	0.39157	0.07566	0.07784	0.02668	**0.10249**
Easy access to water	0.10534	0.10366	0.52444	0.04963	0.21692	**0.16706**
Off-season crop production	0.10534	0.10366	0.52444	0.04963	0.21692	**0.10762**
Cost effectiveness	0.17573	0.06333	0.20412	0.47997	0.07684	**0.10540**
Priorities normalized by cluster	0.27049	**0**.25442	0.22720	0.15348	0.09442	
Idealized priorities	**1.0000**	**0.940595**	**0.839961**	**0.567431**	**0.349066**	

In flood-prone areas (Tables 24 and 25), the practices and indicators identified were different from the drought-prone areas. Here, saving lives, land and property appeared to be the primary objective due to the physical impact of the recurrent floods. The male focus groups have identified easy to see impacts, easy to understand and easy to replicate as important criteria for pairwise comparison. Easy to see impacts of adaptation practices was the most important criteria followed by easy to replicate and easy to understand. Most adaptation effectiveness indicators showed similar priority values (normalized by the cluster) with highest for the indicator of amount of land saved. Among the practices, none of the practices identified were fall under agriculture but focus on saving lives and assets which appeared to be the most important priority throughout the flood-prone areas in Nepal. Lifesaving activities here constitute the emergency medical services and safeguarding the most vulnerable such as women and children. Since the overarching goal is saving lives and property, the early warning ranked the first, as per the idealized overall priority value. Erecting embankment and lifesaving activities were 67% and 57% as effective as early warning respectively.

TABLE 24 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY MALE FOCUS GROUPS IN FLOOD-PRONE AREAS OF NEPAL

Indicators	Human lives saved	Land saved	Property saved	Raise in awareness	Easy access	Priorities normalized by cluster
Criteria						
Easy to see impacts	0.39946	0.01970	0.05073	0.39946	0.13066	**0.78701**
Easy to understand	0.27775	0.14711	0.13198	0.16540	0.27775	**0.04571**
Easy to replicate	0.18459	0.02051	0.06990	0.62909	0.09592	**0.16728**
Practices	**Lifesaving activities**	**Early warning**	**Embankment**	**Transportation during floods**	**Temporary shelters**	
Human lives saved	0.11164	0.50906	0.18915	0.13130	0.05886	**0.20721**
Land saved	0.24585	0.10209	0.59207	0.04239	0.01760	**0.36535**
Property saved	0.25578	0.25578	0.25578	0.17653	0.05612	**0.24456**
Raise in awareness	0.31260	0.29654	0.28410	0.05469	0.05207	**0.12803**
Easy access	0.09622	0.29707	0.19427	0.35268	0.05976	**0.05486**
Priorities normalized by cluster	0.35795	0.02566	0.05765	0.42717	0.13157	
Idealized priorities	**0.567154**	**1.00000**	**0.669396**	**0.350422**	**0.150161**	

Among the female focus groups (Table 25), the most important criteria was easy to see the impact of the adaptation practices in terms of indicators followed by easy to understand the indicators and easy to communicate. The indicator that satisfied most of these criteria was the number of human lives saved followed by protection of livelihoods and protection of property as indicated by the priority values. As a result, the indicator human lives saved ranked first followed by protection of livelihoods and protection of livestock. It can be seen that the order of indicators differed between both gender groups wherein female groups preferred number of human lives saved while the male focus groups preferred the amount of land saved as an important indicator as revealed by the priority values normalized by cluster. Among the practices, evacuation of livestock was ranked first followed by evacuation of assets and erecting river embankment. Evacuation of assets and river embankment were 82% and 72% as effective as evacuation of livestock in terms of providing adaptive capacity to community members.

TABLE 25 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY FEMALE FOCUS GROUPS IN FLOOD-PRONE AREAS OF NEPAL

Indicators	Human lives saved	Protection of property	Protection of livestock	Protection of crops	Protection of livelihoods	Priorities normalized by cluster
Criteria						
Easy to see effect	0.39238	0.12891	0.18207	0.13557	0.16107	**0.76076**
Easy to communicate	0.49316	0.14038	0.17622	0.01729	0.17296	**0. 04805**
Easy to understand	0.62340	0.09102	0.08538	0.02055	0.17965	**0.19119**
Practices	**River embankment**	**Crop protection**	**Evacuation of assets**	**Evacuation of livestock**	**Local embankment**	
Human lives saved	0.25344	0.02138	0.33762	0.29518	0.09239	**0.44139**
Protection of property	0.26187	0.02032	0.13167	0.52109	0.06506	**0.12221**
Protection of livestock	0.06563	0.02181	0.12526	0.52502	0.26227	**0.16331**
Protection of crops	0.62314	0.02194	0.06109	0.05090	0.24293	**0.10790**
Protection of livelihoods	0.08664	0.04180	0.46842	0.26429	0.13884	**0.16519**
Priorities normalized by cluster	0.23613	0.02475	0.26954	0.32886	0.14071	
Idealized priorities	**0.718025**	**0.075271**	**0.819617**	**1.000000**	**0.427856**	

