USAID
FROM THE AMERICAN PEOPLE

FROM ASSESSMENT TO IMPLEMENTATION: APPROACHES FOR ADAPTATION OPTIONS ANALYSIS

JANUARY 2013

This report is made possible by the support of the American people through the U.S. Agency for International Development (USAID). The contents are the sole responsibility of Tetra Tech ARD and do not necessarily reflect the views of USAID or the U.S. Government.

ARCC

African and Latin American
Resilience to Climate Change Project

This report was prepared by Aarjan Dixit of World Resources Institute through a subcontract to Tetra Tech ARD.

Cover Photo: Focus Group Discussion, Uganda, 2012.

This publication was produced for the United States Agency for International Development by Tetra Tech ARD, through a Task Order under the Prosperity, Livelihoods, and Conserving Ecosystems (PLACE) Indefinite Quantity Contract Core Task Order (USAID Contract No. AID-EPP-I-00-06-00008, Order Number AID-OAA-TO-11-00064).

Tetra Tech ARD Contacts:

Patricia Caffrey
Chief of Party
African and Latin American Resilience to Climate Change (ARCC)
Burlington, Vermont
Tel.: 802.658.3890, Ext. 2238
Patricia.Caffrey@tetratech.com

Anna Farmer
Project Manager
Burlington, Vermont
Tel.: 802-658-3890
Anna.Farmer@tetratech.com

FROM ASSESSMENT TO IMPLEMENTATION: APPROACHES FOR ADAPTATION OPTIONS ANALYSIS

AFRICAN AND LATIN AMERICAN RESILIENCE TO CLIMATE CHANGE (ARCC)

JANUARY 2013

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

CBA	Cost-benefit analysis
CEA	Cost-effectiveness analysis
DCLG	Department for Communities and Local Government
ISET	Institute for Social and Environmental Transitions
MCA	Multi-criteria analysis
MEA	Multilateral environmental agreements
NAPA	National Adaptation Plans of Action
PSD	Participatory scenario development
SLD	Shared learning dialogue
UKCIP	United Kingdom Climate Impacts Program
UNFCCC	United Nations Framework Convention on Climate Change
WRI	World Resources Institute

EXECUTIVE SUMMARY

As adaptation to climate change takes a central role in development policy and practice, a great deal of attention has been placed on documenting vulnerability and risk of impacts. However, there is limited experience in linking these vulnerability assessments to the identification and selection of options for climate change adaptation activities. This paper presents principles that should be at the center of adaptation options analysis, along with tools that will introduce rigor into the selection process.

The causes of human vulnerability to climate change are inherently complex. Many factors contribute to it, and these factors are mediated by institutions both formal and informal. As a result, under the uncertainty and imperfect information associated with adaptation, traditional predict-and-plan approaches to making decisions may not work well. This situation calls for particular care in designing effective activities to adapt to climate change.

Adaptation can include both discrete activities, which are designed to directly address climate based vulnerability, and integrated activities, which seek to strengthen the robustness to climate change of a particular development activity. Discrete activities often are based on a vulnerability assessment which should begin to explicitly identify options. Integrated activities, on the other hand, need to deal with a variety of other existing stresses and thus operate under a risk management framework that helps decision makers understand what risks are relevant, what risks need minimizing, and what residual risks to live with.

As a result, across both types of adaptation activities, options analysis must be grounded in a particular decision context, and the processes for selecting options must be transparent, systematic, and inclusive while laying out all assumptions openly. Participation of multiple stakeholders — including people affected by climate impacts — at multiple points of adaptation decision making should be a central feature of all options analysis processes. Participation lays the foundations for making choices about risks and vulnerabilities that may create winners and losers. However, participation is not a panacea to all the challenges of adaptation decision-making and should be combined with additional analytical approaches to identifying as well as selecting options.

Formal decision making tools like decision rules, cost benefit analysis, cost effectiveness analysis, and multi-criteria analysis can be helpful for analyzing adaptation options. Cost benefit and cost effectiveness can help assign monetary values to adaptation options. Multi-criteria analysis and other types of decision rules can help decision-makers consider a wider variety of non-monetary criteria while selecting adaptation options. Innovative ways to manage uncertainties, such as robust decision making strategies and flexible adaptation pathways that use criteria like robustness and flexibility to determine the appropriateness of options, should be explored to build robust options. In practice, a range of analytical and participatory tools can and will be used to identify, narrow, vet, and select effective options to adapt to climate change.

1.0 INTRODUCTION

Development practitioners across a variety of sectors are increasingly becoming aware of the impacts of climate change on vulnerable populations and on the success of development interventions, which have traditionally assumed a stable climate. Despite this recognition and the emergence of tools to document vulnerability and risk of impacts, there is limited experience in linking vulnerability assessments to developing climate change adaptation activities. In many cases, decision makers may not recognize the range of options (also called alternatives, strategies, and actions) available to adapt to climate change, nor how to choose among a collection of viable options. Furthermore, decision makers may not understand the role that the scientific and the broader stakeholder community can play to inform the process of making decisions in the face of climate change. This paper provides an overview of several methodological approaches that can be used to identify and select adaptation options. Many of the methodological approaches are explored in more detail in an accompanying series of fact sheets and papers.

Analyzing adaptation options often starts with an understanding of how climate change may increase the vulnerability of people, ecosystems and our built environment. Limited political power, social or economic marginalization, exposure and sensitivity to hazards, the strength of local institutions, and many other factors play important roles in making people vulnerable. Climate change adds an extra layer of stress to these existing challenges and exacerbates them. In many cases climate change also increases the vulnerability of our natural and built environments. While a detailed treatment of climate change vulnerability is beyond the scope of this paper, it is worth emphasizing several overarching issues:

- Vulnerability has significant spatial characteristics and varies from place to place (e.g., the vulnerability of coastal and mountain communities differ greatly);
- Vulnerability is temporally dynamic (e.g., will vary between rainy and dry seasons);
- The nature of vulnerability differs dramatically at different scales at which projects, plans, or programs operate (e.g., vulnerability of a household living on the flood plains is very different from that of a nation facing food deficits);
- Socio-economic factors create differential vulnerability among groups (e.g., certain groups like women and children are often more vulnerable than others);
- Increasing demands on natural resources causes environmental degradation and resource depletion, which contribute to higher vulnerability driven by socio-economic factors, especially where people depend directly upon natural resources for their livelihoods; and
- Many of the factors that contribute to vulnerability are mediated by institutions, both formal and informal.

In sum, vulnerability tends to be highly ***variable*** and ***context-specific***. Not surprisingly, the kinds of activities or adaptation options that decision makers may undertake to decrease vulnerability will also depend heavily upon the specific context (World Bank, 2010). It is critical, therefore, to examine site- and scale-specific risks, vulnerabilities, and needs in order to identify an appropriate menu of options that can enhance adaptation within a particular decision context.

As experience in implementing planned adaptation activities increases, a variety of adaptation options are slowly emerging that decision makers can use to address emerging climate risks and vulnerabilities across different sectors, scales and regions. Though the most commonly cited adaptation options have focused on hard infrastructure solutions, such as coastal sea walls, flood embankments, or increasing the size of built reservoirs (World Bank, 2010) – there are an increasing number of policy and capacity-building approaches to reducing vulnerability to climate change. Many of these hard and soft adaptation options, however, still face high barriers and costs that result in difficulties with implementation.

When considering the identification and analysis of options, it is important to keep in mind two roughly distinct approaches to adaptation: ***discrete*** and ***integrated*** approaches. Under discrete or "stand-alone" adaptation, adapting to climate change is the primary objective. Typically, **discrete adaptation** takes place in the context of a project or program that would not happen if the climate were not changing or if climate vulnerabilities and impacts were not identified. The starting point is to help a particular place or a group of people adapt to climate change – to do an "adaptation project." Adaptation options under the discrete approach often include highly climate-oriented activities like building a sea wall against rising sea levels or developing early warning systems to warn about increasing extreme weather events. Though such activities may be relevant even in the absence of climate change, in the context of discrete adaptation efforts, they are typically undertaken because they have been deemed most likely to address anticipated climate change impacts.

Integrated adaptation, on the other hand, is undertaken to achieve development objectives in spite of climate change. Rather than taking climate change itself as the starting point, integrated approaches start with a development activity, which would be valuable even in the absence of climate change, and then modify it or add activities to it to address the impacts of climate change. In integrated cases, the menu of adaptation options is typically constrained by the tools and methods used in an ongoing or new development activity. Often, the climate-oriented activities are a relatively small component of a larger endeavor. For example, both the climate proofing of an agricultural development policy or the inclusion of climate indicators in coastal zone management planning could be considered integrated adaptation decisions.

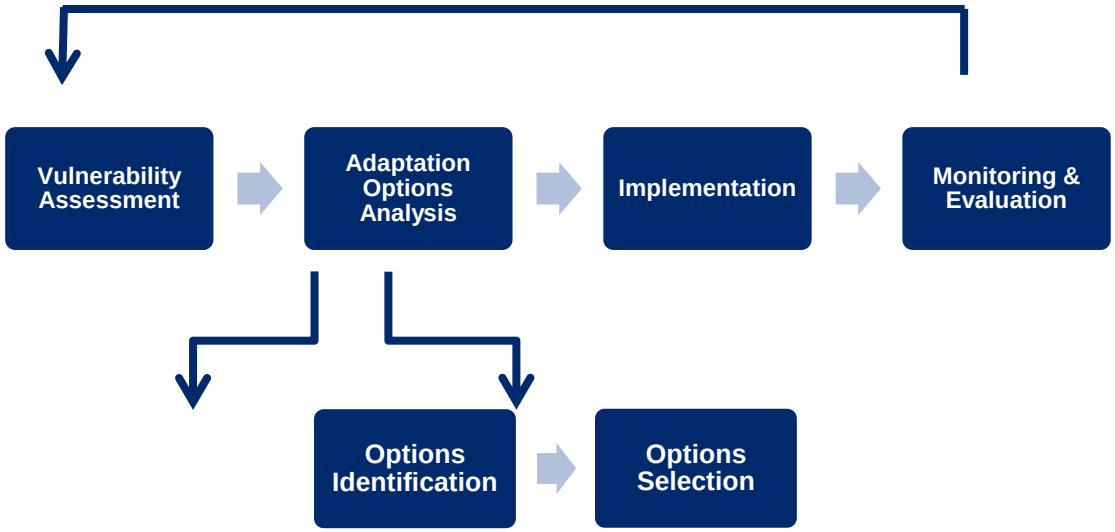
The distinction between discrete and integrated adaptation is not hard and fast. But activities under these two rough approaches tend to be undertaken by different actors, use different analytic tools, and have different overarching objectives. These different starting points and methods can lead to distinct menus of options for dealing with climate change challenges. For example, discrete adaptation activities tend to draw directly on climate-change impact and vulnerability assessments, and will often closely follow a straightforward adaptation planning cycle such as that in Figure 1. Integrated approaches, on the other hand, are more likely to be based on existing national or sector based decision making processes. They represent an effort to insert climate change into an ongoing decision cycle, rather than start a stand-alone project from scratch. As such, the framing of the climate change problem and the selection of decision criteria (steps 1 and 2 in Figure 2) often are quite distinct from discrete adaptation efforts. However, when it comes to the options analysis phase, both integrated and discrete efforts face similar challenges and may benefit from tools that ensure a broad range of adaptation choices are considered systematically. While recognizing that the starting point of the adaptation intervention will inevitably constrain the options on the table, here we aim to identify options analysis approaches that are broadly applicable and potentially relevant in both integrated and discrete cases.

1.1 OBJECTIVES OF THIS PAPER

This paper provides an overview of approaches that can be used to analyze adaptation options. The identification and selection of adaptation options is a critical component of the design of adaptation projects or programs. Many adaptation planning frameworks identify options analysis as a separate and

distinct part of the adaptation planning and implementation cycle (see Figure 1) with both options identification and options selection components.

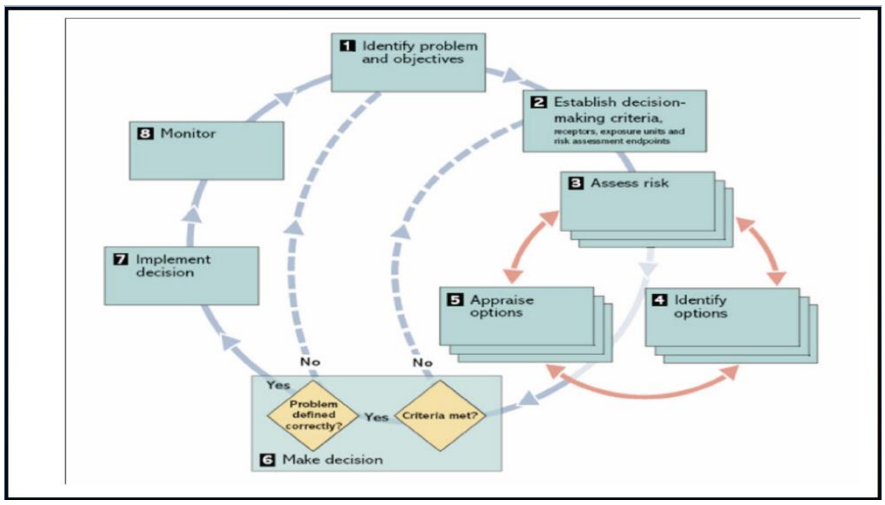
FIGURE 1. AN ADAPTATION PLANNING CYCLE



Source: Modified from ARCC planning framework (ARCC, 2012)