4.3 Bangladesh

In the drought-prone areas of Bangladesh (Tables 26 and 27), male focus groups have identified cost effectiveness as important criteria followed by relation to income and relation to crop production. In terms of indicators, availability of irrigation water was given highest priority followed by ability to choose diverse crop types able to be cultivated as second indicator and increase in income as third. Availability of irrigation water was able to satisfy most criteria followed by choice of crops. Male group was of the opinion that access groundwater will provide them stable water for irrigation leading to be able to cultivate diverse crop types for most part of the year and provides higher income. Hence, the economic indicators were mostly at the end of their hierarchical thinking of how one indicator will lead to another indicator. The use of groundwater as an adaptation option was able to fetch high rank among all other practices due to it being able to provide greater availability of water for most part of the year. Among other practices, only practicing crop rotation using less water consuming crops was as much as 30% effective as having access to groundwater.

TABLE 26 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY MALE FOCUS GROUPS IN DROUGHT-PRONE AREAS OF BANGLADESH

Indicators	Availability of irrigation water	Increase in yield	Choice of crops	Increase in income	Independency from loan	Priorities normalized by cluster	Idealized priorities
Criteria							
Cost effectiveness	0.59315	0.05619	0.22791	0.09625	0.02651	0.76076	
Relates to production	0.59315	0.05619	0.22791	0.09625	0.02651	0.04805	
Relates to income	0.43224	0.11250	0.16184	0.22509	0.06832	0.19119	
Practices							
Crop rotation	0.15985	0.21764	0.13401	0.55678	0.13501	0.21034	**0.295464**
Groundwater	0.79173	0.69096	0.77308	0.29106	0.58416	0.71189	**1.000000**
Farm ponds	0.04841	0.09140	0.09291	0.15216	0.28083	0.07778	**0.109255**
Priorities normalized by cluster	**0.56239**	**0.06695**	**0.21527**	**0.12088**	**0.03450**		

The criteria for prioritizing indicators were similar between male and female focus groups though the relative ranking varied (Table 27). Female focus group identified the relationship with crop production as most preferred criteria followed by relationship with economic wellbeing and cost effectiveness of measuring the indicators. There were similarities among the indicators; the female group has chosen irrigation water availability as most important indicator which is same for the male group. The female group was of the opinion that the irrigation water availability is easy to measure, is related to their economic wellbeing and is directly related to the crop production. Among the practices, the group believed that greater access to groundwater will lead to increase in crop yield, income and food security whose combined impact is much higher than using the surface water and crop rotation which appears to agree with the choice made by the male group. According to the group, the groundwater provides a secure source of water giving them choice to choose different types of crops and be able to cultivate throughout the year.

In flood-prone areas (Tables 28 and 29), the choice of criteria, indicators and practices differed considerably compared to the drought-prone areas. In Bangladesh, issues such as communication, access, income generation during flood season appeared to be major issues dominating the choice. Since male household members resort to short and long-distance seasonal migration during floods, it is imperative for the female members to safeguard the household and be able to engage in some kind of income generating activities which came out clearly during the focus group discussions. Among the male focus group, the predominant criteria for prioritizing the indicators were the ability to communicate the indicators followed by cost effectiveness of measuring the indicators. Interestingly, the criteria for indicators being related to the alternative income generating opportunities are least important criteria for male members. Among the indicators, both improved communication and increase in crop yield stood at par followed by increase in income and balanced nutrition. Women mobility appeared as fifth most important indicator. Construction of flood embankment was able to satisfy most indicators than other practices. Women employment during flood season is 21% as effective as erecting embankment.

TABLE 27 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY FEMALE FOCUS GROUPS IN DROUGHT-PRONE AREAS OF BANGLADESH

Indicators	Choice of crops	Irrigation water availability	Food security	Increase in yield	Increase in income	Priorities normalized by cluster	Idealized priorities
Criteria							
Cost effectiveness	0.29700	0.07608	0.14088	0.17778	0.30826	0.29528	
Relates to economic wellbeing	0.03655	0.62968	0.05552	0.19350	0.08475	0.30665	
Relates to production	0.21680	0.36122	0.12300	0.10702	0.19196	0.39807	
Practices							
Groundwater	0.42857	0.77849	0.53949	0.79276	0.79173	0.69273	1.000000
Pond water	0.42857	0.17993	0.37406	0.13122	0.04841	0.21390	0.308780
Crop rotation	0.14286	0.04158	0.08645	0.07602	0.15985	0.09336	0.134774
Priorities normalized by cluster	**0.18521**	**0.35935**	**0.10759**	**0.15443**	**0.19343**		