Options analysis is an integral part of both discrete and integrated adaptation project or program cycles. While the entry points and the stated objectives of discrete and integrated adaptation projects or programs may differ, special attention will need to be paid to the identification and then the selection of adaptation options in both cases. Discrete adaptation programs may use a vulnerability assessment as one starting point for identifying adaptation priorities that may ultimately lead to identifying adaptation options. Depending on the types of questions a vulnerability assessment answers, results may also help identify specific adaptation strategies that will help develop options to decrease some of the identified vulnerabilities. However, integrated projects and programs may need to deal with a variety of other existing stresses and thus operate under a risk management framework. A risk management framework provides a systematic approach to using climate information in development decision making in order to minimize potential harm or losses associated with climate variability and change (Hammill and Tanner, 2012). For example, a climate risk management framework developed by the United Kingdom's Climate Impacts Program (UKCIP) identifies eight iterative steps in the evaluation of climate risks, and the selection and implementation of appropriate adaptation options (see Figure 2). Stages 1 and 2 help define the nature of the decision problem, the decision-makers' objectives, and criteria that help to differentiate the many adaptation options. In stage 3, climate and non-climate risks are formally identified and assessed. Stages 4 and 5 include the identification and appraisal of options based on the criteria identified in stage 2. Stage 6 is where decision-makers form a judgment on the options based on the information at hand. This stage examines not only the preferred option, but also reassesses whether the initial problem was correctly defined. Such an approach may be particularly important when options analysis begins concurrently with vulnerability assessments. Stages 7 and 8 include the implementation and monitoring of adaptation options which then help to reformulate the problem and objectives of stage 1.

FIGURE 2. UKCIP'S DECISION MAKING FRAMEWORK FOR ADDRESSING CLIMATE CHANGE RISKS



Source: Willows and Connell, 2003

The methods and processes identified in the sections below are not mutually exclusive and may be used together to inform adaptation options analysis. The choice of a particular tool or approach will depend on the objectives and goals of the actors making an adaptation decision. Some of the variables that could influence the choice of approaches or methods include resources, capacity, the availability of information, and knowledge about outcomes of options. No single method will serve as a silver bullet to identifying and selecting adaptation options. Section 2 will introduce some of the key considerations for adaptation options analysis including considerations of participation and different ways of managing uncertainty, and details on the identification and then the selection of adaptation options. Section 3 will provide details on three different analytical approaches for selecting adaptation options. Section 4 presents conclusions.

2.0 KEY CONSIDERATIONS FOR IDENTIFYING ADAPTATION OPTIONS

The task of identifying adaptation options can be particularly challenging because the questions associated with adaptation are complex. Some of the underlying issues include:

- **High levels of uncertainty in climate impacts**: The uncertainty surrounding climate change is high because of the complexity of our global climate system, the large number of variables that influence it, and the dynamic interactions between them. Moreover, the uncertainty increases the further into the future one looks (Kinzig et al., 2003) and does not necessarily diminish — and in fact may increase — with better scientific research (Wardekker, 2011).
- **High levels of uncertainty in socio-economic pathways**: Climate impacts are predictable but subject to large uncertainties and variability spatially and temporally. Yet socio-economic pathways are in many cases equally or more challenging to predict. Political developments, the deployment of new technologies, and local and national development trajectories will influence the implementation of adaptation strategies. Combined with climate change uncertainties, this uncertainty makes adaptation planning extremely complex.

BOX 1: ADAPTATION AND DEVELOPMENT

A 2007 report by WRI and IISE, *Weathering the Storm*, argued that the range of adaptation activities may be framed as a continuum of responses to climate change, from "pure" development activities on one end to very explicit adaptation measures on the other. Most vulnerability-oriented adaptation efforts at one end of the continuum overlap almost completely with traditional development practice. At the far opposite end, highly specialized activities exclusively target distinct climate change impacts, and fall outside the realm of development as we know it. In between lies a broad spectrum of activities with gradations of emphasis on vulnerability and impacts (McGray et al., 2007).

What constitutes adaptation thus depends heavily upon the context in which specific activities take place. Ultimately, it may be difficult to distinguish between adaptation and development per se; the adaptiveness of an intervention depends not upon the activities undertaken, but rather upon the process used to identify those interventions and their relationship with climate change impacts, as well as the vulnerability of the stakeholders targeted (Spearman and McGray, 2010).

- **Vulnerability is complex:** Causes of vulnerability are complex and sometimes may only be indirectly related to the climate. When designing an adaptation project or program, decision makers will need to think hard about whether and how to address other equally important causes of vulnerability (see Box 1 for a description of the relationship between adaptation and development).
- **Effectiveness depends on how objectives are defined**: Definitions of the effectiveness of adaptation options vary greatly with the objectives of a particular project or program. The list of outcomes that constitutes success is wide and varied and can depend strongly on how specific

actors define the goals of a particular project or a program. These objectives will drive the choice of outcomes, which in turn will play a large part in driving the adaptation options analysis process.

On top of these challenges, many parts of the developing world also suffer from inadequacies in biophysical and socioeconomic data. This compounds the difficulty of managing of existing climate variability and increases the uncertainties associated with projections of climate change impacts. Probabilities about future changes that are needed for making long-term and strategic decisions are often absent. Under these conditions, the participation of multiple stakeholders — including people affected by climate impacts — in adaptation decision making becomes critical. In addition, innovative ways to manage uncertainties are emerging that hold promise for responding to some of these challenges. The below subsections discuss why these two issues of participation and managing uncertainty are of particular importance to the identification and selection of adaptation options.

2.1 CROSS-CUTTING CONSIDERATIONS

2.1.1 Public Participation in Decision-Making

The ability to participate in decision making is a fundamental right and involves the ability to access information and have the opportunity to voice opinions and influence policy choices (Foti et al., 2008). Principle 10 of the Rio Declaration identified public participation at all relevant levels as an important component of sustainable development (United Nations [UN] Conference on Environment and Development, 1992). Article 6 of the 1992 UN Framework Convention on Climate Change (UNFCCC) calls for Parties (to the Convention) to promote and facilitate "public participation in addressing climate change and its effects and developing adequate responses" (UNFCCC, 1992).

Public participation in formal decision-making is vital because it enables governments to respond to public concerns, to build consensus, and to improve acceptance and compliance of rules and laws. Widespread participation of different stakeholders in planning and policy making processes further allows questions and assumptions to be scrutinized, especially when issues are sensitive. Ideally, if applied early on, it can lessen the chance that pertinent information and perspectives are neglected. Decision makers can use public participation as a means to gather information, disseminate and educate, influence public opinion, increase legitimacy, generate wider ideas, and amplify the voices of the minority (Foti et al., 2008). Perhaps most importantly, public participation in decision making processes can lead to better outcomes for those affected by the decisions (National Research Council of the National Academies, 2008).

In light of the complexities around adaptation, public participation brings a number of benefits to formal adaptation planning and decision making. It lays the foundations to making choices about risks and dealing with vulnerabilities that may create winners and losers. Public participation, early on and directly in planning and analyzing adaptation options, can help decision makers chose options in the face of ambiguity caused by climate uncertainty and by people bringing their diverse individual worldviews to the decision-making process. The integration of climate risks into decisions is unlikely to succeed without in-depth and sustained public engagement throughout the planning cycle (see Figure 1) (WRI et al., 2011). In the design of an adaptation project or program, participation may occur at the point of assessments, options analysis, or even awareness building. But governments and decision makers need to make sure that the public has rights to be consulted and engaged in adaptation planning processes (WRI et al., 2011). In particular, public participation can play a special role in the analysis of adaptation options (for both identification and selection), which include:

- Participation can help to clarify the goals and objectives of a variety of stakeholders, as well as help these stakeholders arrive at agreed outcomes of proposed options;

- Participation of multiple stakeholders can help to ensure that viable options aren't overlooked and that options analysis reflects detailed local knowledge of the particular place affected;
- Participation can help ensure that options evaluation criteria reflect the risk tolerances of those affected by the decision. This is especially important given the many uncertainties associated with climate change impacts;
- Given the cross-sectoral nature of adaptation activities, participation can create trust, help develop working relationships, and build buy-in from different stakeholders for the implementation of specific options; and
- Public participation helps build mechanisms for feedback and learning during the implementation and evaluation phases of a project.

BOX 2: EXAMPLES OF PARTICIPATORY APPROACHES

An example of public participation at work during adaptation programming is the Participatory Scenario Development (PSD) used by the World Bank during its Economics of Adaptation study to elicit information from stakeholders about their experiences with the shifts in climate and identify possible responses to these shifts. In a 2010 PSD workshop in Bangladesh, participants discussed the impacts of climate change, such as increased cyclones, floods, and droughts. They raised concerns about the social aspects of climate change, such as fewer marriages because the wedding season traditionally coincides with the rainy season, and marriage plans are increasingly being delayed or disrupted by flooding (Bizikova, Boardley and Mead, 2010).

Another example of the use of participatory methods for adaptation includes the use of Shared Learning Dialogues (SLD) by the Institute for Social and Environmental Transitions (ISET). SLDs have been applied to a number of adaptation and disaster risk planning processes across Asia and are meant to be non-extractive tools for soliciting information from a wide variety of stakeholders at different points of program design. SLDs are built on participatory planning and attempt to solve problems in complex situations through deliberation and dialogue. By fostering structured and iterative discussions among experts and local people or among different sector specialists, SLDs aims to improve the quality and effectiveness of decision-making (ISET, 2010).

Adaptation programing can build on the long history of thought and work around community-based natural resource management. There is now a substantial body of evidence that suggests the management of complex human-natural system requires a mixture of technical and local knowledge (Chambers et al., 1989; Sayer and Campbell, 2004). Adaptation in particular requires innovations in the way institutions are set up to manage natural ecosystems, which is not possible without widespread and intense participation from populations affected by changes (Chambers, 1997; Dietz et al., 2003; Pound, 2003). Box 2 provides examples of local participatory processes at work for adaptation decision making.

However, there have been several critiques of participatory processes centered mostly around different methods for participation and the extent to which these methods constitute active participation and empowerment (Few et al., 2006). For adaptation decision making, participation may have its own set of limitations. It is not the same as political representation – it can be influenced by the biases of the organizers, the loudest voice in the room, or other types of political power imbalances between those seeking and providing information, and those making decisions. Using local perceptions of changes in weather and recognition of climate risks in planning activities in particular can be problematic as they are often driven by events in the short term and do not take account of longer time frames. Few et al. argue that while genuine participation maybe useful if the purpose is to define overall priorities for society or to galvanize broad based deliberation of climate change issues, it may not work while engaging in longer-term strategic planning where getting consensus to address long-term and uncertain consequences with low immediate salience is extremely difficult (Few et al., 2006). Moreover, while increased participation can lead to more accountability, participation alone may not directly result in greater accountability. Public participation in particular is extremely difficult to scale up.

2.1.2 Approaches for Managing Uncertainty

Along with the need for higher degree of participation, a growing number of researchers also argue that there will always be "some level of irreducible ignorance in our understandings of future climate" (Dessai et al., 2009a). As a result, traditional predict-and-plan approaches to making decisions often do not work well for adaptation, even as resolution of climate projections improves and reaches more granular scales. Thus, alternative methods for identifying adaptation options that are slightly different from traditional approaches to policy-making need to be developed (WRI et al., 2011; Dinshaw et al., 2012). For example, adaptation options will need to work under multiple future climate scenarios, and under high levels of uncertainty. Distinct from traditional predictive planning strategies, these new types of methods may use a different set of criteria for identifying adaptation options. Instead of focusing on finding an optimal decision for an expected future, they could use criteria such as flexibility and robustness to determine the appropriateness of different adaptation options (WRI et al., 2011).

If all parameters of the future climate are known, picking an optimal adaptation option is more tractable. In the absence of complete information and under high levels of uncertainty, adaptation may require the development of robust options that may not be optimal under one future but will fare well across a range of future scenarios, any of which are possible (Dessai et al., 2009b). For example, although Yemen has faced a 10 percent decrease in precipitation since the 1920s, there is no consensus on future projected annual precipitation levels. The climate models' annual change in rainfall outputs range from -34 to +56 percent. Instead of devising options that work well only in a drier scenario, or only in a wetter condition, the government has chosen to focus on robust climate strategies and low-regret adaptation measures. These include the development of integrated coastal zone management plans, which could help people adapt regardless of wet or dry conditions (Dessai and Wilby, 2011). Robust options may be identified in multiple ways – the simplest form being identifying an adaptation option that is viable in two different climate change scenarios of the future. More complicated scenario development and planning exercises can help develop robust options by asking the participants to deal with multiple types of the future. On the opposite end of the robust decision making spectrum are much more technical and data driven exercises that make use of probabilistic distribution of future impacts and high capacity computer modeling to identify a robust option like those exercises conducted by the RAND Corporation (Lempert, 2010).

A different approach to picking options could be to put flexibility at the heart of adaptation. For instance, one approach to picking adaptation options that has flexibility embedded in it involves the creation of pathways that set predetermined benchmarks and thresholds at which new decisions will need to be taken. At each benchmark, new information can feed into the process and any number of future decisions can be made. The heart of designing and identifying a flexible adaptation option lies in the ability to monitor changes and outcomes, and feed that information back in an iterative manner to reformulate the design of the earlier option. The Australian Centre for Climate Change Adaptation Program is implementing a research and development project to develop flexible coastal adaptation pathways for local communities throughout the island state of Tasmania. The government chose this adaptation decision-making strategy as it had little information on the comparative costs and benefits of different adaptation options, and wanted to avoid the high cost of over-engineering costal protection infrastructure (Australian Government Coastal Adaptation Decision Pathways Project, n.d.).

2.2 IDENTIFYING ADAPTATION OPTIONS

Given the above considerations and complexities of adaptation decision making, identifying a set of options that will help increase resilience and decrease vulnerabilities may not always be straight forward. Identifying options will require clarity around the problem statement and the decision context. The design of options must be based in some understanding and prioritization of the impacts posed by climate change. Most climate change vulnerability assessments will identify a range of impacts and

vulnerabilities, or in other cases development practitioners may be asked to respond to a specific climate impact. An adaptation analysis framework assumes that the problem statement and prioritized impacts or challenges have been defined. In some cases, however, the decision context will help to further refine both the problem statement and the role of the options at hand. Are adaptation options needed at the local or national scales? Are options required for specific ecosystems or groups of people? Who will be making the final decision on these options? What are the specific objectives that the options will need to meet? How can adaptation options that are game-changers in terms of their impact be identified? How can a variety of adaptation options, including hard and soft ones, be included in the same list? And finally how can ideas of flexibility and learning, so critical for adaptation, be integrated into the options that are identified?