TABLE 28 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY MALE FOCUS GROUPS IN FLOOD-PRONE AREAS OF BANGLADESH

Indicators	Increase in income	Increase in yield	Improved communication	Women mobility	Balanced nutrition	Priorities normalized by cluster	Idealized priorities
Criteria							
Cost effectiveness	0.01870	0.26675	0.56415	0.10507	0.04533	0.19119	
Communicability	0.13698	0.42256	0.35607	0.05946	0.02493	0.76076	
Relates to alternative income	0.05602	0.13169	0.46560	0.32585	0.02084	0.04805	
Practices							
Embankment	0.77849	0.78701	0.78701	0.78701	0.78701	0.78607	**1.000000**
Seasonal migration	0.04158	0.04571	0.04571	0.04571	0.04571	0.04526	**0.057574**
Women employment	0.17993	0.16728	0.16728	0.16728	0.16728	0.16867	**0.214580**
Priorities normalized by cluster	**0.11048**	**0.37879**	**0.40112**	**0.08098**	**0.02864**		

TABLE 29 PRIORITY VALUES FOR CRITERIA, INDICATORS AND PRACTICES BY FEMALE FOCUS GROUPS IN FLOOD-PRONE AREAS OF BANGLADESH

Indicators	Increase in yield	Increase in income	Improved communication	Balanced nutrition	Homestead elevation	Priorities normalized by cluster	Idealized priorities
Criteria							
Cost effectiveness	0.19782	0.06342	0.39385	0.03478	0.31014	0.04158	
Communicability	0.15727	0.11745	0.20679	0.11813	0.40036	0.77849	
Relates to alternative income	0.05709	0.26877	0.53927	0.03356	0.10131	0.17993	
Practices							
Modern agriculture knowledge	0.23991	0.05308	0.04158	0.17993	0.15140	0.12257	**0.158174**
Embankment	0.70149	0.78549	0.77849	0.77849	0.79683	0.77492	**1.00000**
Income diversification	0.05860	0.16143	0.17993	0.04158	0.05178	0.10251	**0.132279**
Priorities normalized by cluster	**0.14093**	**0.14243**	**0.27439**	**0.09945**	**0.34280**		

There were no significant differences between female and male members of the household in terms of the most important criteria (Table 29). Interestingly, in terms of indicators, female members measured the effectiveness of adaptation options in terms of elevation of their house. The effective the adaptation higher the elevation communities will be able to raise their house. Height of the house appeared to well reflect the economic wellbeing as well as provide higher social capital since these households will be able to accommodate other households during the floods. The second most important indicator appeared to be the improvement in communication during floods, improvement in terms of communicating the early warning, income opportunities and preparedness measures. Interestingly, increase in crop yield and balanced nutrition received least priority. Though female group were not sure about what kind of modern agriculture practices may be available, they opined that the modern agriculture practices should be able to reduce the crop loss and hence is the second most important option after constructing embankment. The modern agriculture knowledge and income diversification during floods would be 16% and 13% as effective as erecting the embankment.

5. CONCLUSIONS

The previous chapter has clearly laid out various benefits and difficulties involved in employing multi-criteria methods and it was clear that Analytical Hierarchy Process could be a useful tool to map the complex decisions making process that goes into adaptation. In order to find out the feasibility of employing AHP in local adaptation decision making, the researchers have made efforts to conduct focused group discussions using AHP process in various selected locations of the Gangetic Basin and the results are presented in this paper. The surveys were carried out in drought and flood-prone areas by selecting a representative location in each hazard zone. In each hazard zone, two villages were surveyed in each country through a set of focus group discussions. The FGDs were organized in such a way that the farming community participants are able to identify indicators, criteria and practices on their own with minimum suggestive inputs from the facilitators as much as possible. The pairwise comparisons were done using Saaty's fundamental scale of judgment. All the pairwise rankings were decided after the group reaches a consensus and hence represent the collective opinion of the group and the results were analyzed by using SuperDecisions software.

Across the study locations, bore wells were preferred over surface water sources and other efficient water use options for the reason that bore wells provide reliable source of water over surface water and is available when it is needed. In drought-prone areas of Bangladesh, most practices are those that will provide them greater access to the available ground and surface water resources. Among the practices that will enable efficient use of water, change in cropping pattern and organic farming appeared to be the most desirable options. Differences identified across study locations could be attributed to the location-specific conditions such as local vulnerabilities, socio-economic conditions and other prevailing factors including the differences in experiences of communities with the practices evaluated. In flood-prone areas, the emphasis was on saving assets and lives and in most study locations indicators such as access to alternative employment generation and women employment found place among the indicators chosen by the communities. Though migration appeared as an adaptation option in Bangladesh, it proved to be least effective compared to construction of embankments and women employment through identifying alternative employment options for women folks. In terms of gender differences, though both gender groups tend to identify similar set of criteria, practices and indicators, the relative ranking of options did differ between gender groups. Employing AHP appeared to be a challenging task for eliciting responses from farming communities and it took great efforts by the group discussion facilitators. However, the ease of process differed between study locations depending on the education status of the participants. In addition to be able to evaluate adaptation decisions, AHP provided a valuable learning tool for the participants in understanding how to evaluate adaptation options.

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