Answering many of the questions above will require a creative process that allows for a broad range of ideas to be brought to the table. The evidence generated through vulnerability and risks assessments will play a critical role in the selection of appropriate adaptation options. It is only by identifying the major drivers of vulnerability and the types and magnitudes of the risks faced that we can begin to identify options to help lessen them. USAID guidance, for example, requires that vulnerability assessments guide adaptation programming decisions, and that an option analysis framework be used to help transition from assessments to action (USAID, 2007).

This shift from *assessing* impacts, risks, and vulnerabilities to *identifying* adaptation options can be challenging. Existing capacities and knowledge, including indigenous practices for dealing with different kinds of shocks and climate variability, will also need to be utilized and built upon, and a wide range of options, both hard engineering based infrastructure and softer options that include policy, capacity building and institutional innovations, may need to be considered. The context specific nature of adaptation options means that it is hard to draw generalizations about specific options. Generally adaptation options so far have built on existing coping strategies or drawn on options derived from work done in other places (Hammill and Tanner, 2011). Moreover, if vulnerable communities are directly involved in the selection of adaptation options, the chances of their success may be greatly increased. Similarly, at higher levels of governance, if options and ideas are generated through discursive and other processes with broad buy-in within the relevant national institutions, chances of success in achieving desired objectives and in sustaining the intervention beyond project life cycles can be higher.

2.3 SELECTING ADAPTATION OPTIONS

The identification of adaptation options is often a generative and discursive process. The selection of adaptation options, on the other hand, frequently is conducted through more formal decision making processes. Selecting adaptation options is often about picking the best intervention to implement in light of other competing claims to resources and priorities. Thus options evaluation at its heart is about resolving the various trade-offs involved in decision making and in picking options that will be the most successful in helping produce their intended outcomes and be sustainable over the long term. This work is usually best done through a structured and transparent process aided by evidence.

Technical methods that can be used in making decisions about selecting adaptation options often start from a suite of options and then help decision makers prioritize the most efficient and effective adaptation option. Cost considerations can be a big concern; however, other criteria may be more important in a particular context than costs alone. Some of these other criteria can include social and political acceptance, environmental impacts, legal and administrative requirements or technical feasibility. Some of the technical methods that can be used to select adaptation options include cost-benefit analysis, multi-criteria analysis, portfolio theory, real options analysis, and trade-off analysis. Section 3 below discusses a few of these methods in more detail. As with adaptation options identification, the process of options analysis and the conversations it generates about trade-offs, preferences, and adaptation and resilience in general, are as important as the technical outputs from each method.

3.0 TOOLS AND APPROACHES TO SELECT ADAPTATION OPTIONS

Questions about costs and benefits, effectiveness, alignment with existing priorities and value for money have traditionally been important considerations when selecting a set of options to implement under a particular project or program. This section provides details on three processes that can be used to inform the *selection* of adaptation options, after the options and their proposed outcomes have been *identified*. Participation and the use of alternative approaches to planning for adaptation, identified in the section above, form the foundation for the application of the tools presented below. Indeed, the use of any of these tools must also be complemented by a process that vets the selected adaptation options through participatory processes. The three approaches to the selection of adaptation options discussed here include a set of decision rules, multi-criteria assessment, and economic methods.

3.1 A SET OF DECISION RULES

Decision makers or project and program designers may choose to use a set of decision rules or criteria for determining how adaptation options will be picked. Each decision, project or program has its own set of needs and objectives that may lend themselves better to a set of rules over another. These rules for selecting projects need to be determined within the operational framework of a project or program. As an example, an ad hoc of possible rules is presented below, in no particular order:

- Prioritize no-regrets or low-regrets options, or options that may produce high co-benefits;
- Pick options that are robust across multiple future climate scenarios;
- Delay actions that are costly or irreversible until there is more clarity on climate change impacts;
- Take actions now that allow for flexibility in the future to respond to changing risks; and
- When making longer-term decisions, particularly around the building of infrastructure, make sure all climate risks are accounted for to avoid mistakes like technological and vulnerability lock-in.

It may only be possible to pick one of the rules as the main basis for picking options, since there can be irreconcilable tensions between two rules depending on a particular context. For example, a low-regrets option may not always account for all possible climate change risks and delaying action may mean losing flexibility over the longer term. Often the outcomes from particular options need to be fairly fleshed out before decision makers can select adaptation options based on the criteria above. A separate decision tree maybe developed to pick specific options. Or one of these rules can be employed as a criterion in a multi-criteria analysis (see section 3.2) and given high weights to increase its importance.

3.2 MULTI-CRITERIA ANALYSIS

When the monetary values of costs and benefits are known for a particular adaptation option, tools such as cost benefit analysis and cost effectiveness analysis (see sub-section 3.3 below) can be used to analyze and pick options. When monetary values are absent, when there are gaps in technical information, or when uncertainties are high and biases are strong, multi-criteria analysis (MCA) provides a decision-making framework to sift through layers of complex information and make consistent and transparent decisions. MCA techniques allow decision makers to establish preferences for specific policy options by referencing a set of already established objectives. There are multiple ways to conduct an MCA. However, in most approaches the decision-making team exercises significant subjective judgment (Department for Communities and Local Government [DCLG], 2009). The heart of an MCA is the creation of a "performance matrix" which allows for comparison of different options across chosen criteria (see Table 2 for an example of a performance matrix for adaptation). MCA can handle disaggregated data on fundamental measures expressed in different units across relevant criteria, such as health effects and environmental impacts, and potentially over different time horizons and future scenarios (UNEP, 2011).

The first general step of an MCA is establishment of objectives and a decision context. Next, a menu of options needs to be identified that needs analysis and comparisons. Then a clear and transparent process of identifying the criteria against which the options will be judged will need to be established. It is important to define the criteria so that it is possible to draw out the contribution of options for each of them. Often, numeric scores are assigned to each option for each criterion. Each criterion may also be given specific weights to determine its overall importance. It is possible to introduce information at each step of this process; however, the subjective exercise of judgment is embedded in all of steps of a MCA (see Table 1 for the steps involved in an MCA). The final aggregation and integration of numerical scores may be different for different MCA approaches. This largely depends on the analytical capacity of the decision makers, the amount of time and resources available to conduct this analysis, and the availability of data to inform this process. For example, once a certain set of criteria and weights have been applied to a given menu of options, a sensitivity analysis may be performed to check how final rankings change if a different set of weights and criteria are applied.

TABLE 1. STEPS IN A MULTI-CRITERIA ANALYSIS

Step 1	Establish a decision context
Step 2	Identify options
Step 3	Identify objectives and criteria to judge options
Step 4	Describe the performance of each option against given criteria
Step 5	Assign weights for each of the criteria to reflect their relative importance to the decision at hand and aggregate results
Step 6	Examine results
Step 7	Conduct a sensitivity analysis of the results with different weights

Source: Modified from DCLG, 2009

Multi-Criteria Analysis for climate change adaptation were most widely used during the creation of National Adaptation Plans of Action (NAPA). The UNFCCC calls on all Least Developed Countries to create these plans and provided guidelines for tools to use while picking options (UNFCCC, 2002). Table 2 below is an example of a performance matrix used to prioritize adaptation projects in Ethiopia

during the development of its NAPA. A total of five criteria (presented in the Table 2) were identified by the NAPA team. The criterion of losses avoided by poor people was given the highest weight, while criteria like synergies with national plans and sectoral plans, and complementary with national plans with other Multilateral Environmental Agreements (MEAs), were given the lowest weight. Different indicators and units for measurement were chosen for each of the criteria identified above. These different units were then standardized so the numbers could be compared and ranked. The numbers in Table 2 are these standardized scores.[1] In order for criteria to have a meaningful role in a multi-criteria analysis, there must be a range of scores that demonstrate a meaningful difference. For example, in Table 2 the cost effectiveness criteria vary between 0.99 and 1.00 for all, but one of 19 potential projects, making the cost-effectiveness metric largely meaningless in this particular analysis. The UNFCCC has also identified a list of several other possible criteria for assessing adaptation options that could be used in a MCA exercise (UNFCCC, 2011). These include:

- **Efficiency:** are the outputs achieved optimal relative to the resources allocated?
- **Effectiveness:** will the option meet the objectives?
- **Equity:** will the option benefit vulnerable groups and communities?
- **Urgency:** how soon does the option need to be implemented?
- **Flexibility:** is the option flexible, and will it allow for adjustments and incremental implementation and reiteration depending on the level and degree of climate change?
- **Robustness:** is the option robust under a range of future climate projections?
- **Practicality:** can the option be implemented on relevant timescales?
- **Legitimacy:** is the option politically, culturally, and socially acceptable?
- **Synergy and coherence with other strategic objectives:** does the option offer co-benefits (for example, improving agricultural land management practices could lead to reduced erosion and siltation, and carbon sequestration)?

[1] The method used to create standardized scores in Table 2 was helpful in ranking different options, but standardization removed some of the granularity associated with the actual units that were used in the MCA analysis before standardization. In the case of the cost effectiveness column, the cost of second ranked project was almost 100 times higher than the cost of the other NAPA prioritized projects. This resulted in a column of standardized scores for cost effectives that was not particularly useful in the MCA.

TABLE 2. EXAMPLE OF A PERFORMANCE MATRIX USED TO CONDUCT AN MCA ANALYSIS FOR CLIMATE ADAPTATION OPTIONS IN ETHIOPIA

		Criteria					MCA	
	Project Titles	Impact on Economic Growth of the Poor (%)	Complementarities with National and Sectoral Plans (0 to 5 scale)	Losses Avoided by Poor People Units Per Capita Per Year	Synergies Scale 0 to 4	Cost Effectiveness Million USD	Average Score	Rank
1	Promoting drought/crop insurance program in Ethiopia	1.0	1.0	1.00	1.0	0.99	1.00	1
2	Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin	1.0	1	1.00	1	0.00	0.80	7
3	Community Based Development and Commercialization of Non-timber Forest Products (Gum Arabic, Myrrah and Frank Incense)	1.0	0.5	0.56	0.5	0.99	0.71	15
4	Community Based Rehabilitation of Degraded Eco-System in Selected Parts of Ethiopia for Carbon Sequestration and Trading	0.5	0.5	0.56	1	1.00	0.71	14
5	Propagation and Commercial Scale Cultivation of Wild Essential Oil Crops	0.5	0.75	0.56	0.75	0.99	0.71	15
6	Establishment of Centre for Propagation and Commercialization of Traditional Herbal Medicinal Plants	0.5	0.75	0.44	0.75	0.99	0.69	19
7	Establishment of Acacia Woodland Nature Reserve in the Ethiopian Rift Valley System	0.3	0.5	0.56	0.75	0.99	0.61	27
8	Community Based Carbon Sequensation Project in the Rift Valley System of Ethiopia	0.8	0.75	0.67	0.75	1.00	0.78	8
9	Range Shift Cultivation of Selected Cash Crops in Drought Prone Areas	0.8	0.75	0.56	0.5	1.00	0.71	12
10	Establishment of National R&D Center for Rio-Convention	0.5	0.75	0.67	1	1.00	0.78	9
11	Development of an Incentive Scheme for Farmers (Hill-farming communities) to Reforest Hill Areas in the Northern Parts of Ethiopia	0.8	0.25	0.44	0.75	0.99	0.64	24
12	Participatory Approach to Rehabilitate Degraded Hills/Ecosystem in Northern Ethiopia	0.3	0.75	0.22	0.5	1.00	0.54	30
13	Institutional re-enforcement for Bio-diversity Conservation	0.0	1	0.56	0.25	0.99	0.56	29
14	Establishment of National Environmental Education Program	0.0	0.25	0.11	0.5	1.00	0.37	34
15	Reforestation for Fuel in the Highlands of Ethiopia	0.5	0.5	0.33	0.5	0.99	0.56	28
16	Regional Capacity Building for Monitoring and Inventorying of Biodiversity	0.0	1	0.78	0.5	0.99	0.65	23
17	Establishment of Potato-centered Small-sized Cottages	0.5	0.25	0.33	0.5	0.99	0.51	31
18	Reclamation of Bush Encroached Rangelands	0.8	0.75	0.56	0.25	0.99	0.66	20
19	Promotion of Legume-based Agro-forestry Systems and Home-garden Agriculture	0.5	0.75	0.67	0.25	1.00	0.63	25

Source: Federal Democratic Republic of Ethiopia, 2007

3.3 ECONOMIC METHODS

When the monetary value of an objective is clear, techniques such as cost benefit analysis and cost-effectiveness analysis can be used to pick from a list of identified adaptation options. Various well-established economic methods like willingness to pay, and contingent valuation methods can help identify the costs and benefits of a particular adaptation activity (studies include: UNFCCC, 2011a; the Institute for Social and Environmental Transitions [ISET], 2008; World Bank, 2010; Economics of Adaptation Working Group, 2009). Cost-benefit analysis (CBA) compares the costs of implementing a particular option with its benefits and calculates the net benefits or efficacy (measured by net present value, the rate of return or the benefit-cost ration[2]). Countries like the United Kingdom and the United States

[2] The net present value (NPV) is the difference between the present value of benefits and the present value of costs. An option can be acceptable if the NPV is greater than zero. Calculating the NPV of future costs and benefits requires the use of discount rates to determine the value of future benefits in the present. A benefit–cost ratio indicates the overall value

mandate CBA analysis for the analysis of various policy options like the siting of a dam or the building of an irrigation canal. The World Bank Group also extensively uses CBA to analyze development activities. A critical component of conducting a CBA for adaptation includes the definition of a project baseline in order to compare the costs and benefits between two separate conditions (UNFCCC, 2011b).

Cost considerations are a critical element of public decision making. CBA tools can play an important role in decision making around adaptation because they can put a monetary and easily understood value to specific adaptation actions. They help quantify the costs of climate change impacts, the benefits of a proposed adaptation option and finally the cost associated with that option. If the benefits exceed the costs — or if the benefit to cost ratio is greater than one — the activity may be considered worthwhile from an economic perspective. A CBA can also help detail the hidden costs of climate change as well as of an adaptation option. Moreover, CBA tools can help make assumptions of various stakeholders explicit and transparent, thus exposing biases that influence preferences. While CBA tools can be used for both discrete and integrated adaptation activities, they are more useful for discrete activities (detailed in an accompanying paper on CBA).

Despite an increasing number of studies and case studies that try to analyze the costs and benefits of adaptation, it remains a difficult and complex exercise. It may be possible to calculate the direct and indirect costs of structural measures such as building a sea wall, but calculating indirect costs for a complex sector like agriculture or water is fraught with challenges (Parry et al., 2009). Correctly identifying both the monetary and non-monetary benefits of adaptation is an even bigger challenge. Calculating the value of avoided damages from adaptation activities to estimate benefits, for example, can be based on a number of assumptions that may not hold true in the future. Similarly, putting monetary values on non-monetary benefits is a significant challenge faced by all CBA methods, not just those related to adaptation. CBA methods have a few additional disadvantages. Unlike a MCA method, CBA methods do not address the differential impacts of costs and benefits on different groups. The costs of a particular option may be borne disproportionality by a particular group in a specific time period, while the benefits may fall to a completely different group or may accrue at a different time period. CBA methods are agnostic to these equity considerations.

CBA tools can be extremely useful in the selection of adaptation options. For example, a CBA study of two adaptation options (pumping groundwater using solar or diesel, and construction of dams and diesel pumping) in the Gambia found that that net benefits of enhanced irrigation was always negative. As a result both of these adaptation options could be termed unfeasible. However, when the study compared the costs of these two adaptation options with the costs of commercial inputs to agriculture and food aid over the long term, it estimated that these two adaptation options could have resulted in the elimination of cereal imports and saved the country more than $22 million (UNFCCC, 2011b). Improved irrigation was deemed an important option for reducing poverty as well as for adapting to a changing climate. Thus narrow cost benefit analysis may also not be able to capture the wider systemic benefits or costs of a particular option. It might be helpful sometimes to broaden the boundaries of the CBA analysis for adaptation options by including other socio-economic processes as well.

A cost-effectiveness analysis (CEA) can also be conducted to appraise adaptation options. When the objectives of a particular option are very clear but the objective can't be valued, this method can be used to assess the least-cost way of achieving it. Like a CBA method, the construction of a baseline is a critical component of this method. The baseline helps establish a basis to judge if a particular objective of

---

for money of a project. If it is higher than one, a project is acceptable. Finally, the internal rate of return is the discount rate that makes NPV equal to zero. An option is more desirable if its internal rate of return is high.

the option thus identified has been met. CEA exercises focus on calculating all the direct and indirect costs of a proposed option over the course of its lifetime. All the options that are being reviewed would meet a single objective, like the volume of water yields achieved from a particular option. Costs per unit of effectiveness (cost in USD per unit increase in water volume) can then be compared across relevant options. While a CEA is a much simpler tool for analyzing options because benefit considerations are not included, it is very narrow. Cost effectiveness considerations alone may not be the only criteria that decision-makers want to judge adaptation options.

4.0 CONCLUSIONS

Several of the methods and approaches identified above require additional detail before making a decision on the appropriateness of a particular tool or approach to use for an adaptation decision context. While there are multiple ways to identify options, decision makers will need to focus on setting up open and transparent processes for identifying options, deciding on what outcomes are important, and selecting options based on these agreed outcomes.

- **Options analysis needs to be unpacked…** As illustrated in Figure 1, there are two key components of options analysis for climate change adaptation that decision makers working on adaptation to climate change will need to formalize in their planning frameworks. The first piece includes the identification of the range of options for increasing resilience to climate change in a particular place and context. The identification of such adaptation options presents significant challenge and is an area that needs to be well informed by ongoing assessments. The second component includes the selecting of options to implement. This process is no less difficult than the first; however, established decision support tools like MCA and CBA can greatly aid the second process.

- **…Because there are multiple ways to identify options.** Vulnerability, impact, and risk analyses play important roles in the identification of a menu of adaptation options. The objectives and goals of a decision making process will impact the menu of options identified and selected for implementation. An extensive vulnerability assessment can aid in the identification of problems and in devising options to dealing with specific vulnerabilities. Vulnerability assessments must increasingly integrate this step of explicitly identifying options in their reports. There may also be a strong need for a risk management decision-making framework that helps decision makers understand what risks are relevant, what risks need minimizing, and what residual risks to live with. Often participation of affected actors should form the crux of such a risk management framework. Both vulnerability assessments and risks management frameworks are critical to help decision makers build resilience to climate change.

- **A process orientation is key…** Decision makers need to pay particular attention to how specific analytical and evidence based outputs like impact maps and agriculture crop yield models can strengthen many of the process-based tools needed to identify and analyze adaptation options. Such analytical and evidence based outputs emerging from various assessments can form the foundations for identifying and selecting adaptation options that help increase resilience and in helping decision makers make informed choices through processes set up for making adaptation related decisions. Along with scientific evidence, there are numerous other information needs for picking the right adaptation options. These needs can sometimes be subjective, and filling them might be dependent on who is at the table. As a result, a process orientation to picking adaptation options is a critical component of adaptation program and project design. These processes for selecting options will need to be transparent, systematic, and lay out all assumptions and inconsistencies openly. Most importantly, they will need to be participatory and inclusive.

- **…And there is lots of room for learning and innovation.** Decision makers and practitioners will have strong incentives to pick adaptation options that are effective in fulfilling the stated objectives for specific situations. However, the lack of decision support tools can prevent them from identifying and judging trade-offs between many different options. In particular, they lack the tools to

help monitor and evaluate options to answer questions about when these options are the most effective. Monitoring and evaluation can play an important role in any instance where practitioners and decision makers seek to document results and improve performance. Given the uncertainty and dynamism associated with climate change, monitoring and evaluation is specifically important for adaptation. It can provide critical support to the long-term process of learning what works, and helps practitioners innovate and manage their adaptation-related work.

REFERENCES

Australian Government, Coastal Adaptation Decision Pathways Project. (n.d.). Available at: http://www.climatechange.gov.au/government/initiatives/coastal-adaptation-decision-pathways.aspx

Bizikova, L, S. Boardley and S. Mead. (2010). Participatory Scenario Development (PSD) Approaches for identifying Pro-Poor Adaptation Options. Economics of Adaptation to Climate Change. World Bank Discussion Paper Number 18.Available at: http://climatechange.worldbank.org/sites/default/files/documents/PSD-Pro-Poor-Adaptation_EACC-Social%20.pdf

Chambers, R., Pacey, A., and Thrupp, L.A. Eds. (1989). *Farmer First: Farmer Innovation and Agricultural Research*. London: Intermediate Technology Publications.

Chambers, R. (1997). Whose Reality Counts? Putting the First Last. London: Intermediate Technology Publications.

Dietz, T., E. Ostrom, et al. (2003). The Struggle to Govern the Commons. Science 303, 1907-1911.

[DCLG] Department for Communities and Local Government. (2009). Multi-Criteria Analysis: A Manual. UK. Available at: http://eprints.lse.ac.uk/12761/1/Multi-criteria_Analysis.pdf

Dessai, S., M. Hulme, R. Lempert, and J. Pielke. (2009a). Climate Prediction: A Limit to Adaptation?" in W. N. Adger, I. Lorenzoni, and K. L. O'Brien, eds. *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge, UK: Cambridge University Press, pp. 64–78.

Dessai, S., M. Hulme, R. Lempert, and J. Pielke. (2009b). Do We Need More Precise and Accurate Predictions in Order to Adapt to a Changing Climate? Eos 90(13): 111–112.

Dessai, S., and R. Wilby. (2011). How Can Developing Country Decision Makers Incorporate Uncertainty about Climate Risks into Existing Planning and Policymaking Processes? World Resources Report, Washington, D.C. Available at: http://www.worldresourcesreport.org

Dinshaw, A, A. Dixit and H. McGray. (2012). Information for Climate Change Adaptation: Lessons and Needs in South Asia. WRI Working Paper.

Economics of Adaptation Working Group. (2009). Shaping Climate-Resilient Development: A Framework for Decision Making. A report of the economics of climate adaptation working group. ClimateWorks Foundation, Global Environment Facility, European Commission, McKinsey & Company, The Rockefeller Foundation, Standard Chartered Bank and Swiss Re. Available at: http://mckinseyonsociety.com/downloads/reports/Economic-Development/ECA%20%20%20Shaping%20Climate%20Resilent%20Development%20%20%20Report%20Only.pdf

Few, R., K. Brown and E.L. Tompkins. (2006). Public Participation and Climate Change Adaptation. Tyndall Center Working Paper No. 95. Available at: http://www.tyndall.ac.uk/sites/default/files/wp95.pdf

Gamper C.D. and C. Turcanu. (2007). On Governmental Use of Multi-Criteria Analysis. Ecological Economics 62: 298–307. Available at: http://www.napawatersheds.org/files/managed/Document/3485/Gamper2007%20OnTheGovernmentalUseOfMultiCriteriaAnalysis.pdf

Federal Democratic Republic of Ethiopia. (2007). Climate Change National Adaptation Programme of Action of Ethiopia. Available at: http://unfccc.int/resource/docs/napa/eth01.pdf

Foti, J., de Silva, L., McGray, H., Shaffer,L., Talbot, J., and Werksman, J. (2008). Voice and Choice: Opening the Door to Environmental Democracy. WRI Report. Available at: http://www.wri.org/publication/voice- and-choice

Hammill, A. and T. Tanner. (2011). Harmonizing Climate Risk Management: Adaptation Screening and Assessment Tools for Development Cooperation. OECD Environment Working Papers No. 36. Available at: http://dx.doi.org/10.1787/5kg706918zvl-en

ISET. (2008). The Cost-Benefit Analysis Methodology. From Risk to Resilience. Working Paper 1. Online at: http://www.i-s-e-t.org/images/pdfs/WP_1_highres.pdf

ISET. (2010). The Shared Learning Dialogue: Building Stakeholder Capacity and Engagement for Climate Resilience Action. Climate Resilience in Concept and Practice. ISET Working Paper 1. Available at: http://www.i-s-e-t.org/images/pdfs/isetworkingpaper1-sld.pdf

Kinzig, A., Starrett, D., Arrow, K., Aniyar, S., Bolin, B., Dasgupta, P., Ehrlich, P., Folke, C., Hanemann, M., Heal, G., Hoel, M., Jansson, A., Jansson, B.O., Kautsky, N., Levin, S., Lubchenco, J., Maler, K.G., Pacala, S.W., Schneider, S.H., Siniscalco, D., and Walker, B. (2003). Coping with Uncertainty: A Call for a New Science-Policy Forum. Ambio 32(5): 330–335.

Lempert, R.T. (2010). RAND Corporation discusses Robust Decision Making. Available at: http://www.rand.org/multimedia/video/2010/04/2/robust_decision_making.html

McGray, H., A. Hammill and R. Bradley. (2007). Weathering the Storm: Options for Framing Adaptation and Development. WRI. Online at http://pdf.wri.org/weathering_the_storm.pdf

National Research Council of the National Academies. (2008). Public Participation in Environmental Assessment and Decision Making, ed. T. Dietz and P.C. Stern. Washington, DC: National Academies Press, Committee on the Human Dimensions of Global Change. Available at: http://books.nap.edu/openbook.php?record_id=12434&page=1

Pound, B., Snapp, S., McDougall, C., and Braun, A. (eds.). (2003). *Managing Natural Resources for Sustainable Development: Uniting Science and Participation*. London: Earthscan.

Sayer, J., and Campbell, B.. (2004). *The Science of Sustainable Development: Local Livelihoods and the Global Environment*. Cambridge University Press.

Spearman, M. and McGray, H. (2011). Making Adaptation Count: Concepts and Options for Monitoring and Evaluation of Climate Change Adaptation. WRI, GIZ, and BMZ. Available at: http://pdf.wri.org/making_adaptation_count.pdf

UN Conference on Environment and Development. (1992). The Rio Declaration on Environment and Development. http://www.c-fam.org/docLib/20080625_Rio_Declaration_on_Environment.pdf

UNFCCC. (1992). United Nations Framework Convention on Climate Change. Available at: http://unfccc.int/essential_background/convention/background/items/1349.php

UNFCCC. (2002). Annotated Guidelines for the Preparation of National Adaptation Programmes of Action. Available at: http://unfccc.int/files/cooperation_and_support/ldc/application/pdf/annguide.pdf

UNFCCC. (2011). Assessing the Costs and Benefits of Adaptation Options: An Overview of Approaches. The Nairobi Work Programme on Impacts Vulnerability and Adaptation to Climate Change. Available at: http://unfccc.int/files/adaptation/nairobi_work_programme/knowledge_resources_and_publications/application/pdf/2011_nwp_costs_benefits_adaptation.pdf

UNEP. (2011). A Practical Framework for Planning Pro-Development Climate Policy. MCA4Climate Initiative. Available at: http://www.mca4climate.info/_assets/files/FINAL_MCA4report_online.pdf

USAID. (2007). Adapting to Climate Variability and Change: A Guidance Manual for Development Planning. Online at http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf

Wardekker, A. (2011). Climate Change Impact Assessment and Adaptation under Uncertainty. PhD dissertation. Utrecht University, Utrecht.

Willows, R. and R. Connell (eds). (2003). Climate Adaptation: Risk, Uncertainty and Decision-making. UKCIP Technical Report. Available at: http://www.ukcip.org.uk/wordpress/wp-content/PDFs/Risk.pdf

The World Bank. (2010). The Economics of Climate Change Adaptation: The Synthesis Report. Available at: http://climatechange.worldbank.org/sites/default/files/documents/EACCSynthesisReport.pdf

WRI, World Bank, UNDP, and UNEP. (2011). The World Resources Report: Decision Making in a Changing Climate. Available at: http://pdf.wri.org/world_resources_report_2010-2011.pdf

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov