ACCC
Adapting to Climate Change in China
Sharing Knowledge Globally

ACCC Resource Manual : Reflections on Adaptation Planning Processes and Experiences

The National Development and Reform Commission of China

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Preface

This manual presents the processes, methodologies, lessons and experiences from the Adapting to Climate Change in China (ACCC) Programme. It was prepared in different stages and evolved along with the needs, priorities and experiences of the ACCC research teams. An initial manual was prepared during the summer of 2010, shortly after the project's inception, while partners were engaged in the scoping phase. Many of the concepts, including the phases involved in conducting adaptation planning processes and the use of adaptation planning frameworks as research workplans, were new to many of the partners. As the ACCC research teams moved from the first phase into the assessment phase, it became clear that additional conceptual, methodological and case study material was necessary to support the researchers. Many of the researchers had considerable experience in physical science methodologies and research framing. However, investigating the potential socio-economic implications of climate change and familiarity with the social science methodologies and concepts needed to investigate and integrate social and physical implications was limited. Furthermore, many of the researchers were more familiar with conducting science for science's sake and had to learn how to engage with multiple stakeholders from multiple jurisdictional levels and backgrounds and then how to produce research results that could support actual policies and recommendations for China's national and provincial policy makers. In order to support the teams as they transitioned from pure research to action research, extra training workshops and supplementary methodological materials were prepared, with mixed results. This final version of the ACCC Guidebook represents the evolution of the original manual as it was adapted to the programme's realities, incorporated materials from the training workshops and supplementary materials, and reflected on the observations, experiences and lessons of the ACCC research teams that were gathered during interviews toward the end of the programme.

The challenges experienced in ACCC around research, policy, and action are actually quite common in adaptation planning processes and programmes around the world. While climate change is a global phenomenon, the activities that contribute to climate change and its impacts are inherently local. However,

the suites of solutions required to both mitigate and adapt to it reflect actions at the local-level, informed and supported by provincial and national policy and programmes. As a result, there is no single adaptation planning process that is the only correct process; no step-by-step recipe books exist for how to conduct such processes or prescribed methods and steps. There should NOT be a single, prescriptive process, however frustrating this might be to those beginning adaptation work. Numerous manuals from adaptation and disaster risk reduction programmes around the world are emerging, highlighting the experiences, challenges and barriers, and approaches for overcoming these issues. None of these manuals prescribes what exactly should be done; they instead offer advice and case studies of different approaches that have or have not worked in specific contexts. The lessons emerging from adaptation and disaster risk reduction programmes and projects, including the ACCC programme, indicate that flexibility in approach and methodology, as well as the ability to learn while doing, is key to building long-term resilience against a variety of shocks and slow-onset changes and facilitating adaptation, while reducing vulnerability to existing variability and hazards.

This manual does not seek to be prescriptive about adaptation planning processes or offer step-by-step guidance. It describes the general phases of adaptation planning processes, critical considerations and guiding principles common to all processes, while drawing on the lessons and experiences of ACCC researchers. Readers of the manual will see how that even within ACCC, the various research teams employed different approaches and methodologies, adapting the advice of external technical advisors and lessons from literature searches to their specific provincial and/or research expertise. We offer this manual to those research communities, governmental agencies, non-governmental organisations, and community groups that are interested in learning more about, are beginning or are refining adaptation planning processes. We hope that some of the lessons, barriers and challenges of ACCC documented in this manual will help others in their processes, and facilitate the sharing of experiences between adaptation practitioners.

Introduction to the Manual : The Adapting to Climate Change in China Programme

China is a vast country, with diverse cultures, ecological regions and economic priorities. The various provinces, and regions within each province, face a multitude of climate hazard impacts and are likely to experience different changes in local climate. The Adapting to Climate Change in China (ACCC) project investigatedthe conditions contributing to vulnerability to existing climate hazards in three provinces - Guangdong, Ningxia, and Inner Mongolia - and examined likely climate change risks. The three pilot provinces reflect the diversity of China and a wide range of climate hazards, thresholds, sensitivities and coping strategies. Ningxia is a semi-arid province relying on an extensive irrigation system to support agriculture. Guangdong province, on the southeast coast, is highly urbanised with concentrations of population, infrastructure, and import/ export industries exposed to storm and sea hazards. Inner Mongolia is a province with extensive grassland ecosystems. In recent years, it has undergone a dramatic economic transformation, with rapid development of the energy sector, including both coal mining and renewables (wind). At the same time, the traditional livelihood patterns of nomadic herder populations have changed, leading to widespread grassland and water resources degradation. The information gathered through the ACCC process about the provinces and their contexts, as well as the adaptation planning process itself, are being used to inform policy in China and develop and implement various adaptation strategies.

The ACCC programme represented an iteration of initial adaptation planning processes and efforts within China. Some of the most important outcomes of the programme include the development of relationships between physical and social science researchers and the beginning of dialogue between researchers and policy makers. It is through relationships

and dialogue among a broad array of stakeholders that adaptation actions occur; research alone will rarely spark action or inform decisions and priorities. The development of relationships and dialogue between the Chinese research teams and policy makers took considerable time and effort, particularly during the scoping phase of the programme. Continued engagement, relationship building, and dialogue through the assessment and adaptation options identification and prioritisation phases were critical to the success of those phases. Recommendations to China's National Adaptation Strategy and to the provincial- and national-level five-year plans could not have been made without dialogue and other forms of engagement, particularly the involvement of the National Development and Reform Commission (NDRC) in the ACCC process and the efforts of the ACCC Project Management Office (PMO). The dialogue and relationships guided the overall ACCC adaptation planning process and multiple framings of that process by the various research groups.

This manual is organised around the overall ACCC process and the ways research groups framed it, and bounded by the outcomes and experiences that emerged from the multiple levels of stakeholder engagement. The manual begins with a general overview of the adaptation planning process phases and principles. Immediately following the overview is a detailed chapter on stakeholder engagement, covering the reasons why one should engage with multiple stakeholders, the importance of engagement throughout the process, communication strategies, and some sample methods for engaging. Subsequent chapters are phase-specific, discussing the general goals, potential steps, and conceptual guidelines for selecting methodologies that could be pertinent to that phase. Lessons, experiences, and case studies from ACCC are highlighted in each section to show how the research teams approached each phase, the barriers and challenges they encountered, and how they sought to overcome these issues.

Overview of Adaptation Assessment Processes

There are many challenges facing humanity-growing populations, ecological systems under stress, socio-political differences around managing economies and resources, and climate change. The culmination of these changes and their implications for societies and livelihoods indicates that systematic, reflective and iterative ways of planning are necessary. Adaptation planning processes, among other decision-making processes, are evolving to organise how we think about challenges such as climate change and their implications for various groups of people or economic sectors. They are helping us to identify and prioritise what type of policies and actions we need to take to build resilience and adapt; and to develop ways to monitor and evaluate the effectiveness of our actions as conditions change.

There are numerous adaptation planning processes that can be used in situations where data and information are limited and the future uncertain. Multiple frameworks have been developed to help those involved in adaptation and disaster risk reduction to conceptualise and realise their adaptation planning process in a particular context. The aim of using any framework is for the researcher, decisionmaker and other stakeholders to identify where climate change will have an impact on people or systems. Climate change implications and the associated vulnerabilities are likely to be significant and are context dependent, requiring flexibility in approach rather than application of a single solution. One goal of adaptation planning processes and frameworks should be to identify adaptation options that meet stakeholder-agreed criteria and values - such as, equity, feasibility, minimal environmental impact or livelihood/economic development, among others – while trying to ensure as much as possible that the options do not lead to maladaptation and remain valid as the climate and other determinants continue to change. All adaptation planning processes and frameworks involve these general phases, as good practice in decision-making:

1. Scoping

During this first phase researchers, decision-makers, the project management team, and other stakeholders begin building relationships (initial engagement) and develop an initial understanding of the institutional, social and developmental contexts within which they think adaptation take place. Key stakeholders to the process conduct stakeholder analysis to determine which other stakeholders to engage in each phase, and what role and purpose they will have. Information is gathered from previous research efforts on hazards and disasters, vulnerability and risk, and policy and governance, to find out what already has been done and identify potential barriers, and to develop an overall, initial picture of the area's context(s).

Once a basic, baseline understanding of previous work and the contexts has been conducted, it is a lot easier to identify, focus and agree on an issue or issues to be addressed. During the issue(s) identification and framing step, researchers, decision makers and other key stakeholders should discuss policy cycles, priorities, types of information needed to support decisions and the criteria by which decision makers will accept information, geographies and how far into the future the investigation of potential climate impacts should cover. The key stakeholders also discuss and agree on the key criteria and values, such as social equity, that will be used to guide the overall adaptation planning process.

The framing of the issue(s), the initial stakeholder analysis and engagement, and the agreement of decision priorities by key stakeholders during the scoping phase, will greatly influence the rest of the adaptation planning process. During the scoping phase, important elements of the subsequent phases will be decided, such as: 1) which other stakeholders need to be engaged, for what reasons, how and during what phases of the process; 2)

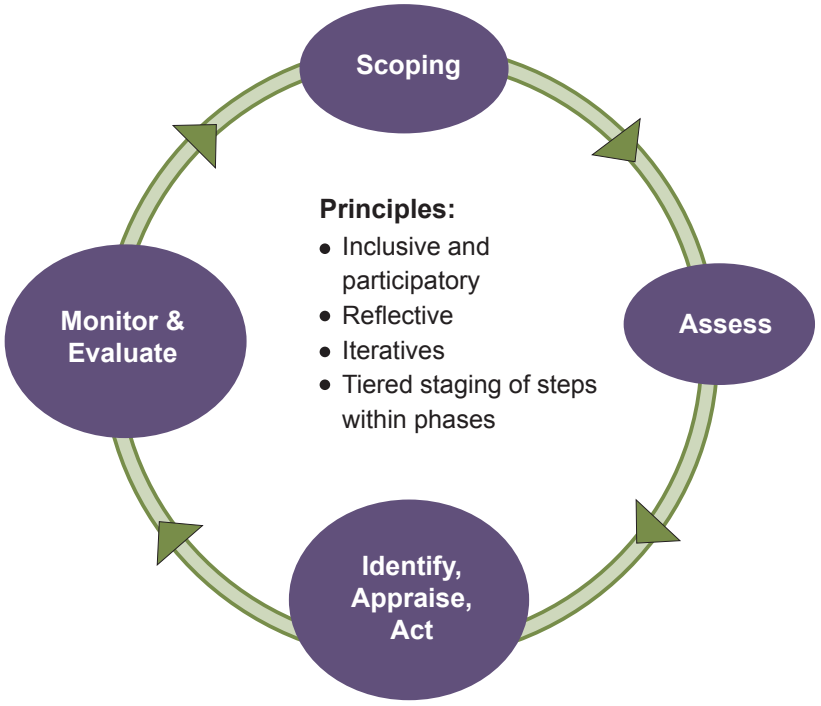


Figure 1: Phases and principles of a general adaptation planning process and framework.

what methods and tools will be used to conduct various assessments and analysis, as only some will be appropriate in some situations; 3) how will the information and outcomes from the assessment phase be presented and discussed with different stakeholders, and, 4) what are some of the possible programmes, organisational activitiesor policies that should be studied or considered.

2. Assessments

The assessment phase involves examining whom or what (e.g. a specific sector like agriculture) is most vulnerable to what kinds of climate changeand other disruptions, the underlying factors or reasons for this vulnerability, and an estimation of future risk and risk factors. Sometimes, assessments start with an examination of how certain climate changelead to particular impacts for sectors or ecosystems and then a projection of how those impacts might evolvein the future, before moving to an estimate of future risk. The first approach is known as a social vulnerability assessment or “bottom-up” assessment, and the second is an impacts assessment or “top-down” approach. Each approach has particular strengths and weaknesses, and provides certain types of information that can aid in the next phase of option identification, appraisal and implementation. Both approaches encompass quantitative measurements of vulnerability and risk, but social

vulnerability assessments also incorporate qualitative analyses that allow for a much more comprehensive vulnerability and risk context and profile than is possible with strictly quantitative impact assessments.

The decisions around whom or what to study (the units of analysis and research endpoints) should have been made in the scoping phase. This is also the time to determine who will conduct the assessment(s), what resources and time the assessment team has for the investigation, to whom they will report the findings from each step and in what formats. Knowledge, data, and sharing from other stakeholders beyond the research team are critical in the assessment phase. A broad set of stakeholders will need to be engaged to inform the assessments. This phase often involves a couple or more iterations between vulnerability and risk analysis steps as new information becomes available and is reported to and reflected upon by key stakeholders.

3. Identification, Appraisal and Implementation of Options

This phase often involves several iterations and requires significant broader stakeholder engagement in order to identify, prioritise and implement policy, cultural, institutional, socio-economic, and technical adaptation options. During the course of the vulnerability and risk assessments, various adaptation options might emerge as stakeholders reflect upon the assessments.The assessments will also provide stakeholders with initial information about the potential benefits or harm (equity issues) that a particular suite of options might cause for a certain group, ecosystem, economic sector or area. Stakeholders evaluate and prioritise options, as well as identify new options, according to the criteria and values they defined in the first phase and refined during the second and current phases.

There are various tools and methods available to evaluate and prioritise options, such as threshold analysis, social preference ranking and scenario building, multi-criteria evaluation, costing and environmental impact assessments. The appropriate tools or sets of methods to evaluate and prioritise options depends greatly on how stakeholders defined the issue(s) in phase one and the information emerging from phase two. As initial suites of options are identified and appraised, it may necessary to do another, more in-depth, iteration of the vulnerability and risk assessments. Options identified and implemented during an adaptation planning process are known as planned adaptation. However, individuals and households will take their own action in response to perceived challenges or opportunities presented by climate change or the planned adaptation programmes and policies of governments or community groups. This “autonomous” adaptation can greatly influence vulnerability and risk- either by building adaptive capacity or leading to maladaptation. Autonomous strategies can also be overwhelmed fairly rapidly if changes – socio-economic, political, climate and environmental – exceed thresholds and sensitivities. The potential autonomous adaptation behaviours and strategies of households should be anticipated and investigated during the assessment phase.

Stakeholders reflecton their criteria and values around building resilience and adaptive capacity, determine the severity and likelihood of various risks, and assess the resources required to address such risks to prioritise which options to implement and in what order. Based on all of the previous phases and steps, researchers can make recommendations to decision makers, communities can take certain actions, and decision makers can implement policies or programmes to support autonomous adaptation efforts and mitigate against maladaptive behaviours.

4. Monitoring and Evaluation

Establishing a monitoring and evaluating process is critical for assessing how well the planned adaptation options are addressing the identified risks, meeting criteria and values, handling unidentified surprises, and building overall resilience and adaptive capacity. The seeds of an effective monitoring and evaluation system are sown during the scoping phase when key stakeholders agree on the criteria and values that will guide the overall adaptation planning process. Some of the key criteria and values can serve as monitoring and evaluation indicators. Each set of planned adaptation options will have unintended outcomes and consequences, especially as socio-economic and environmental conditions change and more individuals and households begin taking autonomous adaptation action. Additional indicators, both qualitative and quantitative, for measuring the performance of planned options will also emerge during phase three as various options are prioritised and evaluated. The monitoring and evaluation phase also establishes how to identify when it is necessary to restart the adaptation planning process as conditions change, and provides a mechanism for learning from and building on the lessons and experiences of the previous iteration of the full adaptation process.

At each phase of the adaptation framework, it is important that a balanced approach is taken into account for both the climate and non-climate sources of vulnerability, risk and uncertainty. A framework helps to guide decision-making processes and allows decision makers and other stakeholders define and refine their attitudes to climate vulnerability and risk. The adaptation planning process should, in theory, involve a broad set of stakeholders. Not all stakeholders will take part in every aspect of the process, or agree with the objectives and criteria defined by the key stakeholders in the process. An adaptation framework may be useful to these stakeholders by providing a roadmap for their contributions tothe process and their involvement in recommendations and reviews of decisions at critical points. Though each ACCC team conducted various phases of the process in a different manner (see Box 1), each adhered to some core principles found in adaptation planning processes:

- Adaptation planning processes are **inclusive** and **participatory**. All will be impacted by climate change, but some will be affected more than others. A single adaptation programme cannot address the vulnerabilities and risks of everyone or every sector, or involve all stakeholders in every step of every phase. A successful adaptation

planning process engages a particular set of stakeholders at critical points in the process for clearly defined purposes so that all may share and co-learn from the knowledge and expertise of each stakeholder group.

- Such processes are **reflective**, allowing review of the performance and outcomes of each step, and the decisions to be made at each step. Decisions are revisited to reflect new information on climate change and its impacts, as well as changing social, economic, policy and ecological conditions.

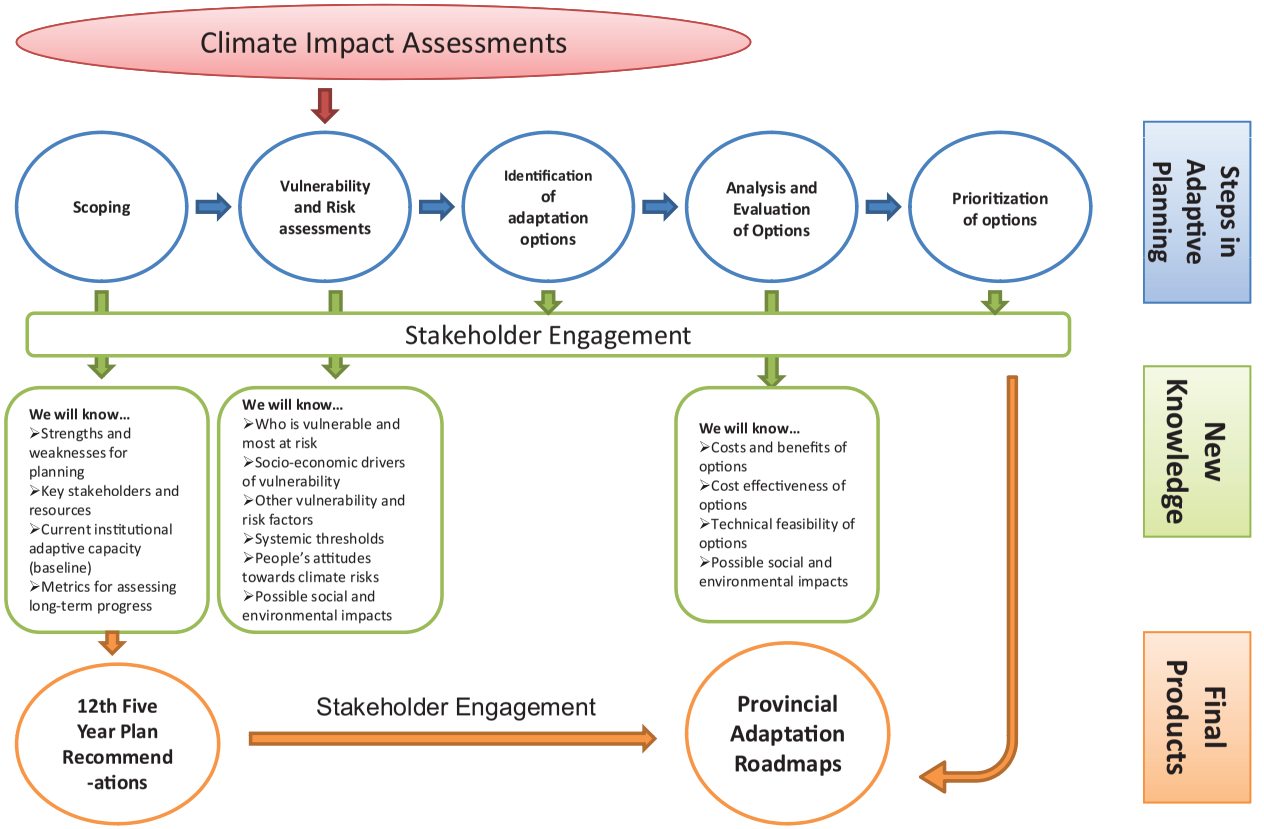
- Adaptation is never complete because conditions and risks are always changing. As a result, adaptation planning processes are **iterative**, allowing the problem, decision-making criteria, vulnerability and risk assessments, and options to be refined as a result of previous analyses and engagement.

- Each phase might consist of several **tiered steps,** allowing decision makers and other stakeholders to screen, evaluate and prioritise vulnerabilities, risks and next steps, and learn from each other before moving on to more detailed assessments and options appraisals.

The rest of this manual is organised around chapters dedicated to key components and phases of an adaptation planning process. Chapter two describes the importance of stakeholder engagement in every phase of the process and provides a few tools for stakeholder analysis. The third chapter focuses on the scoping phase, while the fourth is dedicated to vulnerability and risk assessments. The fifth chapter looks at the identification, prioritisation and implementation of adaptation options, while the final examines monitoring and evaluation systems. Each chapter contains examples of pertinent methods and tools, and concludes with a list of resources for exploring other relevant methods and tools. Many of the listed resources are available online free of charge.

Box 1: ACCC Project Roadmap

The ACCC Project Roadmap followed the general phases of an adaptation planning process, although many elements of the scoping phase, including issues selection, occurred prior to the start of ACCC. Members of the project management offices had existing relationships with the NDRC (policy makers) that enabled identification of pressing issues such as grasslands management in Inner Mongolia prior to the start of the programme.



Engagement: Making Adaptation Planning Processes Work

The goal of an adaptation planning process programme is to inform and/or effect shifts in policy and formal, planned actions that reduce vulnerability and risk, enhance opportunities and are sustainable beyond the duration of the programme.

Adaptation planning processes challenge traditional ways of doing things. The research involved should be done to support policy change and not just done for the sake of research; policy and decision makers need to begin thinking long-term beyond political cycles and sector silos; businesses need to consider the externalities of their actions; and uncomfortable socio-economic inequalities will be uncovered and need to be addressed in order to adapt to an uncertain future. Adaptation planning processes require more than traditional research programmes. These programmes may provide

Box 1: Engagement Challenge: Establishing a Common Language

Vulnerability and risk, adaptation and resilience, impacts - what do these terms mean? In ACCC, social scientists had different definitions for these terms than the physical impacts researchers, and the climate scientists had still different meanings. The different definitions led to methodological confusion between the researchers and difficulty integrating the results of different types of assessments. The differences also led to difficulty in communicating assessment results to decision makers and identifying adaption options.

The definitional challenges around these terms and others associated with adaptation that ACCC stakeholders faced are not unique. Scientific disciplines have different traditions around terms and methods. Vulnerability and risk might mean something very different to insurance agents or government health departments. Identifying, discussing, and clarifying terms amongst key stakeholders during the scoping phase will make the entire adaptation planning process run more smoothly and assist in methodology integration.

detailed information on a particular problem, but they often do not provide relevant and useable information on how that problem fits within broader socio-economic, political or environmental contexts or what sets of options can be taken to address the issues and opportunities uncovered.

The changes in policies and actions that result from the adaptation planning process will impact the lives and livelihoods of many. This requires that the voices of vulnerable populations and communities also be heard in throughout the process as these groups have valuable knowledge and data about the conditions that create vulnerability and risk in their lives, and the acceptability of proposed responses. None of these challenges or the goals of adaptation planning processes can be achieved without continual informed and effective engagement between key stakeholders involved in the process. Failure to engage an appropriately diverse set of stakeholders, using appropriate engagement methods, throughout the process will lead to the identification and possible implementation of options that are at best ineffective and costly, and at worst, lead to maladaptive behaviours that create greater vulnerabilities, diminish potential benefits and/or increase climate risk.

What is engagement? Engagement consists of iterative and continued communication between decision-makers, researchers, businesses, non-governmental and community organizations, and members of vulnerable populations such as fishermen, in order to work toward building a better future. Engagement itself is a process achieved through multiple types of communication methods, such as meetings, workshops, interviews, focus group discussions, and so on, embedded within the larger adaptation planning process. Engagement is about two-way knowledge exchange and thus is more than informing and consulting. The intent is to inform the quality and relevance of the assessments, as well as to stimulate joint ownership and buy-in of the outputs by a broad array of stakeholders. Engagement enables and empowers those so involved to take actions beyond the assessment phase, essential for an adaptation planning process to be deemed successful. This chapter describes how engagement is the glue that facilitates and enables all phases of one cycle of an adaptation planning process. Boxes highlight some challenges and insights of ACCC researchers around engagement in the ACCC programme, which will tend to be common challenges in any adaptation planning process.

Why Engage in Each Phase?

Continual, informed and effective engagement helps achieve the following throughout each phase of the process, and ultimately increases the likelihood that proposed adaptation options realise the intended benefits and are less likely to promote maladaptive behaviour. Some of the roles engagement plays in each phase of the adaptation planning process– sustained two-way knowledge exchange involving key stakeholders to the process, such as those conducting the assessment, are outlined below:

Phase 1: Scoping

Figure 1: ACCC researchers engaging migrant farmers in Ningxia to assess their vulnerability context. Source: CASS 2011.

1. Identifying key stakeholders; why, when and how they should be engaged; their roles and responsibilities; and what each will contribute to the process;
2. Clarifying and rationalising the entire adaptation planning process and the scope and nature of issues to be addressed through the programme, and developing a framework to guide the process that will inform stakeholders, including as to defining and refining their attitudes to vulnerability, risk and opportunities;
3. Agreement and clarity among key stakeholders on the objectives, criteria, expectations, goals, and values that will guide the process;
4. Clarifying roles and responsibilities, resources, and expertise needed for carrying out responsibilities;
5. Developing a common language to inform the undertaking of the phases of the process, particularly the research needed during the assessment and options identification and implementation phases;
6. Developing mechanisms for learning and reflecting upon experiences, mistakes, barriers and challenges throughout the process; and,
7. Developing regular engagement mechanisms to facilitate cooperation, sharing and reflection during and between phases, and to build relationships that can continue the work of an overall adaptation planning process long after an individual programme has completed.

Phase 2: Assessment

1. Clarifying policy makers' information needs and informing policy makers and researchers about issues of which they were unaware, and ensuring that research outputs are able to be tailored and delivered to meet those needs;
2. Clarifying for policy makers and other researchers the nature of the research methods and outputs, including associated limitations and uncertainty;
3. Providing opportunities for coordination and integration of research goals and outputs

between researchers of different specialties;
4. Enabling and encouraging researchers to engage with particular communities likely to be most impacted, for example, farmers or fishermen in a region, local businesses, and other relevant community groups with the aim of bringing their perspectives and observations to inform the vulnerability and risk assessments; and
5. Clarifying the risk preferences of particular communities, policy makers, other researchers and other key stakeholders.

Phase 3: Options Identification, Prioritisation and Implementation

1. Reflecting upon the values, vulnerabilities and the risk preferences of different stakeholders, and learning about their suggestions and preferences for dealing with climate risks and opportunities;
2. Situating the proposed options within the known and projected future socio-economic, climate, political and environmental conditions;
3. Assessing the feasibility, benefits, and equity issues of various adaptation options within the stakeholder-agreed values and goals, the evidence provided by the assessment, and prioritising which options to pursue and in what order (urgency);
4. Identifying and clarifying the criteria, values and goals by which identified options will be evaluated (e.g., relative to identified values, criteria and goals); and
5. Reflecting upon the options as they are implemented and assessing whether the manner in which options are implemented meets values, criteria, and goals.

Phase 4: Monitoring and Evaluation

1. Identifying specific mechanisms for monitoring and evaluating the different implemented adaptation options, including the conditions,responsibilities and roles, and resources for monitoring and evaluation;
2. Developing other appropriate indicators for evaluating the performance and impact of implemented adaptation options;
3. Developing mechanisms for learning and reflecting upon experiences, including what worked, mistakes, barriers, and challenges and why these exist;
4. Agreeing on communication and dissemination mechanisms and outreach to other key stakeholders, including the nature and scope of such mechanisms (e.g., timing) such that they provide relevant information on changes in conditions and/or options; and
5. Agreeing on communication and engagement mechanisms among all stakeholders to identify when wider review is necessary, and on the mechanism for decision-making around wider review.

Who is a Stakeholder? Stakeholder Analysis

“A stakeholder is an individual or group influenced by - and with an ability to significantly impact (directly or indirectly) - the topical area of interest” (Engi and Glicken, 1995:1 in Glicken, 2000).

Stakeholder is a relative term. People only become stakeholders in reference to a particular issue, which, in this case, is around adaptation planning processes. Stakeholders are those who have an interest in the process because they will be affected by the process, have knowledge and data to inform the process, or may have some influence or role to play. Climate change will affect all and require all to adapt, but for practical purposes in an adaptation programme, it is not possible to include everyone in the process. The key stakeholders in an adaptation programme are the project management team, facilitators, researchers, non-governmental and community organisations representing particularly vulnerable populations, and policy makers who play an overarching role in critical steps of a phase and assist in the delivery of key outputs in that phase. A single stakeholder group cannot alone work toward accomplishing the aims of the programme. For instance, researchers conducting assessments without knowledge of policy priorities or community needs might not accurately represent the vulnerability context for an area. The key stakeholders together contribute to the overall development and delivery of the programme, including the provision and sharing of knowledge, data and other information. However, the key stakeholders must engage with a broader set of stakeholders in order for the programme to and/or effect shifts in policy and formal, planned actions that reduce vulnerability and risk, enhance opportunities and are sustainable beyond the duration of the programme.

Other stakeholders include those who can contribute information at critical points in various phases of the process like the assessments or options identification phases, or might be impacted by particular policies, but cannot practically be included in every step of every phase if the programme is being implemented on a national or provincial-level. Engagement and communication with this broader range of stakeholders can be particularly useful during the assessment, adaptation options identification and implementation, and monitoring and evaluation phases. They can provide critical qualitative information and quantitative data on vulnerability and risk contexts, as well as participate in identifying and assessing options thereby broadening the perspective and context. For these reasons, it is absolutely critical to engage with this broader range of stakeholders even though they will not participate in every aspect of the adaptation planning process.

Stakeholder analysis during the scoping phase can assist in determining the role potential stakeholders might play at key steps of each phase, and where a particular stakeholder does not need to be involved, thus targeting stakeholders for specific purposes.

Stakeholder analysis will have to be repeated as the programme progresses, and new information and knowledge emerge from different steps in each phase. Key stakeholders may find that they need to include different stakeholders as part of the broader stakeholder engagement than they initially thought in the scoping phase. Thus stakeholder analysis should be seen as an iterative process.

Generally, the following types of stakeholders (see Stakeholder Mapping Matrix) will have some role to play in an adaptation planning process. The project management team should also consider creating such a stakeholder matrix or map during the initial stakeholder analysis to identify potential stakeholders and their interest in the process. It should then be repeated with the researchers and policy makers most involved in the process to identify and assess the other individuals or organisations that should also be engaged. The stakeholder matrix was loosely based on some of stakeholder groups interested and / or involved in ACCC in some capacity and by generalising their interests

TOOL 1: Stakeholder Mapping Matrix

Stakeholder Classification	Role in Adaptation Planning
National government ministries and agencies with sector policy and planning responsibilities: *NDRC, agriculture, forestry, water resources, health, disaster risk reduction, etc.*	• Provide knowledge and advice on sector policies, plans and related processes. Identifying related barriers and enablers. • Identify priorities related to evidence and knowledge needs, inform researchers of information needs. • Facilitate data and information access. Provide feedback on research capability to impact policy & programme. Identify knowledge and evidence gaps. • Support dialogues and integration across sectors, policies and plans at the national level and other scales • Be ambassadors for the programme, communicating with colleagues and representing constituencies' interests in the programme. • Facilitate capacity building with other national government officials and experts. • Participate in the development of adaptation options informed by the assessments and broader stakeholder engagement. • Act on the knowledge and evidence from the programme to inform national polices, plans and other programmes as adaptation options.
Provincial governments, including provincial components of national *agencies - DRCs, Provincial Institutes of Public Health*	• Similar to above, but at the provincial level working with other provincial officials and experts. • Provide advice and feedback on provincial issues, values and other considerations. • Facilitate integration across and within the province – across local governments and countryside management.
Local city or village government	• Similar to national level roles, but at a local level.

Stakeholder Classification	Role in Adaptation Planning
	• Provide advice and feedback on local issues, values and other considerations. • Support participation in case studies and field investigations; facilitate participation and capacity building of local experts, government officials and community leaders. • Assist in local data collection and identification and exploration of knowledge and evidence gaps.
National and provincial research institutions, universities and other academic institutions *Chinese Academy of Social Sciences, Chinese Academy of Agricultural Sciences* *Chinese Meteorological Agency*	• Contribute to the development, support and delivery of research during the assessment phases and facilitating the identification of research priorities based on knowledge and evidence needs of stakeholders (including other researchers). • Provide data and information (e.g., climate, socio-economic and environmental data and impacts analysis); assist in data and information management, communication and dissemination within the programme and beyond; and, support and guidance on interpretation and use of information and data. • Build the capacity of stakeholders (including researchers) across the programme through co-learning and multi- /trans-disciplinary research
Local community groups and individuals, including business and industry representatives	• Participate in case studies, workshops and other participatory activities providing specific knowledge, information and data to the assessment and adaptation options phases. • Facilitate the transfer of knowledge to and from the programme as representatives of their communities and organisations. • Act on the knowledge and evidence provided to inform practices and activities. • Provide feedback to researchers and policy makers on the utility of knowledge and evidence provided, and input into the identification of further needs.
NGOs and religious organisations	• Facilitate the organisation and engagement of local community groups and other constituents. • Share the results and experience of their own research and programmes, including knowledge and data, to the adaptation programme. • Provide advice and expertise to inform the development and delivery of the programme and its outputs. • Enhance the impacts of the programme by facilitating and disseminating outputs beyond the programme and identifying synergies with other similar activities in the NGO or religious network. • Build the capacity of their constituencies.

and role in the programme. It can be used as a template for one tool in conducting stakeholder mapping, but it should not be seen as prescriptive in exactly how to identify a potential stakeholder, the scale at which that stakeholder operates, or their potential role and interest in the adaptation planning process. The stakeholders listed in italics in the table are examples of types of stakeholders operating at different geographic scales and administrative levels. Two additional questionnaires are presented after the mapping tool to assist in thinking about what stakeholders to engage, their interests and potential influence in the programme, and what role they might play.

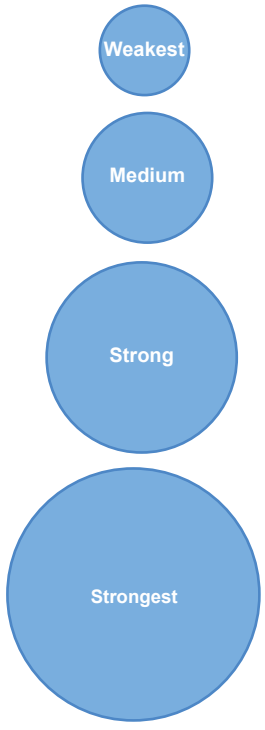
Once potential stakeholders have been identified via stakeholder mapping, it is important to try to understand a potential stakeholder's influencein the adaptation planning process. Influence on and interest in a project can be some of the decision criteria used to determine whether or not to include a potential stakeholder as a key stakeholder to the process, or as a broader stakeholder. The following set of questions as part of the stakeholder identification map can assist in scoping roles and interests. The set of questions is not comprehensive. Additional questions appropriate to a particular adaptation planning programme will be developed during the stakeholder analysis.

TOOL 2: Influential Stakeholder Question Checklist

Some individuals or government ministries, for example, will have power or influence over an adaptation programme and should be included in some role as stakeholders with whom there is regular engagement. Influential stakeholders may control what decisions are made, how they are implemented, or exert some other influence which affects the project negatively or positively. They may be able to coerce or persuade others into making decisions about the project. Asking this set of questions during stakeholder analysis can help determine how to include a potentially influential stakeholder in the adaptation process. This list of questions is not comprehensive and can be amended throughout iterations of stakeholder analysis during the scoping and subsequent phases.

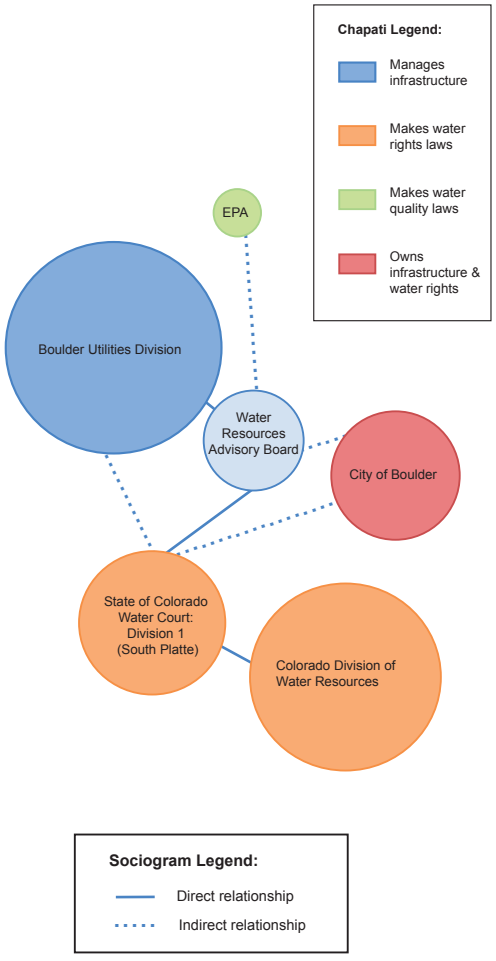
- Do they control decisions – e.g., finances, project deliverable timelines, etc. – about the project?
- Do they have important connections to other politicians, donors, community groups, etc.?
- Do they have access to additional funding?
- Do they have a high standing within the community, city, province, etc., such as religious, social or political influence?
- Can they affect the image of the project?
- Can they affect the delivery of the outputs and impacts or benefits of the project?
- Do they have authority, either formal or informal?
- Are they connected with a government ministry, community group, or NGO with a potential stake in the adaptation project?
- What kinds of relationships do they have with other potential key stakeholders or in relation to the potential issues to be addressed?
- What kinds of expertise, knowledge or data do this individual or group offer to the project?

Sociograms are another tool that can be used to map stakeholder relationships and aid in stakeholder analysis. Sociograms (a version of Venn Diagrams) are visualisation tools in which the perceived power or influence of particular stakeholders and their relationships to other stakeholders is investigated. The relative power or influence of a particular stakeholder in relation to a particular topic, policy or area of interest – such as governmental agencies, ministries or departments involved in regulating and providing water in the area being considered - is designated (by shape and object size – see the Stakeholder Influence/Power circles) during stakeholder analysis by consultation with multiple stakeholders. Other stakeholders with an interest or role in the particular issue are also assigned influence/power shapes. The shapes are then mapped, placing the stakeholders in relative position to each other and marking the relationships between them – whether or not they have direct communications or relationships, or only interact in an indirect manner.



Stakeholder Influence or Power, Additional circles can be added for more options.

TOOL 3: Hypothetical sociogram around drinking water in the city of Boulder, Colorado (U.S). The names of stakeholders are real, but their roles, influence or power and relationships are fictional examples.



There are additional ways of thinking about the potential roles, interests and influence of a stakeholder at various points throughout the adaptation planning process. The Stakeholder Analysis Questionnaire Checklist can assist further in stakeholder analysis. The types of questions in the checklist below will also assist in determining what engagement methods or tools are appropriate to use, and will help identify gaps in expertise on the proposed methods and provide training to fill the gaps. Additionally, the stakeholder group seeking to engage with another group will have a clear sense of the purpose of the engagement and a plan for how to undertake it.

TOOL 4: Stakeholder Analysis Questionnaire Checklist

- Which stakeholders do you want to consult or involve?
- Are you informing, researching, consulting or involving stakeholders in decisions?
- How does this engagement support the overall adaptation planning process? What is its purpose within the particular phase of the process?
- Do stakeholders need to be consulted separately or together?
- Will they be difficult to reach?
- Do you want to involve large numbers or small numbers of people?
- Do they know it is important to them or are you going to have to tell them?
- How complex is the topic?
- What do you want from them? Information, possible partnership, or co-operation?
- Do you want to provide information and have a discussion before you start?
- Do you want to build consensus?
- Do you want qualitative or quantitative data? Will you be asking open or closed questions?
- Do you have the ability to analyse large amounts of qualitative data?
- How will you be presenting the information gathered through stakeholder engagement to the other primary stakeholders and integrating the information with their research?

As stakeholder engagement provides the basis for enhancing the quality and benefits of an adaptation planning process, including through the production and delivery of evidence that can lead to implementation of effective, socially and environmentally equitable policies and adaptation options, it is absolutely critical that the appropriate stakeholders are engaged. Initial stakeholder analysis by the project management team to select other key stakeholders, such as the researchers and policy makers to be engaged throughout the whole process,must be undertaken at programme inception. During the scoping phase, this initial set of stakeholders will conduct further stakeholder analysis to determine which other researchers, policy makers, NGOs, business groups or community groups need to be engaged before proceeding onto the next steps of the scoping phase or subsequent programme phases.There are a number of stakeholder analysis and engagement tools and methodologies beyond the three listed previously available online (see the Resources Section at the end of this chapter), so we do not provide a comprehensive list of these in this chapter.

The Role of the Facilitator

Facilitators are critical members of the individual engagement activities and assist in keeping the adaptation planning process running smoothly. The best-planned engagement approaches will fail if there is not a facilitator who can effectively moderate and ensure that other stakeholders are able to contribute fully to the process. The facilitator or facilitation team helps to balance the conflicting interests of different groups, identify common ground and help integrate different approaches and ideas. The facilitator's role is *'to encourage everyone to participate, promote mutual understanding and cultivate shared responsibility'* (Kaner et al. 1998: 31). The person or team acting as the facilitator(s) must be aware of his or her own desires, biases and prejudices and not allow these to influence the process. Some think that the facilitator should be a neutral player who is not a stakeholder to the process. However, in adaptation planning processes, it is not always practical to have a neutral player as the facilitator. Instead, the facilitator might be a member of the project management team or an external advisor working closely with the project management team. Thus, the facilitator or facilitation team can also be a stakeholder assisting the other

Box 2: ACCC Stakeholders

How an adaptation planning process is constructed and then evolves in the scoping phase will determine who is a primary stakeholder and who is a more passive stakeholder. In ACCC, for example, the goals of the programme were to inform national policy and investigate the vulnerability and climate risk conditions in three provinces. These programme goals determined the stakeholders. ACCC brought together a diverse set of researchers – economists, climate scientists and physical scientists – each with different methodological practices, terminology and research interests. At the same time, ACCC engaged with national-level and provincial-level policy makers from project inception to ensure that all information was relevant and usable in China's Five Year Plan. The National Development and Reform Commission (NDRC) is the main governmental agency in charge of developing and implementing China's policies around socio-economic and land development. The ACCC Project Management Office (PMO) worked with NDRC at all stages of the project, and included them in training workshops and project meetings. ACCC researchers soon found that they needed to engage with members of vulnerable populations and local policy makers in order to really grasp local vulnerability contexts and how there were multiple contexts even within the same province. Some research teams also found that secondary stakeholders were better able to identify and recommend context-specific adaptation options that would not have been identified without the broader engagement.

Some ACCC Stakeholders:

- Project management team
- National and provincial research teams
- Policy makers or government in the NDRC and provincial DRCs
- Vulnerable populations – e.g., farmers, herders, coastal urban dwellers, etc.
- International consultants
- Members of other government agencies

key stakeholders through all phases of the process. The facilitator(s) to an adaptation planning process serve several key purposes throughout an adaptation planning process:

- Assisting the stakeholders, who have different backgrounds, expertise and interests, to navigate those differences and work together effectively to achieve the common goals of the process.
- Helping the stakeholders communicate more effectively and consistently with each other, in order to be able to integrate and coordinate efforts and outcomes, and overcome research differences and barriers more rapidly.
- Assisting the stakeholders in their outreach and engagement efforts with other stakeholders, such as when researchers engage with vulnerable populations like farmers for assessment research, or when gathering input to inform the identification of adaptation options.

Box 3: Engagement Challenge: Overcoming Traditional Attitudes

The need for regular and appropriate communication between policy makers and researchers, between researchers of different disciplines, and between researchers, policy makers, and members of target communities, such as farmers in Ningxia, was a new and difficult concept for all involved in the programme. Many of the researchers involved in the assessment phase had never worked with policy makers or conducted research to support policy. Some had difficulty understanding how engagement was necessary for the adaptation planning process, or even how it contributed to their research during the assessment phase.

These types of institutional barriers against communication and collaboration are quite common throughout the world. Scientists are used to working in silos and conducting research separately from policy needs. Policy makers are more comfortable using sound-bite information produced in short timeframes in response to specific questions and less so with using broader scientific evidence to incorporate into policies that consider impacts and actions for the next 20, 50 or more years. Members of the public rarely listen to either policy makers or scientists. Yet the actions of all determine adaptation in an uncertain future and require iterative discussion and sustained engagement to work towards the desired outcomes. It takes time to build relationships through engagement and change traditional attitudes toward working with others.

It might also be possible to have a rotating facilitator from the different stakeholder groups so that the responsibility is shared and no single group appears to be favoured. To be able to function effectively, the facilitator chosen must be acceptable to everyone involved. He or she also needs to have experience of running participatory processes, know multiple engagement methods and tools, be responsive to the needs of the group and be able to vary the style of their approach to fit the demands of the situation. It is also important that the facilitatorhas experience and background knowledge of adaptation planning processes, climate change issues, and the challenges of bridging traditional research and policy-making divides. The facilitator helps the other stakeholders navigate the challenges and discomfort of engagement, which can be particularly daunting to researchers and policy makers, especially those from backgrounds that do not traditionally encourage such types of collaboration and work.

Some Core Principles and Good Practice

Even the principles that are adopted to guide engagement and participation throughout the adaptation planning process are not set in stone. However, good practice and experience from other adaptation planning programmes indicate that the following core principles assist in successful engagement in any phase of the process and with multiple stakeholders:

- Key stakeholders are involved in relevant phases and critical decision points in the programme;
- Methodologies for engagement – i.e., workshops, interviews, or meetings - must respect the knowledge and experience that all participants bring to the project;
- Engagement emphasises knowledge, transparency, trust-building and learning throughout the project, especially from mistakes and challenges;
- Time and resources are adequately allotted for engagement throughout the process, as insufficient time and resources will hamper the process;
- The project team members continuously and critically examine attitudes, ideas and behaviours;
- The adaptation planning process, and methods for engagement, acknowledge and address inequalities of power and voice amongst participating stakeholders;
- Engagement explicitly aims to build capacity.

At every phase of the process, the primary stakeholders should consider the above principles when engaging with each other and when reaching out to other stakeholders. The principles are described in greater detail:

Clarity

Be clear about the aims and objectives of the engagement. What are you trying to achieve with the particular group you wish to engage? What techniques are culturally appropriate and account for socio-political power differences? Work towards a shared definition of the problem, acknowledging differences in people's perception of it. Be realistic about what can be achieved given the resources of time, money, expertise and political will available. Have a clear communication strategy including access to, and presentation of, information. Short-term interests inevitably take over when resources are scarce.

Understanding of related processes

Be clear about how the engagement fits in with official decision-making processes. Will the engagement process feed into and inform these other processes effectively? It is important to identify people, groups and structures that can provide support to achieve any actions identified through the engagement process.

Management of information

Having access to information is a form of power. Some groups will need to be persuaded of the benefit that they will receive from sharing information and developing a more holistic understanding of the issues. Information should be provided in an accessible way that relates to decision-making needs or a vulnerable population's interests, without using complex concepts and scientific jargon. Communication and decision-making is not purely a rational process; people's feelings and attitudes are also important. People understand and use information in different ways. This needs to be taken into account and respected. Information may also be presented in different ways, for example as values or moral opinions, as scientific facts or as personal experience, depending on the audience – i.e., other policy makers or members of vulnerable populations. Explain the aims and purpose of the process in advance as well as detailing what participants will actually be required to do.

Respect for information and data

The information, knowledge, expertise and data held by non-technical experts, such as farmers or policy makers, is as important as that produced by formally trained researchers. Community members, members of vulnerable populations, policy makers and NGOs, among other stakeholders to the adaptation planning process, understand their particular underlying situations, such as the socio-economic or cultural contexts, much better than external researchers because they must live through these on a daily basis. The data and knowledge that non-scientists contribute to the process are critical to ensuring its success.

Support and capacity building

Some groups may need training or other support to enable them to engage on an equal footing with the other stakeholders. This may be in the form of information that enables them to contribute to the discussions or provision of data on likely impacts for their area or sector.

Transparency

Stakeholder groups should be identified in an open and transparent manner. Throughout all stages of the process, the primary stakeholders need to maintain consistent and open communication with each other in order to handle the methodological, informational, and relationship challenges that will inevitably arise. Transparency about challenges and barriers will help all stakeholders learn from the process and develop solutions to address issues as they arise.

Figure 2: Stakeholder engagement vulnerability ranking exercise in Ningxia. Source: CASS 2011.

Primary stakeholders need to be transparent – i.e., not withholding important information or failing to cover uncertainty or the implications of a particular action – with secondary stakeholders.

Trust-building

Stakeholder processes may bring together groups with opposing views or with socio-political power differences, such as local villagers with provincial policy makers. Trust between certain groups may be poor. People need to feel that the other members of the process will hear their views respectfully and that they will not be censored for expressing their opinions. If power or social differentials are too large, it may be important to separate the groups to allow participants to safely express themselves. Assuring parti cipants that this is the intention of the process is important. When people feel reassured that their voices will be heard, they will be more able to listen effectively to others.

Time and resources for the process

Lack of time and resources are given as the most common constraints of many engagement processes. Effective stakeholder engagement does take more time than conventional processes as time is required to develop the process, build partnerships and strengthen networks between stakeholders, raise awareness and build trust, and maintain effective communication throughout the entire adaptation planning process. Sufficient resources, such as trained facilitators and an array of materials for different communication techniques, are important to the process.

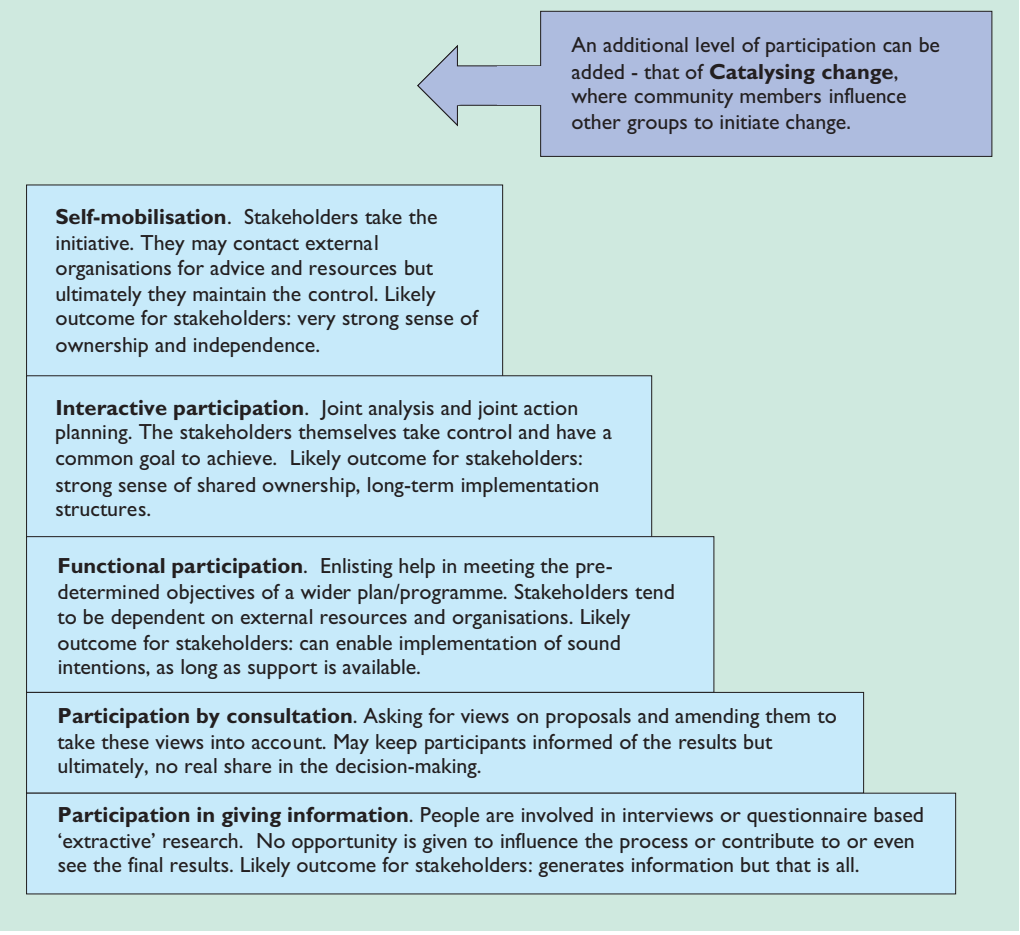
Feedback and flexibility

Participatory processes can be very flexible. If one technique is not working, another can be used or the questions changed to obtain the information required. This flexibility needs to be planned, and time must be allowed to get feedback on how effective the process is. Are the right questions being asked? Is everyone contributing fully? If not, what is preventing them and what could be improved? The analysis and synthesis of the outputs should be presented to stakeholders before general dissemination. Any conflicts of interest should be stated explicitly. This demonstrates a respect for differences, which is absolutely critical in adaptation planning processes because they involve so many different stakeholders with different expertise, expectations and roles.

Stakeholder engagement approaches vary from quite passive interactions, where the stakeholders provide and receive information, to ‘self mobilisation’, where the stakeholders themselves initiate and design the process. In an adaptation planning process, there can be quite a few levels of stakeholder engagement that depend on the stakeholder (for example, a researcher or policy maker) and their role and interest in the process. The level of participation can be illustrated using the ladder of participation (see figure). Some stakeholders will be able to participate in the levels of self-mobilisation and interactive

participation. Other stakeholders will be engaged at different levels of participation, such as functional or consultation participation, for different phases of the project, given the experience of the research team and the goals of that phase. However, it is important that the stakeholders understand how they are being involved, how the information they provide will be used and to what degree they have any power to influence decisions.

Box 4: Ladder of Participation (adapted from Pretty, 1994, Typology of Community Participation)



Tips for Engagement

It is important to consider the scope of the issues that stakeholders will participate in defining and solving (Thomas, 1996), especially in the scoping phase. When designing the engagement, it is important to take into account the phase at which the engagement is occurring in terms of the policy making process, what decisions have already been taken and what positions are already fixed, and how these relate or are likely to shape the overall adaptation planning process. Certain engagement approaches will be more appropriate

in certain situations than in others. For instance, if the policy agenda is already clearly defined, participatory approaches inviting stakeholder input to the agenda are not likely to be very effective; the approach and goals of the engagement should reflect the goals and phase of the overall adaptation planning process.

There are a vast number of approaches, tools and methods to stakeholder engagement. The choice of which to use depends on the complexity of the issues to be discussed, the purpose of the engagement and who is being engaged. All of these will initially be determined in the scoping phase of the adaptation planning process, where a careful evaluation of the time and resources available should be performed, and re-evaluated and adjusted at subsequent phases of the process as the stakeholders learn what is working and what is not. The stakeholders should be able to draw from a variety of tools, methods and techniques in order to find the set most appropriate to the situation; there is no 'one size fits all' formula, but a number of tools and techniques that can be applied to suit a given situation. We provide a list of online resources at the end of this chapter that can assist with stakeholder analysis and engagement.

Summary

An adaptation planning process should involve as many stakeholders as possible because all will be impacted by climate and socio-economic change. In practice, capacity, interest, resources and decision priorities will influence the roles and levels of participation of various stakeholders. How each phase is conducted, who are involved in each phase and the various tiered steps within, the methods and techniques used and the outcomes, is entirely dependent upon context. The context depends upon things such things as overall criteria, values and research priorities, the resources – time, expertise, monetary, etc. – available for conducting the process, and cultural preferences and traditions for how such work should be conducted. Stakeholder engagement is critical for deciding context and all aspects of an adaptation planning process – indeed such a process is less likely to be successful at reducing vulnerability and risk, enhancing capacity or securing buy-in and support for adaptation options without broad stakeholder participation in the programme.

Resources and References

Note: Many of the methods and tools for stakeholder engagement emerged from the Participatory Rural Appraisal (PRA) and Participatory Learning and Action fields that developed in the late 1980s and 90s and are evolving today. While some of the resources listed below mention 'rural' in their titles, the methods, tools and techniques each resource documents are useful in a variety of geographies beyond rural areas and with a broad array of stakeholders.

Allen, W., et al. (2013), *Learning for Sustainability: Helping People Collaborate and Innovate,* http://learningforsustainability.net. The website contains multiple resources, methods and techniques geared around multi-stakeholder learning processes. Accessed 16 August 2013.

Bharwani, S., et al. (2013), Stakeholder analysis and engagement: Introduction to stakeholder analysis and engagement. In *weADAPT,* http://weadapt.org/knowledge-base/transforming-governance/Stakeholder-analysis-and-engagement accessed 22 September 2013. One contributor to this resource (K. Lonsdale) also provided material to this engagement chapter.

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Community-Institutional Partnerships for Prevention Research Group (2013), *Developing and Sustaining Community-Based Participatory Research Partnerships: A Skill-Building Curriculum,* http://depts.washington.edu/ccph/cbpr/intro/intro.php. Accessed 16 August 2013.

Glicken, J. (2000), Getting stakeholder participation 'right': a discussion of the participatory processes and possible pitfalls. *Environmental Science and Policy* 3: 305-310.

Kaner, S.,et al. (1998), Facilitator's Guide to Participatory Decision-Making, John Wiley & Sons, Inc. Publishers.

MaClune, K., S. Opitz-Stapleton and K. Hansen-Tyler (2012), *Climate Resilience Framework: Training Materials. Series 1: Establishing Resilience Principles,* ISET-International. All training materials available from http://training.i-s-e-t.org as of 23 September 2013.

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Participation, Power and Social Change Team [PPSC] (2013), *Participatory Methods,* Institute of Development Studies, www.participatorymethods.org. Accessed 16 August 2013.

Pretty, J.N., et al. (1995), *Participatory Learning and Action: A Trainer's Guide,* International Institute for Environment and Development, ISBN 1 8998 2500 2. Available from: http://www.earthprint.com

Reed, M.S., et al. (2009), Who's in and why? A typology of stakeholder analysis methods for natural resource management, *Journal of Environmental Management* 90: 1933-1949.Accessible from http://sustainable-learning.org/wp-content/uploads/2012/01/Who%E2%80%99s-in-and-why-A-typology-of-stakeholder-analysis-methods-for-natural-resource-management.pdf on 16 August 2013.

Salas, M. and Wise Andean People's Networks (2013), *Voices and Flavours from the Earth: Visualising Food Security in the Andes*, International Institute for Environment and Development [IIED]. Available from: http://pubs.iied.org/G03593.html?c=part on 16 August 2013.

Shah, M. K., S. D.Kambou and B.Monahan (1999), *Embracing Participation in Development: Wisdom from the field,* Care-US, available online at http://pqdl.care.org/CuttingEdge/Embracing%20Participation%20in%20Development-Wisdom%20from%20the%20Field.pdf as of 22 September 2013.

Wageningen UR Centre for Development and Innovation (2013),*Participatory Planning, Monitoring and Evaluation: Managing and Learning for Impact in Rural Development,* http://portals.wi.wur.nl/ppme/?Home. Accessed 16 August 2013.

Phase 1: Introduction to the Scoping Phase

The scoping phase, including the initial stakeholder engagement, provides the foundation that informs and guides the rest of the adaptation planning process. Before embarking on the assessment phase, it is essential to clearly articulate the reasons for the adaptation process and expected outcomes, as it is during this scoping phase that some of the most important decisions are made. It provides the reasons for undertaking particular types of assessments to support the process, and the broad objectives and wider context for the desired outcomes. It also establishes the required contributions to the process, which stakeholders will undertake particular activities and how these will together deliver the required adaptation planning process. Therefore, it is absolutely critical to ensuring the success of the process.

There are a number of decisions to be made in the scoping phase that can only be achieved through the initial stakeholder engagement. The types of decisions can also be thought of as steps in the scoping phase and include:

- Discussing initial reasons for the adaptation planning process;
- Conducting initial stakeholder analysis and engaging identified stakeholders;
- Framing the adaptation planning process with key stakeholders by
    - Soliciting additional stakeholder analysis and engagement,
    - Clarifying decision priorities and issue areas of concern,
    - Establishing a common language,
    - Establishing guiding principles, criteria and values;
- Mapping out the assessment phase; and
- Conceptualising the later phases of the process.

This chapter discusses the steps of the scoping phase, which rely heavily on stakeholder engagement. It will reference and link to other chapters in this manual.

Step 1: Initial Reasons for the Adaptation Planning Process

Agovernment department or agency, a non-governmental organisation, a research group or a donorwill often initiate an adaptation planning process programme in response to a perceived need. The need for such a process may arise from a range of factors, including:

- Development of a new policy or project;
- Changes in legislation, government or other policy, or regulatory guidance;
- Regular reviews of on-going programmes of activity;
- Public concerns (possibly reflected by the media);
- Pressure from interest groups;
- New scientific information on present day or future climate risk;
- New technologies.

Figure 1: Scoping visit to Inner Mongolia to assess grassland and livelihood contexts. Source: Opitz-Stapleton 2010.

The factors that have led to the need for an adaptation planning process will also affect the extent to which those initiating the process are able to integr ate climate change and adaptation into the planning process. While knowledge and awareness of climate change have improved in recent years, many decisions are still and will continue to be taken without considering the potential effects of climate change, or in ignorance of the **sensitivity** of the issue to assumptions regarding current and future climate. Hence, consideration of climate change may mean that a problem needs to be re-framed. For example, a problem that is defined as *'How do we protect a community from coastal flooding over the next 100 years?'* may, in light of anticipated rises in sea level, need rethinking, so that a broader range of options can be considered at the options identification phase. The problem could usefully be reframed as: *'How do we manage the consequences of sea level rise for the community at risk over the next 100 years?*' For some planning processes, however, there may be policies in place to guide the decision-maker towards a set of appropriate adaptation options. Where there is uncertainty, a well-defined problem should be as open as possible, so that options for the decision are not cut off at an early stage.

Some members of the group(s) initiating the adaptation planning process will likely become key stakeholders to the overall process, often as members of the project management team or the guidance team. It will be up to this initial group of key stakeholders to identify the need(s) for the adaptation planning process, conduct the initial stakeholder analysis and engage with those stakeholdersaround the needs for, and scope of, the process. This initial analysis may change once a broader set of stakeholders has been engaged and begin actively participating in the scoping phase.

Step 2: Initial Stakeholder Analysis and Engagement

Stakeholder analysis is fundamental and should be undertaken iteratively throughout all phases of the adaptation planning process. This involves a preliminary identification of stakeholders and then working with those stakeholders to further discuss who should be engaged, in addition to when, why and how. In undertaking these analyses, it is useful to remember that stakeholder is a relative term, with individuals and organisations becoming stakeholders in reference to a particular issue or aspect of the adaptation planning process. They include those who have an interest in the process, those that have knowledge or data that is needed or those that may have some influence over the process and its outcomes. See the Engagement chapter for a discussion on stakeholders in adaptation planning processes and various types of engagement and analysis in the different phases.

An initial stakeholder analysis by the project management team or those initiating the process will identify the stakeholders to be engaged. It is an analysis consisting of identifying those that should potentially be engaged, assessing their interests and determining the way these interests may affect the proposed engagement. The analysis will also help to identify what support they might need to be able to participate effectively as a stakeholder. The initial analysis should identify relationships; potential synergies and conflicts; sources of knowledge, information and data; and the timing and methods for engaging the different stakeholders. It should also identify whether they should be part of the scoping phase and/or subsequent phases of the adaptation planning process.

One approach for undertaking a stakeholder analysis comprises the following:

- Create an initial list of stakeholders.
- Identify their interests by asking the following questions:
  - What will they want or expect from the assessment?
  - What are the likely benefits for them?
  - What are the likely benefits they would bring to the assessment?
  - How does the proposed stakeholder regard others, and how would they be regarded by others on the list? Are there potential synergistic or conflicting relationships?
  - What is the nature of the constituency they represent and their relationship with that constituency?

Within the scoping phase, it is essential to identify and engage those stakeholders that are critical to the success of the adaptation planning process. These are the individuals and organisations whose needs, interests, capabilities and activities (policies and programmes) will be affected by the outcomes of the process. If they are not engaged, the adaptation planning process would be less successful. Some questions (Tool 1) that may be helpful in identifying these stakeholders include:

TOOL 1: Questions for Identifying Critical Stakeholders

- Who are the individuals and organisations that will or should be using the outcomes of the adaptation planning process (i.e., the target audience)? Who has asked for the process and an assessment of vulnerability or risk?
- Who are the individuals and organisations that will need to buy into the process and the outcomes?
- Who will be affected by the outcomes of the assessment? What are the different relationships between those that will be affected?
- Are there existing bodies or organisations that represent those who will be affected?
- Who has data, information or knowledge that you will need?
- Are there synergistic or conflicting relationships or interests that would affect the adaptation planning process?

There is also a need to engage those stakeholders who have power that could influence the adaptation planning process or the implementation of its outcomes. These stakeholders may control aspects of the process, decisions that could be made based on the outcomes or how these decisions are implemented, or exert some other influence that could affect the process and its outcomes either positively or negatively (e.g., encourage others to make and implement decisions based on the assessment phase outcomes). The questions that may be helpful in identifying these stakeholders are:

- Who controls or can exert an influence over decisions about the process, particularly the assessment phase?
- Who has important connections (e.g., political, budgetary, or cultural)?
- Who has high standing with the community of interest (e.g., religious or community leaders, professional institutions, or industrial leaders)?

Additional considerations for stakeholder analysis, tips and methods for analysis and engagement, as well as links to other resources are provided in the previous chapter on Stakeholder Engagement.

Step 3: Framing the Adaptation Planning Process

Once a broader set of key stakeholders has been identified, it will be necessary to engage them through a workshop, meeting or other facilitated gathering so that they may meet each other and make some key decisions about the adaptation planning process. It may take multiple meetings and additional communication between key stakeholders before

Box 1: Scoping in the ACCC Programme

ACCC brought together a diverse set of researchers, including economists, climate scientists and physical scientists, each with different methodological practices, terminology and research interests. For many of the researchers, the adaptation planning research process, beginning with scoping and initial stakeholder engagement before moving to vulnerability and risk assessments, was a new concept. Many of the physical scientists were more familiar with an impacts assessment approach (see next chapter) and not familiar with the methodology or rationale behind a socio-economic vulnerability-based assessment approach. Few of the research partners had experience engaging with policy makers or formulating their research to support decision-making criteria and priorities.

Partners held a number of scoping workshops at the project's inception to map the process and begin learning about other methodologies. They were introduced to the importance of stakeholder engagement, which was a new way of doing work in China, and began to learn about vulnerability assessments. Following the scoping workshops, provincial teams conducted preliminary research and began engagement to gain a basic overview of the policy landscape in each province. This information was compiled into provincial scoping reports that were shared with other ACCC partners so that each might learn from the others and exchange ideas for moving forward. It took quite a bit of time for partners to become comfortable with the new methodologies, stakeholder engagement and working across disciplines as introduced during the scoping phase, which is quite normal in all adaptation planning processes.

At the same time, ACCC engaged with national- and provincial-level policy makers to ensure that all information was relevant and usable in China's Five-Year Plan. The National Development and Reform Commission (NDRC) is the main governmental agency in charge of developing and implementing China's policies on socio-economic and land development. The ACCC Project Management Office (PMO) worked with NDRC at all stages of the project, and included them in training workshops and project meetings.

decisions can be finalised. The types of decisions to make at this step of the scoping phase include:

- Understandingand clearly articulating the purpose of the process;
- Deciding the issues to be addressed and investigated;
- Exploring decision-maker priorities and decision cycles;
- Establishing a common language;
- Establishing key stakeholder criteria, goals and principles; and
- Confirming understanding of the above points and of the timing, roles and resources needed to conduct various steps of each programme phase.

Some tools that can assist these and the other steps of the scoping phase include:

Understanding the Purpose of the Adaptation Planning Process

The group initiating the adaptation planning process had reasons for doing so. Once this group begins engaging with a broader set of key stakeholders, they may identify other needs for conducting the process. A wider discussion is required to see if additional purposes should be considered, although policy and decision priorities might

be constrained and not allow for such consideration. An adaptation planning process can have multiple purposes, from primarily a research focus with the desire to inform policy to a complete programme with the stated goal of actually changing policy and the implementation of other types of adaptation options. Discussion around the purpose(s) of the adaptation planning process can assist the key stakeholders in framing the issue(s) to be investigated. At this time, they will alsobegin articulating desired outcomes (goals) and defining the principles and criteria that will guide actions throughout the process and assist in forming metrics for monitoring and evaluating the success of the programme.

Table 1: Some Tools and Techniques for the Scoping Phase

Tool/Technique	Level of Familiarity with Problem Area	Number of Stakeholders	Identify Related Decisions
Brainstorming	Low/Medium/High	Low/Medium	Potentially
Engagement Exercises	High	High	Potentially
Focus Groups	Medium/High	Medium/High	No
Analysis of Interconnected Decision Areas (AIDA)	Medium/High	Low/Medium	Yes
Problem Mapping Tools	Low/Medium/High	Low/Medium/High	Potentially
Free-form Gaming	Medium/High	Medium/High	Yes
Policy Exercise	Medium/High	Medium/High	Yes

Determining Issues to be Addressed

Climate and socio-economic changes will have multiple impacts on societies and biophysical systems like agriculture. However, it is never possible to address every single issue in an adaptation planning process. While key stakeholders are determining the purpose of the process, they will also need to spend time framing the issues to be addressed. Whether the purpose of the adaptation programme is to conduct research to inform policy or to actually change policy and institute other adaptation options, it is necessary to understand and relate the adaptation planning process to policy priorities and cycles, and where climate change risk considerations fit.

Stakeholders will need to incorporate and reflect upon new knowledge and changes in capacity that continually emerge as a result of the assessment phase and other adaptation initiatives. As such, assessments within an adaptation planning process are more than traditional research programmes.The entire process is likely to require a long-term component, which in itself is flexible and adaptive in response to evolving political, socio-economic and environmental conditions, as well as evolving science and practice knowledge.

The framing of the adaptation planning process needs to consider:

1. *Planning for and managing the process* ('what's on paper') are important for establishing a strategy, as well as for monitoring and evaluating progress. Some important considerations in planning are:

- Planning provides the means of establishing aims and objectives against which actions will later be judged through monitoring and evaluation initiatives. Without this anchor, the assessment phase is much more difficult.
- Plans will need to be tailored to the institutional environment in which they will be applied.
- Plans themselves must also adapt so that they are formed and developed through an on-going, institutionally constrained process.

2. *Organisational process:* The real world system of people, processes and protocols that constitute the social and institutional environment and mechanisms through which any plans and actions are produced and delivered. This includes existing culture, capacities and practices and the building of additional capacity and practice.

3. *Outcomes, decisions and actions:* Planning and process must result in a series of decisions and actions, the outcome of which is intended to reduce the risks or enhance opportunities posed by climate change. These need not, and in most cases should not, be based purely on climate change adaptation considerations.

- What are policy and programme priorities? What are the socio-economic and environmental priorities? What are the relative sensitivities of these to climate variability and change, including knowledge of thresholds and these sensitivities? These should include consideration of the capacity and willingness of policy, programmes and practices to include the implications of a changing climate and proposed adaptation measures.
- What constitutes an outcome is potentially complex. For example, organisational process changes, sometimes categorised as building adaptive capacity, might lead to real changes in levels of resilience or adaptability and therefore be considered outcomes. There is a tendency to consider these as just processes and categorise outcomes only as changes in physical assets and infrastructure. This simplistic division may be unhelpful and privilege hard (technical) adaptation measures over soft adaptation measures.

4. *Desired and deliverable outcomes:* The objectives and criteria by which outcomes will be assessed need to be articulated and agreed upon by key stakeholders, particularly where trade-offs need to be made or where synergies are possible or desirable.

5.*Understanding the policy and practice communities and their decision-making culture and requirements:* This includes consideration of enablers, barriers/constraints, capacities and risk aversion, as well as potential interdependencies, trigger points and associated timeframes.

- Mechanisms by which adaptation options will relate to established policy and management mechanisms and approaches, and to what extent adaptation has and can be integrated into these.

6. Stakeholders to engage in each phase of the process: Other key stakeholders (individuals, organisations, and communities) and a broader array of stakeholders that should be engaged - why, when, and how.

7.*Resource commitments and requirements:* How much time do the process partners have for each phase? What kinds of resources – monetary, expertise, equipment, data and information, additional methodological training – are needed to complete each phase? What kinds of contingency plans exist for dealing with barriers and time delays that will arise? What expectations does each process partner have of the other partners?

Box 2: Engagement Challenge: Communication between Researchers and Non-Scientists

Non-scientists – policy makers, farmers, fishermen and businesses, for example – create policies and make decisions at a more rapid pace than at which research is typically conducted, and they depend on different types of information than research sometimes produces. Researchers within ACCC initially had limited engagement with policy makers at a variety of administrative levels in China. As a result, researchers had difficulty understanding policy cycles or how their research would support policy. They were uncertain how to tailor or communicate research and its results to decision-makers' needs.

ACCC researchers were also unused to engaging with members of different communities (e.g., herders in Inner Mongolia) beyond surveys and structured interviews. They found that multiple focus group discussions, workshops and meetings were necessary to begin understanding the vulnerability contexts of different populations within each province. Furthermore, ACCC researchers found such engagement was necessary to collect data for the assessment phase. It is only through time and continued engagement with policy makers and other non-scientists that researchers can understand how to conduct research to support policy needs and priorities.

Situating the adaptation planning process and outcomes within policy cycles and priorities (points 2, 3 and 5) can partially be accomplished through a policy review. Policy and decision planning processes – whether sector-specific like water infrastructure or public health - consist of a ***planning cycle*** (how frequently plans are made) and the ***planning horizon*** (how far into the future each plan is supposed to cover). The outcomes of a planning process – changes in policies or other implemented options – have a ***planned lifetime*** of how long decision makers intend for the outcomes to last. In reality, most outcomes, especially those related to infrastructure or land use development, will continue to have an impact or be used longer than the planned lifetime. This is known as the ***effective lifetime***. These aspects of decision-making should be considered during the scoping phase when framing the overall adaptation planning programme and the

issues(s) to be addressed by it. A policy review is a critical part of the scoping phase, as it helps to identify existing policies, laws and rules that may influence or be influenced by the adaptation planning process. In particular, a policy review assists in identifying:

- What policies already exist that could relate to your adaptation efforts;
- Identify the interaction between policies instituted at the national level and sub-national levels;
- Identify which agencies are in charge of implementing and enforcing those polices at each level;
- Identify the communication mechanisms between each implementing and enforcing agency;
- Identify conflicts between policies or between implementing and enforcing agencies at different scales.
- Identify who is currently benefiting or being harmed by those policies;
- Identify the metrics that are currently used to determine whether a particular policy is effective or not.

The following types of questions (Tool 2) can assist in framing the issues and understanding decision priorities and cycles, and the relative importance of climate change to these. It will also help to focus on how climate change-related risks and uncertainties should be taken into account during later phases of the planning process.

TOOL 2: Key Questions for Issue Framing

- Where does the need to make the decision come from? What are the main drivers behind the decision? What beneficial objectives are intended?
- Is the problem explicitly one of managing present-day climate or adapting to future climate change?
- If the main driver is not related to climate or climate change, is climate change believed to be a factor in the problem?If so, how important is climate change believed to be, relative to other factors?
- Is the focus to inform a policy-, programme - or project-level decision?
- Who or what will benefit or suffer as a consequence of the problem being addressed? Who are the key stakeholders representing these interests?
- Have timescales been established for making and/or implementing a decision? Do these timescales constrain the time available for the decision appraisal, or vice versa?
- Is the decision expected to provide benefits in the long-term (> 10 years) or have other long-term consequences?
  - Describe what they are, the likely time period, and to whom they may be important.
  - Decisions with long-term consequences are likely to be more sensitive to climate change.
- What makes the correct decision? In other words, what are the criteria against which your options will be appraised? Criteria might include the risk of the option not succeeding, ease of implementation, cost, equity, public approval, public acceptability, etc.
- What are the legislative requirements or constraints?
  - For government agencies, does the decision require an appraisal that explicitly considers both costs and benefits?
  - Do guidelines exist that set out the approach that should be taken to the appraisal?

- What are the rules for making the decision, given the uncertainty in climate change? For instance, what is the relative focus on risk aversion, maximising benefit and/or minimising cost?
- What is the decision-making culture?
  - Is the culture one of open and explicit decision-making?
  - Do different stakeholders need to be involved in the decision-making process? If so, how?
  - Is the goal consensus or a demonstrably 'rational', if not unanimous, choice?
- Could the decision being considered constrain others' ability to adapt to climate change (i.e., contribute to climate maladaptation)?
  - Options or decisions that may constrain climate adaptation can be difficult to identify at this stage. They may be only apparent when the option is assessed.
  - If it is believed that the options being considered may adversely affect the ability of other stakeholders to manage climate change risks in the future, their interests and involvement in the decision-making process should be considered.
- Who is the ultimate decision-maker?
- Has climate change already been accounted for at a strategic level? If so, was this consideration adequate? Does the strategy take account of all possible climate change outcomes?

Beyond the above sets of questions, it is important to evaluate how current policy priorities or activities about to be implemented may exacerbate or reduce vulnerability and risk in light of climate change. This will have to be investigated more completely during the assessment phase. However, if critical infrastructure or some other type of policy with long-term implications is being considered, these need to be accounted for during the scoping phase of the adaptation process to ensure that the process addresses issues (potentially beyond its scope) that will affect programme design and outcomes. Some questions (Tool 3) to assist in thinking about the lifetimes and potential long-term implications of various policy or decision priorities and cycles, and how the adaptation planning process may affect or be impacted by these, include:

Box 3: Examples of a Decision Planning Process:

A water utility/water department might plan to build a new water treatment plant that will become operational six years from now, meaning that six years is the timeframe for the planning process. The resulting treatment plant is expected to provide drinking water to the city for at least 50 years (this is the planned lifetime), but is likely to actually provide water for 80 years (effective lifetime). Another example is a health department's efforts to identify likely dengue fever hotspots in a city prior to the rainy season each year and implement, over the next five years, a campaign to reduce dengue transmission and incidence. Yet another example might be an urban planning department's 20-year vision for expanding city boundaries or developing land in low-lying areas. Development of those lands would occur over the next two to ten years. However, once these areas are developed, it is likely they will be occupied for at least 100 years or longer. Once developed, they will change the floodscape of the city.

Policy Review

	Policy	Administrative Scale	National Agency(s) Responsible	Regional/ Municipal Agency(s) Responsible	Coordination Mechanisms	Who/ What Benefits	Conflicts w/ Other Policy	Metrics of Effectiveness
Hazards and Disasters	Policy XXX -Storm resistant building standards	National level down to parroquias	Ministry of the Environment (MoE)	Planning and Construction Department (PCD)	None for the moment. The MoE issues the policy and expects all lower level agencies to implement and enforce it. There is no communication from the PCD back to the MoE.	Residents and businesses in storm risk areas might be better protected and have fewer asset losses	Does not easily support poverty reduction policies because poor residents can't afford to build homes according to code	Number of storm resistant buildings that survive a storm with minimal damage and the loss claims of building inhabitants as compared to non-storm resistant buildings
Environmental Protection								
Energy								
Climate Change								
Water								
Poverty Reduction								

TOOL 3: Understanding Decision Time Frames

- How often are plans made (planning cycle) and who is involved in, develops and implements the plans?
- How far into the future do these plans extend (planning horizon) and what do these plans do?
- What kind of structural elements (institutional arrangements, legislative/regulatory/physical structures) or programmes might be put in place to support such plans? What kind of decisions might be implemented under such plans?
- How long are the resulting structural elements, programmes and related decisions planned to last (planned lifetime)?
- What is the nature and history of similar existing structural elements?
  - How long have similar decisions been part of the institutional, legislative or physical environment?
  - Are any of these still considered to be current and legitimate (nature and scope of buy-in and ownership) and what was the expected lifetime?
  - How long will the proposed structural elements, programmes and related decisions actually last or continue to have an impact (effective lifetime)?
- What kind of climate and socio-economic information is used in each plan? What are the variables and other information? What are the time steps? How far into the future should the climate projections and socio-economic scenarios cover?

Additional methods that can clarify policy or decision-making priorities and cycles include policy reviews matrices. An example tool for a policy review is provided below, with additional resources listed at the end of this chapter.

Establishing a Common Language

Developing a common language and set of terms across the assessment team and other stakeholders is essential to the success of the adaptation planning process and the eventual buy-in of the assessment outcomes. These are critical for success, considering the range of research and stakeholder expertise and perspectives engaged. They are required to guide the scoping phase and to identify and implement thevulnerability and risk assessment methodologies that are the foundation for the subsequent adaptation planning. In particular, developing a common language is the critical first step toward methodological and assessment output integration, and will help to identify expertise gaps and expectations across the assessment team and other key stakeholders. The issue of establishing a common language is re-visited in the assessment chapter.

Establishing Criteria, Principles and Values for Decision-Making

The scoping phase establishes the criteria for decision-making around all aspects of the adaptation planning process, including the scope and breadth of the analyses in the assessment phase. The broad objectives of decision-makers and other key stakeholders need to be translated into operational criteria that can be used in the adaptation planning process, and against which the performance of different options and the subsequent

Box 4: Definitions of Vulnerability and Risk

Vulnerability is one of the fundamental concepts in an adaptation assessment. Although widely used, its interpretation varies, viewed as a residual of climate change impacts minus adaptation (an alternative interpretation of adaptive capacity) or as a general characteristic or state generated by multiple factors and processes, but exacerbated by climate change. The following definitions have some common features:

- All define vulnerability as the degree, extent or magnitude to which the system is susceptible to harm/adverse effects of climate change
- All state that vulnerability depends on a system's sensitivity and its adaptive capacity

Vulnerability – The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC AR4, 2007).

Vulnerability – the degree to which the exposure unit is susceptible to harm due to exposure to a perturbation or stress, and the ability (or lack thereof) of the exposure unit to cope, recover, or fundamentally adapt, that is become a new system or become extinct (Kasperson et al., 2000). It can also be considered as the underlying exposure to damaging shocks, perturbation or stress, rather than the probability or projected incidence of those shocks themselves (UNDP, 2005).

Vulnerability – The extent to which a natural system or human society is unable to cope with the negative impacts of climate change, variability and extremes. It depends on changes in climate as well as the sensitivity and adaptive capacity of the system or society (Australian Greenhouse Office, 2003).

Vulnerability – Refers to the magnitude of harm that would result from a particular hazardous event. The concept recognises, for example, that different sub-types of a receptor may differ in their sensitivity to a particular level of hazard. Therefore climate vulnerability defines the extent to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It depends not only on a system's sensitivity but also on its adaptive capacity. Hence arctic alpine flora or the elderly may be more vulnerable to climate change than other components of our flora or population. (Willows and Connell, 2003).

Vulnerability – The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. For positive factors, which increase the ability of people to cope with hazards, see definition of capacity (UN/ISDR, 2004).

Vulnerability – The degree to which an individual, group or system is susceptible to harm due to exposure to a hazard or stress, and the (in)ability to cope, recover, or fundamentally adapt, that is become a new system or become extinct (Tompkins, E., 2005).

There are multiple definitions of risk, depending on the research tradition, such as natural hazards, climate science, or insurance and economics. Some definitions are presented below:

Risk – The probability that a situation will produce harm under specified conditions. It is a combination of two factors: the probability that an adverse event will occur; and the consequences of that adverse event. Risk is a function of likelihood of the biophysical and socio-economic impacts being realized and vulnerability (Preston and Stafford-Smith, 2009).

Risk – encompasses impacts on human and natural systems, and arises from exposure and hazard. Hazard is determined by whether a particular situation or event has the

potential to cause harmful effects (Australian Greenhouse Office. 2003).
Risk – (climate-related) – Is the result of interaction of physically defined hazards with the properties of the exposed systems – i.e., their sensitivity or (social) vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its consequences – i.e., risk equals the probability of climate hazard multiplied by a given system's vulnerability (UNDP, 2005).

The term 'risk' is often used in the context of climate change. However, it has not yet been defined, either by the UNFCCC or by the IPCC.

decisions can be appraised. It prompts consideration of the context for the decision-making process. These criteria should reflect uncertainty about the future and future climate, and will be influenced by the policy and decision-making culture and attitudes to risk.

*Adaptation Planning Processes and their Outcomes **SHOULD**:*

- Help a particular group, community, organisation, service delivery agency, ecosystem or urban area to adapt to and beneficially shape processes of social, environmental and climate change.
- Help prepare for and mitigate the impacts or outcomes of not only short-term shocks (e.g., as a result of extreme events like floods or landslides or when conditions are such that thresholds, coping mechanisms and sensitivities are exceeded for a critical element of a system or group of people), but ALSO long-term, gradual changes, like longer-term increases in temperature during a particular season. Long-term, slow changes may garner as much attention as specific hazard events that cause massive damage, but over time they can cause even greater damage and be even harder to recover from because their gradual occurrence may escape notice until it is difficult to change course.
- Help prepare for uncertainty. Conditions – socio-economic, environmental, political and environmental including climate – will never evolve exactly as projected. Processes and outcomes should consider uncertainty and its implications when identifying risks and adaptation options to work toward robustness against a variety of situations.

*They SHOULD **NOT** :*

- Make socio-economic, environmental or climate conditions worse or create newproblems.
- Undertake adaptation planning based on a single / deterministic future.
- Commit to a course of action that is hard to correct or redirect later on if it turns out to have been ill-informed, when new knowledge becomes available, or if socio-economic, environmental, political or the climate drivers change differently than that projected.

In many cases, the criteria for decision-making will be constrained, for example, by the legislative and regulatory environment, other stakeholders and decision-makers, budgets, etc. Stakeholders may have different, and sometimes conflicting, decision-making criteria.

Decision-makers need to recognise these conflicts (as well as potential synergies) at an early stage in the process, as they may provide a focus for any decision. Such constraints should have arisen, or had their appropriateness examined, through a risk-based decision process such as that advocated here. The constraints can be different for climate adaptation and climate-influenced decisions, as follows:

- For climate adaptation decisions, the process may be informed or constrained by policies formulated specifically to lead towards a portfolio of appropriate climate adaptation options.
- For climate-influenced decisions, climate adaptation may be peripheral to the initial objectives. In these cases, climate change may represent a risk to or constraint on these objectives. The purpose of the adaptation planning processes and the assessment phaseis then to recognise the nature and significance of these climatic risks and constraints, and identify modified objectives that can be achieved.

During the scoping phase, the decision-maker may only be aware of some of the possible decision options, and may wish to consider other decision criteria as a result of further analyses within the assessment phase. It may be necessary to revisit this step of the scoping phase further on during the adaptation planning process, to ensure that the criteria chosen are correct. Stakeholders to the process may also decide that a set of core principles and values are needed to guide the process and assist in the formulation of the process. These core principles and values are complementary to the decision-making criteria, and may include considerations of:

Legitimacy – Do people believe in, support, and provide resources/authority to enact the policy or action? Who is responsible for implementing the policy?

Equity – Who or what is being helped/harmed by the policy or action? What are the potential impacts for society or the environment?

Efficiency – Does the policy or action fit within budget, planning timelines and technical capacity?

Effectiveness – Can the policy or action do what it says it will do to reduce risk? Does it acknowledge and/or address critical thresholds? Can it respond flexibly to unanticipated changes or impacts?

Sustainability – Can the options contribute to sustainability and are they themselves sustainable?

Acceptability – Are they culturally, socially, environmentally and politically?

Urgency –Do they match the importance of timing of required action?

Costs – What are the associated economic, social and environmental costs (focus on estimates of size rather than precise figures)?

Timing – Are they consistent with policy, investment, maintenance and other planning cycles?

Coherence – Are the options consistent with other development goals and priorities (including mitigation), and not just a ‘bolt-on’? Do theyinclude potential conflicts and synergies within and across sectors?

Robust – Do they reduce vulnerability under current climate? Do they include low-

regret options that should be undertaken anyway, incorporate uncertainty, safety margins, and are flexible and mindful of actions by others?

Dependencies – What actions, legislation, regulatory framework, incentives (existing and gaps), investments, externalities, etc. are needed as pre-requisites to implementation? What synergies (win-win options) and conflicts exist?

The sets of criteria, values and principles that stakeholders choose during the scoping phase should be reflected upon during the subsequent phases of the adaptation planning process. As information emerges during the assessment phase, stakeholders may want to reconsider criteria, values and principles and assess whether these are still applicable to the process or need to be modified. Brainstorming exercises, Venn Diagrams and visioning exercises are just some of the types of methods that can be used to help stakeholders explore and define the criteria, values and principles that will guide the overall adaptation planning process.

Step 4: Mapping out the Assessment Phase

The assessment phase of an adaptation planning process is where the majority of the research will be conducted. This research will establish an understanding of vulnerability and risk related to stakeholder-defined issues before identifying and implementing adaptation options and establishing a monitoring and evaluation system. Formulating the issues that the assessment phase will address represents a critical step. Before embarking on the assessment phase, it is essential to understand the reasons for the assessment, the broad objectives, and the wider context for the assessment. The way an issue is framed is likely to affect the approach and the associated analysis. It may well be necessary to revisit this scoping phase further on during the adaptation planning process to ensure that the problem has been correctly defined and is being addressed properly.

It is during this first phase (scoping) that key stakeholders consider the appropriate level of the assessment phase, which will later influence adaptation options and monitoring and evaluation. The scoping phase focuses on framing the following aspects of the adaptation planning process:

- The planning horizons and comprehensiveness of the required assessment, both in depth (detail) and breadth (scope). Refer to the Tool 3. This will have implications for, and may be constrained by, the available capacity, time and financial resources and will need to be balanced with the requirement for the assessment to be well-informed and based on sound information, science and policy/practice.
- The policy and practice communities and their decision-making culture and requirements, including consideration of enablers, constraints, capacities, risk aversion, as well as potential interdependencies, trigger points and associated timeframes.
- Other key stakeholders (individuals, organisations, and communities) and a broader array of stakeholders that should be engaged, and why, when and how they should be engaged, in order to support the assessments – such as the sharing of knowledge and

insights that are necessary to developing the vulnerability and capacity contexts.

- Definitions of vulnerability and risk to be used, as well as a discussion and confirmation of the required methodologies, degree and manner of integration between research methodologies around vulnerability and risk and the intentions and rational for that integration, and required outcomes. Details and some tools for deciding these aspects of mapping out the assessments are discussed in the assessment chapter.
- Coordination across the research teams to facilitate the integration of their efforts such that research findings are integrated, complementary and use a consistent set of terminology. The aim is to provide a research environment that promotes understanding between the engaged policy makers and research teams.

Mapping out the assessment phase during the scoping phase will facilitate stakeholder buy-in to the assessment methodologies and outcomes and assist in the effective integration of all assessment components prior to moving into the adaptation options identification and implementation phase. Additionally, broader stakeholder engagement will be critical to the success of the adaptation phase. Scoping ahead of time can assist in thinking about broader engagement:

- Who are other key stakeholders likely to be involved in the phases of the process because they can offer information for the assessments and/or options identification (for example,herders that have been directly experiencing changes to the grasslands due to socio-economic, policy and climate change)?
- Who are likely to be impacted by the decisions made? Who has knowledge and information that can inform the assessment?
- How should they be engaged?

The list of questions above is not comprehensive, but it illustrates the types of planning and delivery considerations that should be addressed at the beginning. If done properly, scoping can assist in proper vulnerability and risk identification, as well as ensuring that the outputs of the assessment and resulting adaptation options are more meaningful successful. The following types of questions (Tool 4) should be considered when mapping out the assessment phase, whereas Table 2 provides an example of a simple framing of an issue to be investigated and a mapping of how it might be investigated in an assessment phase:

TOOL 4: Key Questions for Framing the Assessment Phase and Outcomes

- Has climate change already been accounted for at a strategic level? If so, was consideration of climate change at the strategic level adequate? Does the strategy take account of all possible climate change outcomes?
- What resources (financial and human resources) are available to undertake the assessment? This will help determine how in-depth the assessment process can be, and what expertise and tools are available to deliverthe process.
- Have the potentially vulnerable units of analysis – who or what is to be studied - been identified?

- Have assessment endpoints been identified as a basis for assessing vulnerability and risk to the exposure unit and units of analysis?
  - Assessment endpoints should be directly relevant to the problem, useful to the decision-maker, and amenable to the vulnerability and risk analysis.
  - One or more assessment endpoints may be required, depending on the complexity of the problem.
- Can assessment endpoints be analysed in terms of:
  - Past records and future scenarios of climate variability?
  - Other non-climate factors?
  - Providing a basis for quantitative risk assessments, if required?
- Have assessment endpoints and timescales over which they will be assessed been agreed between the assessment team and other key stakeholders?
  - If there are consequences beyond this time frame, e.g., to future stakeholders ('sustainability'), it may be beneficial to consider longer timeframes.
- Have all project management issues been agreed? For example:
  - Are the resources and time allocated to undertake the integrated vulnerability and risk assessment reasonable and proportionate to the importance and urgency of the assessment problem?
  - Are the objectives clearly defined and achievable?
  - Are the necessary expertise and data accessible?
  - Have assessment tasks been allocated and the appropriate key stakeholders to carry out those tasks been identified?

Table 2: An example of a possible policy objective, relating to health outcomes, to demonstrate the relationship between the objectives, assessment criteria, units of analysis, exposure unit, and vulnerability and risk assessment endpoints. Factors contributing to the risk assessment are also identified. These factors should be chosen in such a way that informed decisions might be taken that would help the policy objectives to be achieved. Source: Willows and Connell 2003: 15.

Policy objective	Reduce the frequency of winter fracture injuries in the elderly population.
Criteria	20% reduction in hospital in-patient elderly admissions and attendance at outpatient clinics for fracture injuries by 2025.
Units of analysis and exposure units	(i) Population of people aged over 60 years within health authority districts throughout England and Wales. (ii) Hospitals providing inpatient and outpatient orthopaedic services. (Additional aspects of the exposure unit may be included as factors contributing to the vulnerability and risk assessment. Importantly this might include significant variability in climate across the exposure unit.)
Assessment endpoints	(i) 90% confidence that the risk of (a) Colles wrist fracture and (b) Hip fracture (expressed as rates per 10,000 population) can be reduced by 20% by 2025, compared to 2000. (ii) Probable impact on the total level of A&E presentations, hospital

	admissions and outpatient clinic attendance due to all fractures that may result from falls.
Factors (to be considered in terms of assessment endpoints)	Months (September to March) Weather (perhaps including consideration of freezing conditions, presence of snow, wind speed, prolonged wet periods) Mobility (pre-injury) Gender Social status Disability Domestic situation (living alone, partner/family, sheltered accommodation, etc.) Car ownership Income Age group (60-70, 70-80, 80+) Provision of advice to help minimise risk of falling, etc.

The scoping phase of the adaptation planning process is very important. The iterative aspect of adaptation planning processes allows the decisions made during the scoping phase to be revisited as understanding develops during the assessment phase. However, taking time at the beginning of the process to select the most appropriate possible exposure units, units of analysis and endpoints can save much time and many resources. Choosing these variables can be difficult in practice and, in the case that key stakeholders have difficulty answering the questions intended to guide the selection of these variables, it might be more appropriate to refocus the process on developing an understanding of the baseline or current level of risk posed by weather and climate.

Failing to actively engage in a scoping phase can result in tacit assumptions about different approaches and tools used, resulting in misdirection and creating confusion during the assessment phase. It can also have a strong influence on outcomes or create path dependencies that limit the flexibility of the assessment and the planned adaptation during the options identification, prioritisation and implementation phase. This does not mean that all critical decisions need to be made during the scoping phase. Careful and explicit scoping and designing of the assessment phase relatively early on will enhance the quality of the assessment and its outputs. It will often be necessary to revisit the decisions made in this initial scoping throughout the assessment phase to confirm the continued validity of the objectives and decisions made in the context of the information coming to light during the assessment. The assessment chapter provides more detail on mapping out the vulnerability and risk assessments and the general steps of this associated phase.

Step 5: Considering Adaptations Options Identification and Implementation

Once socio-economic and biophysical vulnerabilities have been integrated and risks have been identified and prioritised in the assessment phase, adaptation options can be identified.

Continued engagement throughout the assessment phase helps to refine and inform the policy priorities, decision timeframes, and decision criteria first identified in the scoping phase (Phase 1) to which the adaptation options should adhere. Additional engagement,for example through workshops, focus groups and interviews, is absolutely critical to the identification and prioritisation of adaptation options. Through engagement, stakeholders will refine the criteria by which to judge adaptation options in a manner that reflects the desired outcomes and the planning and cultural framing, including risk tolerance. These criteria, initially developed in the scoping phase, also help to form the foundation of the monitoring and evaluation system to be put in place while assessing and implementing options. The criteria help in forming monitoring and evaluation (M&E) indicators, and in establishing the mechanisms by which the monitoring and evaluation will occur.

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Phase 2: Assessment

Overview of Vulnerability and Risk Assessments

The assessment phase is critical for determining who (which group of people) or what (a key sector such as agriculture) might suffer harm (vulnerability) due to current climate variability and/or extremes and future climate change, and why they are vulnerable. This investigation of vulnerability is integrated into an assessment of risk, which is a determination of the severity of the consequences of a climate event might be given underlying vulnerability and the likelihood of the impact occurrence. These consequences could be the result of a typhoon, a hot spell during an unusual time of year, or long-term gradual changes to an area's average precipitation. While it is easier to investigate the potential consequences of climate hazards and extreme events, the impacts of slow-onset, creeping changes in overall climate – such as sea level rise or desertification - can be just as detrimental or beneficial. See Glantz (1999) for more on slow-onset, creeping climate and environmental change problems. Figure 1 depicts how climate change will manifest through overall, slow-onset shifts in an area's average

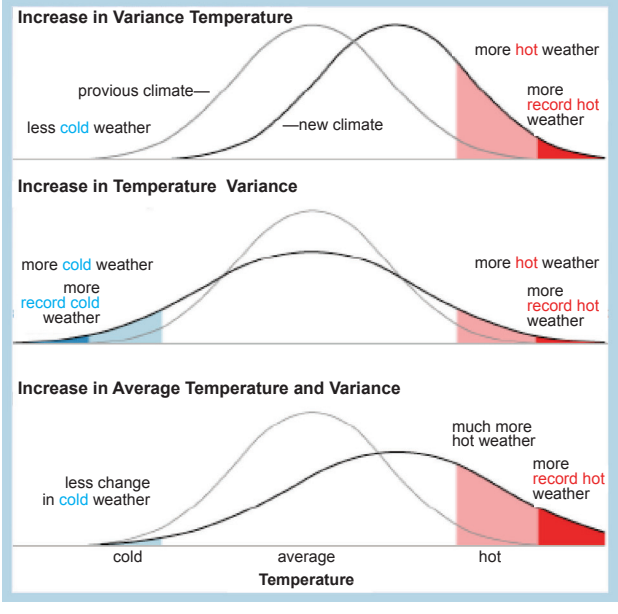


Figure 1: Climate change will alter an area's overall climate and extreme events. Source: Birkmann and Seng (2011).

climate (the 'Increase in Average Temperature') and through an increase in extreme events/hazards (the 'Increase in Temperature Variance'). The combination of these two types of climate change will have impacts – some potentially beneficial and others potentially negative – for people, sectors, systems and areas. It is critical that an integrated vulnerability and risk assessment investigate the potential vulnerabilities, capacities and risks associated on both types of change. Focusing only on climate variance (extreme events or hazards) can have profound consequences and increase maladaptation. It cannot be stressed enough that both types of change must be considered during the assessment phase.

An effective assessment phase is accomplished through a variety of mechanisms and methodologies, including participatory workshops, specific research models and secondary data collection, among others. Whatever mechanisms are chosen, they should involve a broad range of stakeholders to conduct the assessments, contribute and co-learn knowledge, data and information, and reflect upon on vulnerability and risk contexts at a variety of geographic (e.g. community-level on up to national-level) and temporal (current to stakeholder-defined future period like the 2040s) scales.

This chapter describes vulnerability and risk assessments, some methodologies and techniques for conducting assessments. It also provides a list of resources to a broader variety of information, methodologies and tools on VA and RA. The chapter opens with some tips for planning the assessment phase before beginning the research and analysis components. These tips can help ease some of the common challenges likely to arise. The experiences and observations of ACCC key stakeholders, namely the researchers, around the assessment phase are highlighted throughout the chapter.

Step 1: Planning the Assessment Components for Easier Integration

The vulnerability and risk components of the assessment phase can be quite complex and difficult to integrate. It is important that sufficient time be spent during the scoping phase to determine what key stakeholders will participate in the assessment phase, their roles, and the issues to initially be investigated through assessment. It is also important to spend time determining how to integrate the efforts and results of the various research teams. As the assessment progresses, regular engagement among key stakeholders and with a broader set of stakeholders can assist in keeping the analysis manageable and operationally feasible, with analysis and results clearly supporting and informing stakeholder priorities. Challenges will inevitably arise during the assessment phase – quantitative data gaps may prevent certain methods from being used; output from a small number of climate models may limit the ability to estimate future climate risk; and power differentials between broader sets of stakeholders may require more engagement activities with various groups than initially anticipated.Allotting sufficient time and resources to regular engagement, facilitated where needed, can greatly assist in smoothing assessment activities.

TOOL 1: Checklist Prior to Beginning Vulnerability and Risk Assessment

- What are the policy makers' needs and expectations about the assessments?
  - What information and data (both qualitative and quantitative) do the policy makers' need to support and inform policies and adaptation actions?
  - With what vulnerability and climate issues are policy makers most concerned?
  - In what format(s) do the policy makers need the information and data from the researchers?
- What are the issues that the assessments will investigate?
  - What geographic scales will they cover? How far into the past and into the future (time periods) will they cover?
  - Clarify the units of analysis (who or what) and to what types of climate change (slow onset to extreme events)
  - What critical data and information gaps were identified during the scoping phase?
- What definitions of vulnerability, risk, adaptive capacity, impacts, etc. do the key stakeholders use?
- What are the risk preferences of key stakeholders?
  - As the assessments progress, are researchers and other key stakeholders seeking to understand the risk preferences of a broader set of stakeholders – members of vulnerable communities, other policy makers and researchers, etc.?
- What methods and tools will researchers likely use to understand vulnerability factors and context and climate risk?
  - How will researchers engage with other stakeholders – e.g. herders, farmers, women's groups and others most likely to be impacted – to co-learn and share the knowledge, information and data of these stakeholders in a respectful manner, with the aim of bringing their perspectives and observations to inform the vulnerability and risk assessments?
  - What are the strengths and weaknesses of each method and potential outputs? Do all the key stakeholders agree on the acceptability of the methods, given their understanding of the method and the potential data and information gaps?
  - What data, information and knowledge are required to conduct the assessment tasks?
  - What are the sources for this data and information, and the processes required to access these?
  - What do physical scientists understand about social science methodology? What do social scientists understand about physical science methodologies?
  - What is the work plan/timeline for completing various research tasks? Do certain tasks, such as climate modelling or conducting multiple interviews, focus groups, and community meetings with a broader set of stakeholders, require more time and resources than others, and thus have to be started before other assessment elements?
- How often will the key stakeholders meet to co-learn, coordinate, reflect upon and integrate the research techniques and outputs of the different research teams?
  - What other engagement mechanisms – such as monthly calls and training workshops – can assist key stakeholders in meeting assessment goals and addressing challenges as they arise?
- What resources are needed to conduct the assessment tasks? Such things can include physical resources like analytical software such as SPSS or a facilitator's toolbox, or additional training on participatory methods.

The following types of questions (Tool 1) should be considered at the inception of the assessment phase via a workshop, meeting or other engagement exercises to clearly map out the key stakeholder roles, expertise, time and resources needed, and the common language around the assessments. These questions are best answered with the participation of key stakeholders, preferably through a joint, facilitated workshop/meeting, with additional follow-up with various key stakeholders as needed. This checklist tool is not comprehensive; key stakeholders will likely identify additional issues and areas to be addressed before the assessments begin and revisit these questions as they progress and challenges arise.

Establish a Common Language

Assessments involve key stakeholders from many different backgrounds and with different expertise, so it's important to establish a common language around central terms so the parties can work across the disciplines and integrate the results to the benefit of the assessment process and the different stakeholders and researchers. While it may be surprising to non-scientists, there are no commonly agreed upon definitions for words like vulnerability and risk, among others. Economists might use these terms in a different manner than sociologists; climatologists may not consistently use the words projection and prediction in the same way (Opitz-Stapleton et al. 2010; Bray and von Storch 2009). Translating these words into a common language or understanding, and making them meaningful to a broader array of stakeholders like farmers or fishermen, can be challenging. It is important to take sufficient time to answer Question 3 in the Assessment Checklist Tool. The Quick Check of Key Terms tool lists some words that have been known to cause confusion in adaptation planning programmes. Depending on the scope and nature of the assessment and those engaged, additional terms may need to be clarified.

TOOL 2: Quick Checkof Key Terms

1. What do the key stakeholders to your programme mean when they use the following words?
2. How do these words translate into your language?
3. What other words are important to key stakeholders?

Vulnerability	Probability	Projection
Risk	Likelihood	Prediction
Adaptation	Forecast	Mitigation
Resilience	Trend	Possibility
Impact	Weather	Confidence
Consequence	Climate	Extreme Event
Scenario	Season	Threshold
Engagement	Participation	Method
Adaptive Capacity	Sensitivity	Exposure
Ecosystem Service	Culture	Equity

Different research traditions around terminology caused difficulty for the ACCC research teams in comprehending each other's methodologies and research outputs, and integrating results. Each team initially used varied definitions of vulnerability; it was not until a significant portion of work had been completed that teams could agree on a common definition of vulnerability and risk. During a workshop held in June 2011 to integrate results

from the various work areas, the partners agreed that vulnerability is a characteristic of people and human systems, depending on their exposure to a particular hazard and how susceptible to harm from that hazard they are, given their sensitivity and capacity to adapt or cope with it. The following conceptual definitions of vulnerability and risk were adopted in ACCC to frame the joint research work. These definitions are specific to ACCC:

Vulnerability = f(exposure, sensitivity, adaptive capacity)
Risk = f(hazard (likelihood and future impact), vulnerability)

Box 1: Conceptualising Vulnerability and Risk in ACCC

The ACCC definitions of vulnerability and risk were adapted from the IPCC, with the sub-components of the two words further defined as follows:

Vulnerability is a function of exposure, sensitivity and adaptive capacity (although the formula to combine the three elements may not be simple). These elements combined create the vulnerability of a system. In the ACCC project, this vulnerability may be biophysical - e.g. agricultural vulnerability - or socio-economic - e.g. the vulnerability of a specific community or area.

- Exposure is the extent to which a system (physical or socio-economic) is exposed to climate variability and change. For instance, the number of people living in a flood-prone area, or the amount of cropland exposed to drought.
- Sensitivity is the way in which a system (physical or socio-economic) reacts to a specific climate impact. For instance, elderly people may be more sensitive to the effects of heat. Some crop varieties are more sensitive to drought than others.
- Adaptive capacityis the ability of a system to adapt to climate variability and change that threaten it or opportunities than may arise. For example, a community with diverse sources of income is better able to adapt to crop failure than those completely dependent on farm income. Or, an agricultural system using water-saving technologies is better able to adapt to drought than one without these technologies.

Riskis a function of all the elements above, helping to determine the likelihood of certain impacts or vulnerabilities being realised, rank their severity and decide which to prioritise (although the combination may not be simple). An integrated understanding of risk is necessary in order to make informed adaptation decisions.

- Hazard describes the external threat that a system is exposed to. In the ACCC project, the impacts or vulnerabilities were associated with direct climate impact (e.g. drought, typhoon, heat waves) or the indirect physical impact (crop yield, water resource availability). Hazard combines both the potential impact(s) and the likelihoodof that impact occurring.
- Likelihoodis the frequentist probability of hazard having occurred or the subjective probability of it occurring in the future; for instance, a 1 in 50 year flood is more likely than a 1 in 300 year flood. Future climate change probabilities are subjective as they are based on climate projections, extreme event analysis and impact modelling and cannot be treated as true probabilities.

The definitions that were adopted in ACCC might not be appropriate to other adaptation planning contexts. One weakness of these definitions is that they focus on hazards and extreme event; climate variability and change encompass more than these. Slow-onset changes, such as an overall decrease in an area's precipitation may not be noticed at first, but can cause much greater impacts than a hazard event.

While these definitions were used in the ACCC programme, they may or may not be applicable to other adaptation planning programmes. One weakness of the ACCC programme framing of these two terms is that they caused the researchers to focus more of their attention on investigating the potential biophysical and socio-economic impacts that might arise in China due to hazards and extreme weather events, and not investigate impacts of overall changes to the average climate. However, increasing climate variability and slow-onset changes like the gradual warming and drying of an area's climate can have severe impacts on people and sectors that are being ignored in the assessment phase. For instance, some IPCC assessment framings – up to the Fourth Assessment Report and the SREX Report - do not even include a discussion of risk; impacts and the likelihood of the impacts are described as vulnerability under the traditional IPCC definitions. There are indications that the forthcoming Fifth Assessment Report will discuss risk. Much depends on key stakeholders' negotiation and engagement around these two terms, as there are other ways of conceptualising and framing vulnerability and risk. It is important to develop working definitions of these two terms, in particular, as the definitions as held by key stakeholders can influence the methodological framing and outputs of the assessments.

Review Assessment Approaches: Biophysical impacts and socio-economic vulnerability approaches

As the key stakeholders begin the assessment phase, it is useful to review the general approaches and steps for conducting vulnerability and risk assessments. There are two general approaches to assessing vulnerability: a socio-economic vulnerability approach (bottom-up) or a biophysical impact approach (top-down). Each approach consists of tiered steps, and several possible iterations between steps. A complete assessment attempts to integrate the two approaches and their results to take advantage of their different scales of focus. A diverse group of researchers, through their expertise and research culture, will traditionally focus on one of these approaches; facilitation, engagement and support can help the researchers work together to foster multi-disciplinary investigations that integrate the two. Some resources that review the two general approaches include Dessai and Hulme (2004), and Carter et al. (2007). The full citation to these resources and others is located in the Resource Section at the end of this chapter.

Biophysical Impact Assessments: An Overview

The biophysical impact approach wasthe standard Intergovernmental Panel on Climate Change (IPCC) assessment approach for the first three IPCC reports. This approach utilise smultiple climate scenarios and focuses on key sectors – agriculture, grassland ecosystems and livestock, and water resources, among others – typically on a regional or national scale. Such types of top-down approaches do not typically focus on the vulnerability of people or human behaviour per se; the focus is on biophysical systems. The physical science teams in ACCC adopted this approach. The term 'top-down' reflects the cascading of the information as inputs from one step to the next.

This approach is model-intensive, feeding global climate scenarios that have been downscaled to regional- or local-scale projections into impacts models to identify impacts on such sectors as crops, productivity, future stream flows and health. Biophysical risks for a period in the future are then derived from the results of the impacts models. Adaptation measures may then be suggested that will reduce or counter the model-projected risks and maximise identified benefits. The general steps involved in an impacts assessment approach include:

1. Developing the climate projection scenarios and information over the key stakeholder-defined time periods and geographic scales.
    a) Ideally, the climate projections are developed using outputs from a variety of general circulation models that have been downscaled – either via dynamic, statistical or a combination of the two techniques – to the appropriate geographic scales.
    b) An analysis of historical climate data and information for trends and area general climate statistics is also undertaken.
2. Developing impact models – e.g. crop models such as DSSAT or APSIM, surface water or ground water hydrology models and livestockor disease vector models.
    a) Establish baseline conditions using historical climate information and data.
    b) Estimate future climate impacts using projected, downscaled climate information and data,

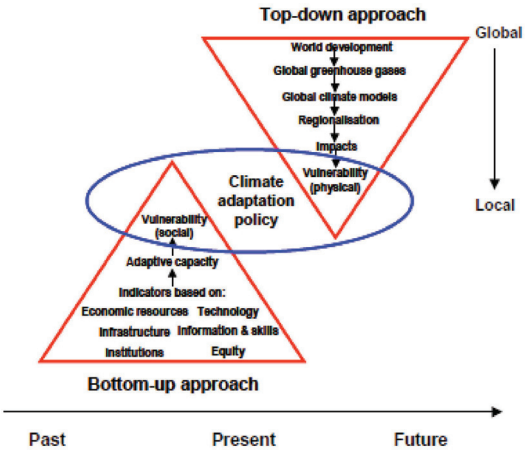


Figure 2: A conceptualisation of vulnerability assessment approaches. Source: Dessai and Hulme, 2004.

Box 2: Assessments in ACCC

The ACCC project relied on a broad partnership, including more than 25 partners at national, local and international levels. The Chinese Academy of Social Sciences (CASS) together with researchers from the three provinces formed teams to examine the factors contributing to vulnerability of specific groups of people or livelihoods in each province and the impacts of historical climate hazards. The teams also learned more about the adaptive strategies people traditionally took to cope with historical and present climate challenges. At the same time, research teams from the Chinese Academy of Agricultural Sciences (CAAS) investigated the potential impacts of climate change on ecosystems, water resources, livestock and crops, and the Chinese Meteorological Administration (CMA) developed climate projections using a number of general and regional circulation models. CAAS research into biophysical vulnerability at the provincial and national scales will be combined with CASS research on socio-economic vulnerability at the same scales to develop adaptation responses. The research results and the adaptation options identified are expected to inform the ongoing formulation of adaptation strategies and plans both at provincial and national levels.

usually holding other variables constant.

3. Identifying future climate risk - ascertains potential, sector-specific future climate risks from the impact model.

The components contributing to a sector's or ecosystem's vulnerability are limited to descriptions or parameters related to biophysical sensitivity and exposure – e.g. the sensitivity of wheat at different stages of the crop's life to temperature or humidity, soil type or pests. Impacts models typically do not account for socio-economic trends, changes in market preferences, or land-use changes, among other human activities (i.e. non-climate stressors/social vulnerabilities) that can enhance the adaptive capacity or vulnerability of the sector or system to climate change, or impact it as much or more than climate change.

A challenge when using this approach arises when moving from the impact assessment stage to identify risks that can be used to inform adaptation planning. Identifying risks relies on estimations of the likelihood of hazard or impact occurrence. Uncertainties propagate, or cascade, through each step of the top-down approach and limit risk identification. Some sources of uncertainty inbiophysical impacts assessments are due to the associated models' limited abilities to account for social determinants that also impact on biophysical sectors, uncertainties in climate change, and uncertainties in the scenarios used to estimate future risk. These weaknesses can cause the identified impacts and proposed adaptation options to span such a wide range that they may not practically inform adaptation decisions. An alternative approach would have researchers integrating their results with the social vulnerability approach by using the information on potential biophysical impacts to inform the social vulnerability and risk assessments.

Because of the variety of biophysical impact models available –from empirical to mechanistic – we do not provide detailed methodologies for conducting biophysical modelling. Nor do we provide methodologies for downscaling the outputs of global or regional climate models for use in these impacts modelling. Refer to the Resource and Reference Section for resources on different types of biophysical impact models and information on their various strengths and weaknesses.

Social Vulnerability Assessments: An Overview

The social vulnerability-based approach adopted by the socio-economic teams in ACCC is based on what is typically referred to as a 'bottom-up' approach. The focus of this type of approach is on understanding socio-economic vulnerabilities – through a vulnerability assessment (VA) - and assessing the associated and differentiated risks in the context of current and projected climate and socio-economic conditions. Socio-economic vulnerability assessments provide a basis for better understanding of who and what may be vulnerable to current climate variability and future climate change, and what their existing capacities are to adapt and be more resilient to the existing and projected changes in climate. Vulnerability assessments should aim to be holistic, recognising the various social, economic, human, environmental and physical factors shaping vulnerability

and the interdependencies across these dimensions and vulnerable systems. In short, vulnerability assessments seek to establish **Who** or **What** (unit of analysis) might suffer harm due to **What** (slow-onset change and extreme events) and the reasons **Why** (vulnerability determinants) they might suffer harm as a result of such climate change. The risk assessment steps are complementary to the vulnerability assessment steps and help to establish the **Severit**y and **Type** of the harm and the **Likelihood** of occurrence for that type of climate change and/or impact.

Vulnerability assessments are a crucial component of the ACCC adaptation learning and decision-making framework. Like all aspects of decision-making processes, vulnerability assessments are iterative. As new information becomes available, conditions change and adaptation priorities evolve, it will be necessary to repeat and refine various aspects of the vulnerability assessments. With this in mind, vulnerability assessments can be broken into four main steps:

1. Establish or clarify the vulnerability framework. Determine:
   - Vulnerability "to what" (climate risks- both slow and rapid onset) and "of what" (social group, area, sector/system – the "units of analysis")
   - Factors that contribute to vulnerability - physical, environmental, social, economic, human
   - How the information will be used to complement the risk assessments, inform decision-making criteria, and contribute to the overall adaptation framework and process
2. Assess current vulnerability to existing climate risks. Assess:
   - Current risk and event history and response to existing climate risks
   - Current dimensions of vulnerability and adaptive capacity
3. Identify future climate and other socio-economic stressors and related impacts. Identify:
   - Potential future climate trends and risks
   - Development trends and growth scenarios
   - Potential direct or indirect consequences of those stressors
4. Assess future vulnerability.
   - Having assessed existing vulnerability (#2), and overlaying future trends,

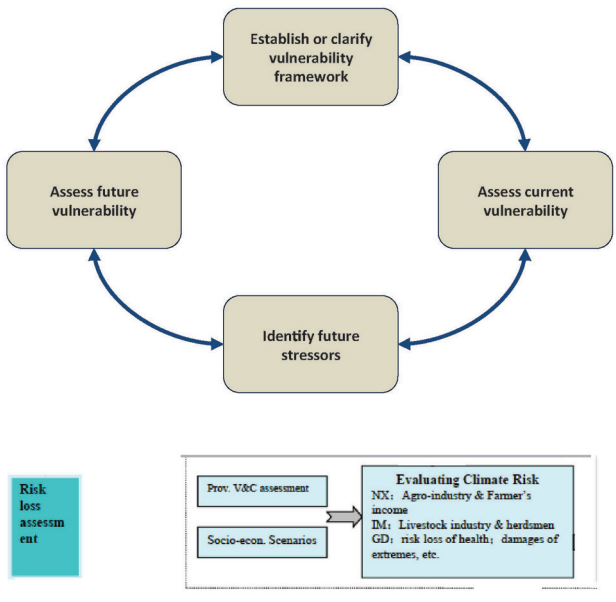
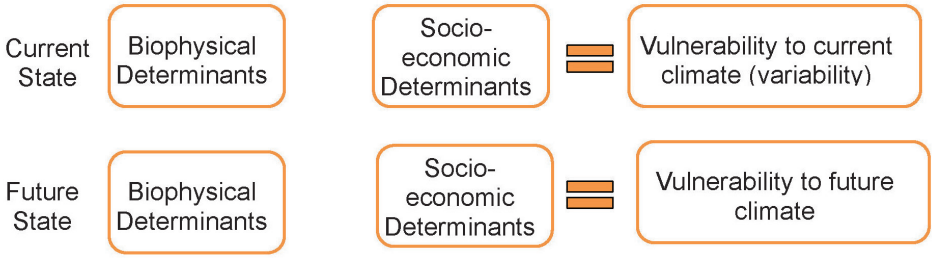


Figure 3: General social vulnerability steps and iterations. The ACCC (turquoise boxes) social vulnerability assessment used these steps to integrate vulnerability with risk.

scenarios, and risks (#3), future vulnerability can be assessed
- Identification of most vulnerable:
  - Populations/groups
  - Areas/neighbourhoods
  - Systems/sectors, the linkages between them and factors contributing to vulnerability and capacity
- Assessment of governance and institutional mechanisms

The critical first step to conducting vulnerability assessments is to clarify the vulnerability framework that will guide the research efforts. The framework provides a starting point for determining the units of analysis – specific populations, sectors/systems or geographic areas – should initially be studied. At the same time, it can help identify important links between the initial units of analysis and other units of analysis that will need to be investigated. Once a vulnerability framework has been selected, it will become easier to decide which methods for conducting vulnerability assessments are appropriate at each step.

The preliminary work done during the scoping phase should guide the development of the vulnerability framework and provide a starting point for selecting interim assessment endpoints and metrics for assessing long-term progress. A vulnerability framework that identifies who and what is vulnerable to what can be based on an informed review of priority climate risks and interdependencies during the scoping phase. It should be remembered, however, that the vulnerability framework will evolve during the assessment to reflect findings as they emerge, new information coming from other areas of the project (such as the physical impacts group or the climate scenarios), and changing policy priorities or socio-economic conditions. Finally, the vulnerability framework and assessments must be updated and repeated to verify the extent to which the assessment outcomes remain current and useful.



A social vulnerability-based approach is more comprehensive and challenging than a biophysical impacts approach because it focuses on the wider context beyond climate change, examining the underlying factors (economic, cultural, built environment, social, etc.) that contribute to a group of people's or community's adaptive capacity or vulnerability to climate change. Social vulnerability approaches do not tend to investigate biophysical sectors – the focus is more on people and human behaviour. Results from the biophysical

impact assessment must be integrated with the social vulnerability assessment to supply necessary information and data on how changes in ecosystems, crops, or water supply (biophysical sectors/ systems) might contribute to the overall vulnerability or adaptive capacity of a particular community, city, etc.

One weakness of the bottom-up approach is that the scale of the work tends to focus more on the local- to regional-level, due to the amount of data and information needed to investigate vulnerability contexts and the highly localised factors contributing to vulnerability that may or may not translate from place to place. Some researchers have created quantitative vulnerability indices (Cutter et al.2003 and 2010; O'Brien et al. 2004) at the national-level as a first-pass, rapid assessment technique, but stress the need for additional localised quantitative and qualitative research to provide deeper meaning to the indices. The social vulnerability and risk approach recognises that adaptation is more than a technical issue that can be tackled on a project level as a discrete package of work, but is a process to reduce vulnerabilities and risks, and enhance opportunities as conditions change. An overall social vulnerability approach involves the following key elements:

- Draws on historical climate and socio-economic information, as well as future projections / scenarios and related estimates to assess current and potential vulnerabilities
- Uses a systems-based approach to understanding responses to existing climate variability and trends in climate variables, and the different dimensions (physical, environmental, social, economic, and culture) that may exacerbate vulnerability -- or enhance capacity.
- Pays specific attention to governance, business and institutional dimensions that affect access to and use of information, inclusive and co-ordinated planning processes, and the ability to be responsive and flexible to vulnerabilities.
- Considers how vulnerability may differ across scales, and be affected by immediate pressures and systems, as well as the social, economic and environmental factors at regional or even global scales.
- Analyses how future potential climate and other dynamic stressors (e.g. development plans, migration, and epidemiological changes) may affect vulnerabilities in the future – exacerbating existing conditions, and possibly creating new vulnerabilities.
- Pays specific attention to the vulnerabilities and capacities of thepoorest and most vulnerable groups

These elements recognise the need to assess vulnerabilities by considering coincident biophysical and socio-economic determinants. Such an approach also recognises that unless the current factors contributing to current vulnerability are addressed in the adaptation options (so called 'low-regrets' options), the options are unlikely to reduce future vulnerability and risk.

Integrating Biophysical Impacts and Social Vulnerability with Risk Assessment

Given the need for policy to be informed by the best available knowledge and evidence, it is important that the assessment is structured and managed so as to integrate the results from the biophysical impacts approach and fromthe socio-economic approach. This integration should be planned from the start and not undertaken as an add-on after the fact. Each of these approaches have their specific strengths, weaknesses and geographic scope and foci. The top-down (biophysical) approach will provide insight into how various crops, ecosystems and watersheds, for example, might be impacted by various projections of climate change. The bottom-up (socio-economic vulnerability) approach will provide insights into factors that contribute to people's, organisations' and/or a community's vulnerability and capacity to adapt to current climate variability and future climate change, as well as into how they may be impacted by and shape changes to biophysical systems. The integration of information and data from the two approaches can betterinform the characterisation of future climate and non-climate risk and the development of a more robust range of adaptation options than would be achieved through reliance on a single approach. Figure 4 is a conceptual model of the integration of the two approaches with Risk Assessment.

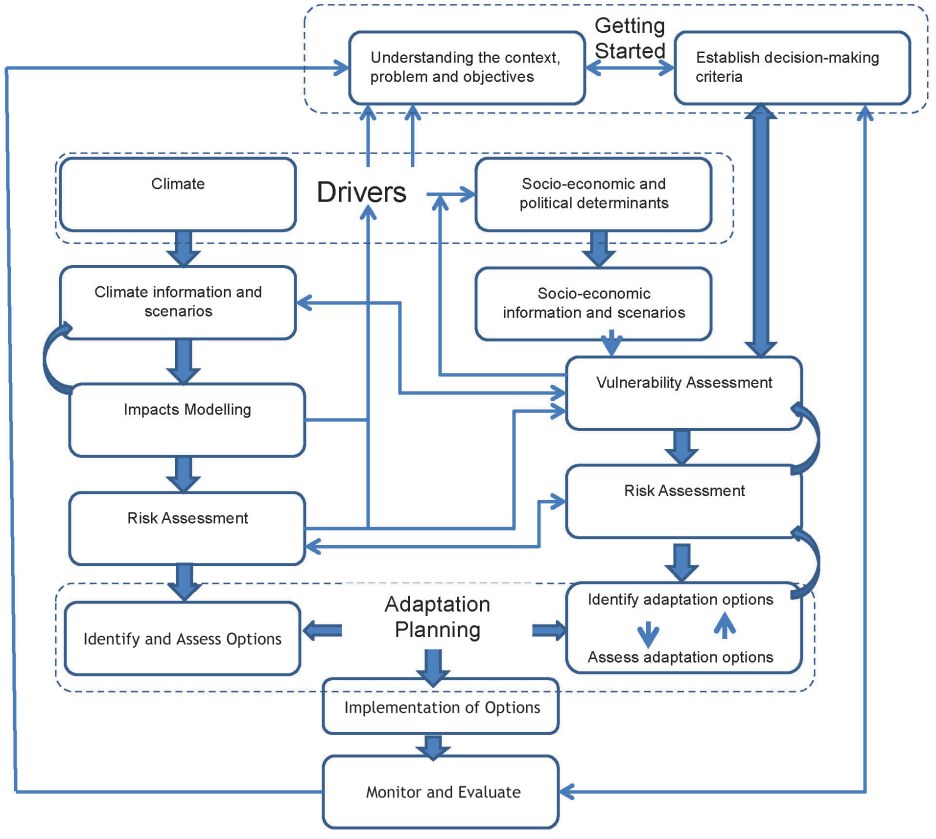


Figure 4: Conceptual model of the integration of the top-down (left) and bottom-up (right) approaches introduced in ACCC.

Risk is a determinant of the qualitative or quantitative likelihood of certain impacts occurring as a result of changes in underlying vulnerability conditions and climate conditions. A risk assessment involves tiered steps, and may consist of qualitative or quantitative assessments of risk, depending on what level of certainty, confidence and information is required for decision-making, and the resources – data, time, methodology, etc. – available for the assessment. Quantitative risk assessments can be costly and require significant amounts of detail and data that may not be available. Qualitative assessments can help with comparing risks and in deciding whether a more detailed quantitative assessment is necessary for decision-making purposes. Through risk assessments, partners compare sources of risk, both climate and non-climate; rank the severity of potential outcomes and risks based on existing knowledge; assess the consequences of uncertainty in terms of the decisions being made; and prioritise the risks to be addressed. An integrated understanding of biophysical and socio-economic vulnerability, coupled with a risk assessment, is necessary for identifying and prioritising adaptation options, and follows these general steps:

1. Define and clarify the vulnerability and risk framing:
    a. Vulnerability “to what” (climate impacts and hazards - both slow and rapid onset) and “of who or what” (social group, area, sector / system – the ‘units of analysis’), over what geographic scale and time periods;
    b. “The why” factors that contribute to vulnerability or enhance capacity - physical, environmental, social, economic and cultural – that will be investigated;
    c. Clarify climate information and data needs and expectations;
    d. Determine how the information will be used to complement the risk assessments, inform decision-making criteria, and contribute to the overall adaptation framework and process.
2. Assess current vulnerability and current climate risk:
    a. Assess current dimensions of vulnerability and adaptive capacity – socio-economic, governance and institutional conditions, historical development trends, environmental conditions, etc.
    b. Assess current climate variability risk– historical impacts, damage and consequences of climate impacts, existing trends in climate variables and hazard events. The integrated vulnerability assessments provide insights into which factors make the unit of analysis more sensitive, and thus why the impacts were so severe. This incorporates an analysis of historical climate data and information, as well as the baseline analysis from the biophysical impacts models.
3. Identify future vulnerability and non-climate risk:
    a. Potentially vulnerable: populations/groups; areas/neighbourhoods; or systems/ sectors and the interdependencies that might be in addition to the unit(s) of analysis from Step 2.
    b. Scenarios of potential future vulnerability/ adaptive capacity determinants
        i. Assess potential socio-economic stressors, development trends and growth

scenarios, and the potential direct or indirect consequences (risks) of those non-climate stressors.

4. Identify future climate risk and related impacts:
   a. Potential future climate risks. This stepincorporates climate projections (ideally from multiple climate models) with the scenarios of future vulnerability.

Risk assessments need to consider how climate variables will change for the units of analysis over the stakeholder-defined region and future time period of concern. Assumptions concerning changes in the mean and variance of the climate variable statistics will be particularly important, especially where impacts are associated with lower probability extremes of climate (e.g. changes in numbers of frost days or the return period of high magnitude rainfall events). They are also important in the context of understanding where thresholds or sensitivities are being exceeded as a result of anomalous conditions that may not be associated with extremes. These conditions include dry spells persisting through critical periods, warmer than average, but not extreme, temperatures adding to pressure on water resources and health, or the slow processes of desertification and sea level rise. Identifying risk associated with extreme values may require the application of specialist statistical modelling techniques, such as generalised extreme value distributions. These might be applied to scenario-based climate ensembles or forecasts based on historical time series data. Climate science experts, experts with particular knowledge of the 'unit(s) of analysis' and how they may be affected by climate and other factors (including the consequences and effectiveness of any decision), and experts in the application of the analytical techniques to help decision-makers assess options should be included in the risk assessment. All of the technical or scientific methods employed and the information they produce must be reconciled with the overall project goals, criteria, and policy concerns identified through continuous engagement with a variety of stakeholders throughout the whole process.The remaining sections of this chapter provide more detail on the individual steps of an integrated biophysical and social vulnerability and risk assessment, starting with Step 2 as the first step was covered at the beginning of the chapter.

Step 2: Assess Current Vulnerability and Climate Risk

The vulnerability of a group of people, a city, nation or a sector (the unit of analysis) to current climate variability is used to establish a baseline of current conditions and to describe current climate risk. The overall vulnerability of a unit of analysis is determined through a combination of biophysical (e.g. built infrastructure, crop and livestock system health, water supply, etc.) and social (culture, economic, technological, political, etc.) factors, which are investigated through the integration of the different approaches. Figure 5 conceptualises some of the various factors that combine to make a city, province or other grouping of people vulnerable to harm from the climate hazards and variability that now

affect that area and/or enhance their capacity for dealing with present climate conditions. People, sectors or systems may suffer harm because they are directly exposed (physically located where a hazard or slow-onset change occurs) or because of indirect exposure (the physical/ built infrastructure or ecosystems on which they depend are damaged as a consequence of a climate event). Their access to and the strength of social, cultural, technological, economic and financial systems can improve their capacity to prepare for, respond to and recover from an extreme event or slow changes in local climate. It can also increase their vulnerability. A systemic approach to defining and measuring integrated vulnerability involves analysing the array of factors that may affect the vulnerability of individuals, communities and social, ecological, physical and economic systems. These include the following dimensions:

Physical:

- The nature of physical infrastructure (building, housing, roads and transport hubs, water supply and sewage delivery systems; drainage, flood and coastal defences; energy; communication) and their management. This includes the quality and design of infrastructure and the degree to which it is vulnerable to disruption by climate variability and extremes. For example,whether transport lines can continue functioning during natural hazards and connect to services like health care, markets, ports and other business areas, schools, etc.
- The degree of physical exposure as a function of geology, topography (floodplains, how close to the coast, etc.), and climate conditions

Ecological:

- Ecosystems and the natural resource conditions - particularly the degree to which ground and surface water systems are disrupted, resulting in changes in availability and quality of water,

Box 3: Integration Challenge:

The time periods and geographic scales of the biophysical impacts and social vulnerability assessments can be mismatched, making integration difficult, if there is not sufficient stakeholder engagement around this issue during the assessment planning step.

Historically, the climate projections from global climate models tended to be produced for the late 21st century (e.g. the 2080s), with biophysical models focusing on impacts to sectors or systems in the same time periods. However, these periods so far in the future frequently do not match planning or policy cycles – except for infrastructure planning purposes. Social vulnerability approaches have traditionally focused more on near-term issues (e.g. the next 5-30 years) and not necessarily incorporated climate information into scenarios of future vulnerability. Biophysical impact assessments can better support social vulnerability assessments by conducting near-term scenarios – as well as long-term ones - in the models that match the time periods of concern in the social approach. The near-term biophysical information and data can inform issues related to crop and food security, livestock viability, flooding, ecosystem services provisioning, etc. – all of which are important to comprehensive vulnerability assessment.

habitat loss and increasing salination. It also includes for example, the destruction of natural storm barriers (e.g. mangroves), lack of maintenance of floodplain zones and coastal ecosystems, degradation of wetlands, obstruction of natural drainage systems, and creation of areas for breeding of disease vectors.

- The ability of households in regions to obtain secure sources of water for domestic uses, whether from local or trans-boundary sources, water markets or rural supply schemes;to obtain electricity for domestic and business ventures;
- Ecosystem provisioning: the sensitivity of crops, livestock, fisheries and other ecosystem provisioning services to both human changes (e.g. to ecosystem destruction through monoculture) and climate variability and change directly impact various populations and their livelihoods.

Box 4: Assessing Current Vulnerability in Guangdong

Guangdong is a populous province in southern China, with a long coastline, and exposed to maritime hazards such as typhoons and storm surges. Significant portions of its population live in urban areas like Guangzhou. Rapid urban expansion and migration to urban areas are contributing to differentiated vulnerability and risk to climate hazards. The ACCC research teams in Guangdong considered some of the following questions, among others, when investigating vulnerability in the province:

- What are the differential impacts of a storm? For example, are different areas of the city more vulnerable to storms because they are in floodplains, in the storm surge area, comprised of low-quality housing or buildings that cannot withstand storms?
  - Who are the people/or groups of people that are particularly vulnerable?
- What factors (physical, social, ecological, human and economic) combine to make these people vulnerable?
  - How will people with poor health (physical or mental) be affected by storms?
  - How are particular vulnerable groups (e.g., women, children and the aged) affected by storms?
  - How will people with fewer financial resources be affected by storms?
  - How will people living or working in poor-quality homes or workplaces be affected by storms?
  - How will people with limited mobility (e.g., access to public or private transport) likely to be affected by storms?
- What capacities and coping strategies do each of these groups have to help them to prepare for or recover from storms?
- Who are the people/groups of people that are disempowered?
  - What factors make these groups of people disempowered?
  - Do these people have their urban migration papers? What kinds of services can they not access without those papers?
- What aspects of the storm (high winds, flooding, electricity and water shortages after the storm, loss of cell phone service, etc.) are the biggest areas of concern for particular groups?
- What kinds of social networks (informal family networks, formal support of a strong business leader or politician, etc.) do these groups have that they can turn to for help to prepare for and recover from a storm?
- How are people with little access to systems and support services (e.g., emergency services, health care) particularly affected by storms?

Social:

- Social factors of age, gender, income, social position and political connectedness, which affect access to resources and services (water, energy, health, education, finance),affect sensitivity and adaptive capacity. Indirectly, they may also affect physical exposure, because socially marginalised populations without land tenure often have little choice than to live in exposed areas, such as floodplains or in a low-lying coastal zone.
- Presence of families, social networks, community institutions, self-help groups, formal institutions such as government departments and banks, NGOs, and the media that mediate people's access to services;
- The functioning of governance institutions, including disaster management planning, co-ordination across sectors and agencies, co-ordinated planning across scales.

Economic:

- The nature of economic and financial systems and their functioning at times of disruption, including:
  - Degree of reliance on climate-sensitive livelihoods (e.g. fisheries, agriculture) and ability to diversify to alternative livelihood options
  - Reliance on informal economies with limited social protection and often poor working conditions
  - Degree of debt and ability to access formal or informal banking and credit systems that may help people to invest in alternative livelihoods and better manage risk
  - The vulnerability of industrial manufacturing and economic sectors to direct disruption in extreme events; disruption of supply lines for water availability, power, water quality; transport of goods; and reliance on inputs from distant sources or transport hubs affected by climate change

Human:

- Health: Increasing poor health conditions due change in disease vectors (dengue, malaria, cholera), gastrointestinal disorders due to flooding, poor sanitation conditions, decreasing water quality and particular vulnerability of elderly and children. It also includes limited reach and delivery of health systems particularly to poor
- Degree of access to knowledge, social media, information and education opportunities on, for example, climate adaptation or skills for alternative livelihoods
- Personal or cultural attitudes that may either lead to resistance to change, acceptance of conditions. Feelings of empowerment may enhance resilience

Because people's vulnerability and capacity at any geographic scale is influenced by all of these factors, a comprehensive vulnerability assessment needs to investigate all of these factors. Some of the information needs to be related to the physical and ecological aspects of vulnerability derived from the biophysical impacts assessment,while the rest of the information will come via the social vulnerability assessment. Social vulnerability

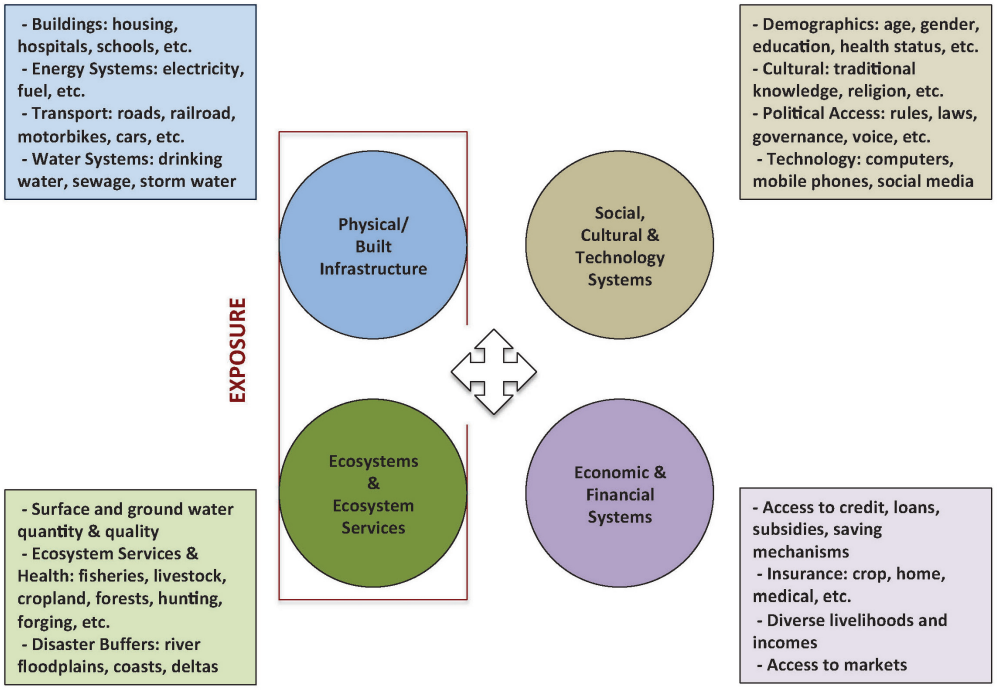


Figure 5: Conceptual framework of vulnerability and capacity components

assessments comprise both qualitative and quantitative analyses. This mix depends on data availability and key stakeholder preferences, among other factors, as negotiated via stakeholder engagement in the first step of the overall assessment phase.

Information on and evidence of the role of each component in overall vulnerability will be gathered from both quantitative and qualitative sources. Qualitative and semi-quantitative sources include interviews, focus group discussions and surveys with households in frequently affected communities, representatives from women's unions, fishermen unions and emergency responders, and community leaders – that is, engagement with a broader array of stakeholders. These techniques will have to be deployed across a broad segment of suspected vulnerable populations to ensure the sample is sufficiently broad and diverse. The analysis of community perspectives on vulnerability and capacity should be augmented with interviews with experts and government officials, and reviews of impacts from past studies, government data, situation reports and other write-ups following specific hazard events. Government, communications or financial sector data – such as demographic data collected for census, social media usage or insurance loss reports – can provide quantitative data for vulnerability indices, network analysis or other types of quantitative analysis. When questioning the potential role of each vulnerability component, it should be noted a) if there is evidence and b) what sort it is - expert, published research, modelled, etc. Additionally, information on the approximate scale of the effects of a hazard on vulnerable groups should be identified.This information will aid in the assessment of current climate variability risk.

There are some critical points a researcher and other key stakeholders must remember when using any quantitative vulnerability assessment technique:

- When trying to quantify vulnerability and capacity, there is no single set of correct criteria, scores or weights that can be ascribed to an index. Any index that a researcher develops will be subject to interpretation and should be discussed by other key stakeholders.
- Any quantitative framework or tool is meaningless on its own without a qualitative, supporting narrative on the local context, hazards/risks, social relations and institutional assessments.
- VCIs or vulnerability maps are not comprehensive, but rather give an indicative picture of the current situation.
- Quantitative VCIs can be as complex, and include as many variables (dimensions of vulnerability and capacity) as the researcher chooses. However, when trying to ascribe casual relationships between variables in a model, the more variables included, the more difficult it is to investigate relationships between variables.

TOOL 3: A Vulnerability and Capacity Index

Vulnerability and Capacity Indices (VCIs) are simple tools for assessing vulnerability and adaptive capacity at scale to current climate hazards and assist in extrapolating vulnerability and capacity to potential future climate hazards. A well-designed VCI provides a simple way of quantifying these factors and determining the various weights – relative level of importance – of each factor for a particular group or community. A VCI supports comprehensive vulnerability assessments and helps identify which social groups (e.g. herders, coal miners, Han migrant farmers) and households within such groups (e.g. women-headed households, single parent/grandparent households or those living in highly drought-prone areas) are more vulnerable to what (drought, wind erosion, heat/cold waves) than others and why (the factors contributing to vulnerability and capacity). There are multiple ways of calculating VCIs and portraying the information from the VCIs. The VCI table below is from Mustafa et al. 2010.

1. Vulnerability and capacity indices are constructed by assigning weights to the components of vulnerability and capacity described previously, or those that the key stakeholders have decided to investigate.
   - The researcher must decide the score for assigning the weights. A common score to use is to ensure that the maximum total score cannot exceed 100.
   - The researcher must decide how to assign and calculate the weights of the dimensions of vulnerability and capacity. Some researchers choose to assign every dimension that contributes to vulnerability a positive score, and every dimension that contributes to capacity a negative score. If this convention is followed, a low total score indicates low vulnerability and a score near 100 would indicate high vulnerability.
   - Because vulnerability and capacity are so complex, it will not be possible to assign a weight to every dimension described previously. Therefore, the researcher will have to select which dimensions are the most important to include in the index, based on broader stakeholder engagement, such as expert opinion, interviews and focus group discussions.
   - The rationale and basis for selecting vulnerability and capacity components for the VCI, as well as how weights are assigned and calculated, need to be clearly documented.

2. Information from stakeholders must be supplemented with government and expert datasets, such as census data, situation reports detailing government aid and response after previous hazards, and other data sources following a specific hazard. Researchersmust document what kind of evidence/data exists and the source of the data – is expert, published research, from stakeholder interviews, surveys or focus groups, modelled, etc. In addition, information on the approximate scale of the effects on vulnerable groups should be identified.

3. While there may be common, shared dimensions of vulnerability and capacity between different groups – herders, farmers, coal miners, etc. – it will often be necessary to construct a separate VCI for each group or area of interest. Some attempts have been made to create generalised VCIs on the national-level (for example, see Cutter et al. 2003 and 2010 or O'Brien et al. 2004).

Dimensions of Vulnerability and Indicators	Vulnerability	Capacity
Physical:	**20**	
Exposure: Percentage of farmland, grazing land or household assets in a drought prone area.	10	
• Lower vulnerability score by 1 for every 10 percent of land or household assets NOT in drought-prone area		
Infrastructure:	10	
• Lack of an all weather road		
• Lack of electricity		
• Lack of clean drinking water		
• Lack of good mobile phone or radio telecommunications		
• Lack of local medical facility		
• Decrease score by XX for hazard proofed infrastructure		-XX
Ecological:	**20**	
Ecosystem Services/ Ecological Conditions:		
• Poor soil conditions, significant soil erosion		
• Low quantity of water (groundwater or surface) available		
• Poor water quality (high salinity, contamination from agricultural or coal mine runoff)		
• Loss of grasslands		
• Loss of biological (insect, small animals, birds) diversity		
• Inability to grow sufficient food to feed household or livestock		
Social:	**20**	
Social Networks: Member of ethnic, extended family, professional (union, etc.) or religious organization or group. If no membership, then high score.		
• Decrease score for membership		-XX
Extra-local Ties: Family members or close friends living in cities or other areas that can provide financial assistance or shelter if hazard strikes.		
• Lower score by XX for every income earning family member living extra-locally		-XX

Dimensions of Vulnerability and Indicators	Vulnerability	Capacity
Proportion of dependents in a household: • If single parent headed household, assign score of XX • For every additional income earning member of household, decrease score by XX. Institutional Access: • Access to local leader • Access to assistance from university, local government, non-governmental organization • Well coordinated and organized disaster response team		 -XX -XX -XX -XX
Economic Economic and Financial Systems: • Access to insurance • Access to banks and credit • Access to disaster relief • Access to informal credit • Lack of good working conditions and workplace protections, increase score Income Source: If 100 percent dependent on local livelihood highly influenced by climate hazards (farming, herding, production of dairy products, etc.) then high score • Decrease score by XX for every 10 percent of income derived from source that is stable and not sensitive to hazard. • Add XX to the score for instable income source, like day labour • Add XX to the score for every XX monetary unit of household debt	**20**	 -XX -XX -XX -XX -XX
Human Health: Poor health conditions, disease vectors, malnutrition Knowledge Access: • Lack of access to education • Lack of knowledge about potential hazards • Lack of knowledge about resources for preparing for or recovering from hazards • Lack of ability to change livelihoods or diversify income sources Attitudinal: • Cultural attitudes believing no steps can be taken to reduce vulnerability to hazard • Feeling defeated or unable to cope with hazard	**20**	 -XX
Subtotal of Vulnerability and Capacity Scores	+X	
Total Possible Vulnerability Score (out of 100)		

Quantitative information collected at the household and community levels can be aggregated to provide an overview of vulnerability and capacity for a large area. There are a number of mapping techniques that use data from the VCIs, GIS layers and other data sources to build vulnerability maps. Remote sensing data can provide valuable insight into the socio-economic and environmental conditions of resident populations, from settlement types to road access and location. High resolution, multispectral imagery is becoming available through free sources like Virtual Earth or Google Earth. These high-resolution images are of good-enough quality to understand building types and sizes, spot grassland degradation and identify areas of predominant vegetation type, or classification of road infrastructure, for instance. When combined with the information gathered from multiple sources and the VCIs, spatially explicit maps of aggregated vulnerability and capacity data can be created.

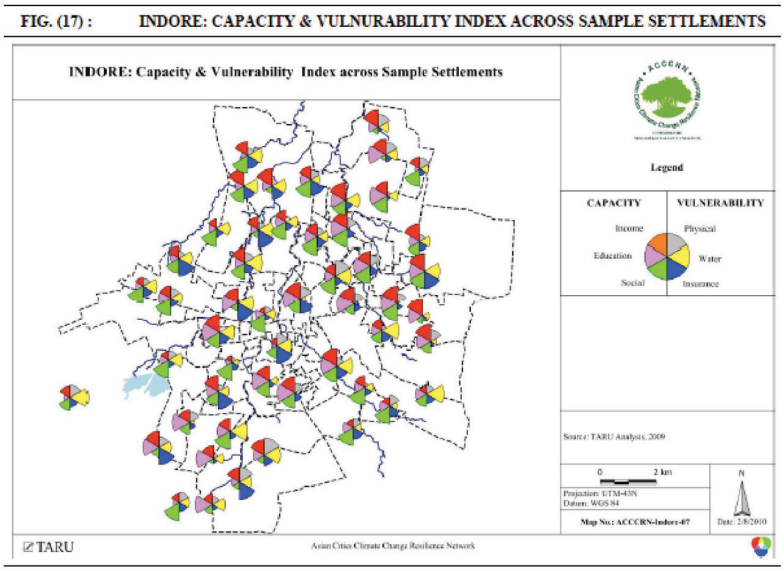


Figure 6: Data from VCI aggregated for Indore City, India at the ward-level and combined with GIS data to produce maps (Bhat and Chopde 2009).

There are multiple methods available for conducting vulnerability assessments. The following table lists some of these methods and how they apply to vulnerability. This list is not comprehensive – there are many more methods than those listed here. No single method alone will provide a comprehensive picture of vulnerability and adaptive capacity. It is necessary to use multiple methods at each step of an integrated vulnerability assessment to uncover dimensions of current and future vulnerability.

Table 1: Some Methods for Assessing Vulnerability

Methods	*Application to Vulnerability*
Secondary data collection and review (e.g. reports, economic surveys, census data, official statistics, early warning systems)	Contextual information on a variety of issues, including population characteristics, external shocks and stresses (e.g. rainfall and temperature trends), health (morbidity and mortality), impacts of previous disasters.
Geospatial data (e.g. maps, satellite images, social mapping)	Identify physical and environmental features (including hazards), land use, resources and infrastructure, location of populations and vulnerable groups. Community and resource maps can be combined with hazard maps to generate vulnerability maps. GIS mapping can combine various layers of biophysical and social vulnerabilities for integrated maps.
Environmental checklists	Questions to gain information about environmental conditions and concerns revealing the relationship between people and their environment (e.g. what role do environmental resources play in resilience? How do environmental hazards, degradation and changes affect communities?)
Biophysical impacts modelling	Quantitative data on environmental conditions, environmental hazards, degradation and changes that can affect communities through changes to ecosystem services and provisioning (e.g. food, water, biofuel, etc.)
Sample surveys and vulnerability/capacity indices Interviews (individuals, households), focus groups, community meetings	Quantitative data on dimensions of vulnerability (e.g. education, employment, health, nutritional status, household economies). Information from different perspectives (among communities, other local stakeholders, external experts) on events and trends that cause stress, differential vulnerability and effectiveness of adaptive behaviour, identification of capacities, discussion on potential interventions.
Individual and household case studies	Data on different experiences of vulnerabilities and abilities to withstand environmental hazards and other shocks.
Timelines	Historical occurrence and profiles of longer-term events or trends (e.g. floods, droughts, epidemics, environmental trends/cycles).
Preference, matrix and wealth ranking	Reveal vulnerability of different groups' assets to shocks and strategies, and strategies against this. May be useful in prioritising interventions.
Venn diagrams and institutional appraisal/mapping methods	Social capital, relations between groups, institutional and policy environment.
Scenarios and computer simulations	Explore possible future outcomes and models of social–environmental interactions over time. Climate downscaling.
Problem trees	Describe the main vulnerability, primary factors/dimensions of the vulnerability, and in turn whatis causing these factors/ dimensions.

Assessing Current Climate Risk

Depending on the type of question, and to a certain extent the information and resources available, there are two broad approaches to assessing current climate risk. These are characterised in the UNDP APF as natural hazards-based and vulnerability-based (see Figure 7). These approaches differ primarily on whether the starting emphasis is on the biophysical or the socio-economic aspect of climate-related risk. In other words, is the emphasis on the climate hazard or on socio-economic outcomes? These two approaches are complementary and can be developed separately or together.

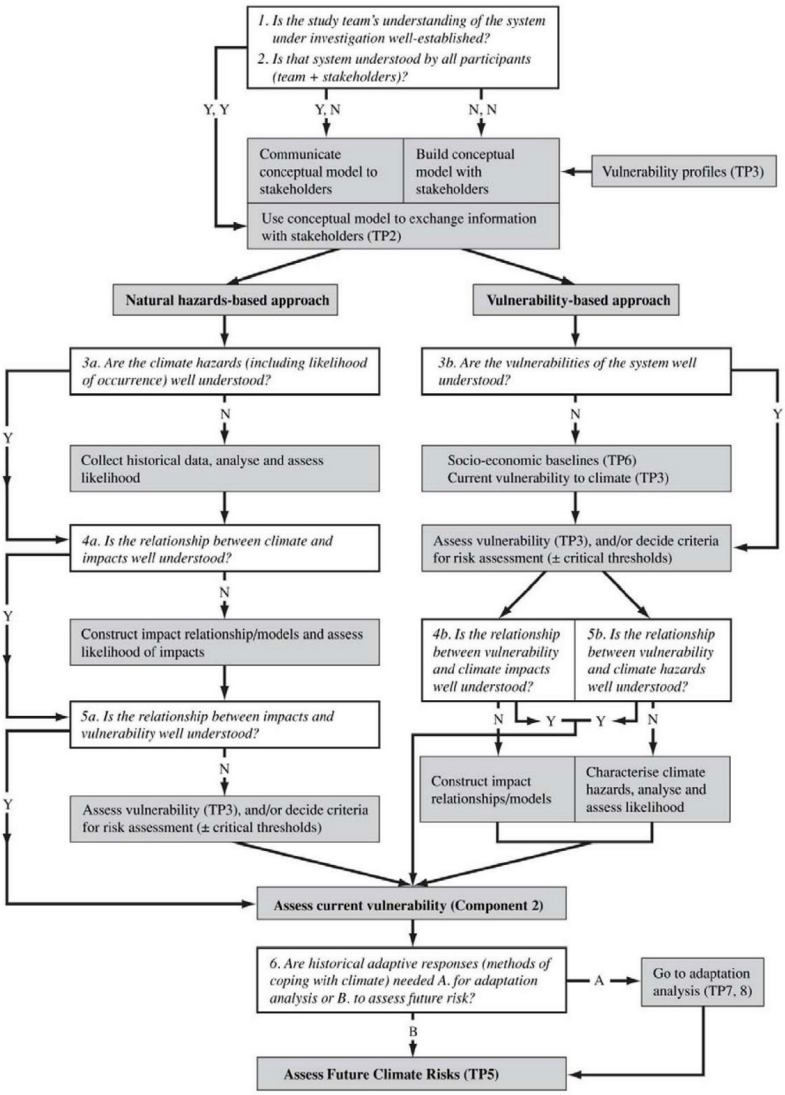


Figure 7: Flow chart for assessing current climate risks. Notice how the biophysical impacts approach (called natural hazards-based approach) and the social vulnerability approach (called vulnerability-based approach) are integrated to form a comprehensive assessment of current vulnerability before moving onto an assessment of current and then future risks. Source: UNDP AFP 2005.

The path chosen will depend on whether the starting point focuses on climate or on vulnerability to climate. For example, a project focusing on the identification of regional climate hazards and how they may alter vulnerability will probably be more suited to a natural hazards-based approach. Approaches focused on the nature of vulnerability or critical thresholds may well start at that point then work backwards to determine the magnitude and frequency of hazards contributing to that vulnerability. Natural hazards-based approaches are favoured where the probabilities of the climate impacts can be constrained, where the main drivers of impacts are known and where the chain of consequences between impacts and outcome is well understood. The vulnerability-based approach will be favoured where: the probability of the hazard is unconstrained, there are many drivers and there are multiple pathways and feedbacks leading to vulnerability. Steps can be carried out in any order to suit the needs of an assessment and can be skipped if they are not considered necessary. Previous information on risks and impacts can also be introduced. The most basic elements needed are a conceptual model of the system and a basic knowledge of the impacts and vulnerabilities in order to prioritise risk. Both qualitative and quantitative methods can be used to assess risk depending on the quality of information needed by stakeholders and the data and knowledge available to provide that information.

Although an understanding of current climate–society interactions is an important starting point for adaptation to future climate, it would be dangerous to assume that new impacts will not arise and that new adaptations may not be needed. In most cases both current and future risk will need to be investigated. If knowledge of current climate risks is already established, then the team may move straight to developing an understanding of how climate and socio-economic change may affect future climate risks. However, where current climate vulnerability is high, then adaptation to those risks will be required to develop sufficient capacity to address future risks. In this case, basic information about how climate may affect those risks in the future could be sufficient.

The aims of undertaking risk assessments are to:

- Characterise the nature of the risk;
- Provide qualitative or quantitative estimates of the risk;
- Assess the consequences of uncertainty for decision options;
- Compare sources of risk, including climate risks.

Key features to consider when choosing a tool are the decision-makers' familiarity with the problem area, and the number and range of stakeholders involved. Table 2 indicates tools that are likely to be useful for identifying other decisions that could be affected by the decision under consideration (i.e. potential 'knock-on' effects) and could therefore help avoid adaptation-constraining decisions.

Table 2: Tools and techniques

Tool/Technique	Familiarity with problem area	Number of stakeholders	Identify related decisions?
Brainstorming	Little/some/great	Few/some	Potentially
Consultation exercise	Great	Many	Potentially
Focus groups	Some/great	Some/many	No
Analysis of Interconnected Decision Areas (AIDA)	Some/great	Few/some	Yes
Problem-mapping tools	Little/some/great	Few/some/many	Potentially

Comparing sources of risk is an important aspect of risk assessment. A tiered risk assessment, in which stakeholders begin with qualitative assessments of risk before moving onto more quantitative levels of analysis, allows different sources of future risk, from both climate and non-climate sources, to be compared and prioritised before undertaking what may prove to be costly, detailed, quantitative assessments of climate risk. It also allows different options for the management of specific risks to be identified and examined at an early stage in the assessment. Investigations of current and future vulnerability will provide information on the non-climate stressors (vulnerability and capacity determinants) that contribute to the overall unit of analysis' or relevant decision's vulnerability and risk. One effective approach is to undertake a different level (tier) of analysis, depending on:

- The level of decision (i.e. policy, programme or project);
- The level of understanding about how climate change will affect targeted decisions, which will be determined in part by previous assessment iterations;
- Whether the aim is to make a climate adaptation decision (in which case climate change will have already been identified as a significant risk as part of a Tier 1 assessment) or a climate-influenced decision (in which case there is less certainty about the implications of climate change).

The purpose of risk assessment for each tier is as follows

- Tier 1 – risk screening;
- Tier 2 – qualitative, and generic quantitative risk assessment;
- Tier 3 – specific quantitative risk assessment.

Where there is some uncertainty as to how, or if, a decision could be affected by climate change, a broad, preliminary climate change risk assessment as outlined in Tier 1 should be undertaken. These Tier 1 assessments apply particularly when trying to decide, perhaps for the first time, whether a problem or decision may be **climate-influenced**. Decision-makers dealing with **climate adaptation** decisions may move directly to Tiers 2 or 3. Each of the tiers in a risk assessment, the level of investigation and outcomes associated with each are discussed in Table 3.

Table 3: Key to selecting the appropriate tier of risk assessment. The table emphasises climate risk, but we emphasise that risk assessments need to determine the balance of risk due to climate change and due to other non-climate factors

Tier	Tier 1 – preliminary climate change risk assessment	Tier 2 – qualitative, semi-quantitative and generic quantitative risk assessment	Tier 3 – specific quantitative risk assessment
Decision level	Policy Programme Project	Programme Project	Project
Understanding of importance of climate change to the decision	Start at this tier if unsure about how, or if, climate change could affect your decision	Start at this tier if already confident that climate variables are/ are not important for your decision	Use this tier if datais available to support quantitative assessments, including climate variables and impacts
Decision type	Start at this tier for decisions that may be influenced by climate change	May start at this tier for climate adaptation decisions or following Tier 1	For climate-influenced and climate adaptation decisions, once a range of adaptation options has been identified through previous circuits round 'assess risk/identify options/appraise option' loop
Purpose of risk assessment	For preliminary risk screening, in particular: • Identifying potential factors that might represent a present or future climate hazard within the exposure unit, (associated level of confidence should be high) • Excluding potential factors that do not represent a present or future climate hazard, (associated level of confidence might be low, medium or high); • Identifying units of analysis at risk (associated level of confidence might be low, medium or high); • Excluding units of analysis not at significant risk, (associated level of confidence should be high); • Helping to identify, in broad terms, potential climate risk management options (See next chapter)	For risk characterisation, prioritisation and ranking, in particular: • Identifying the influence, dependencies and causal pathways linking climate hazard to receptors • Assessing the (relative) sensitivity of a receptor to climate (and non-climate) hazards, based on agreed assessment endpoints • Characterising the nature of the risk posed to the receptor; • Prioritisation and ranking of climate and non-climate risks	• Essential where the choice between options, or the effective management of risk, will be improved by detailed quantitative assessment of the risk or uncertainties, including exploring the sensitivity of the assessment to key assumptions

An immediate progression to potentially complex and data-intensive quantitative techniques of risk assessment (Tier 3) is not recommended. Tier 2 includes a range of risk assessment techniques that may progress from the qualitative, through semi-quantitative to simple quantitative risk assessments where suitable data are readily available.

Box 5: General Steps in a Risk Assessment

- Identify and define a set of climate and non-climate variables or factors for the unit of analysis and how (receptors) it may be sensitive to these.
- Use climate scenarios to help determine nature and significance of the climate change dependent risk to the receptors;
- Use the non-climate forecasts or scenarios to help determine the nature and significance of the non-climate dependent risk.

The information from the vulnerability assessment – of both current and future vulnerability/capacity components – supports the steps of the risk assessment. Information from the risk assessment will likewise feed back into the steps of vulnerability assessment as research teams iterate between the two.

In terms of identifying current climate risk, current climate and non-climate data and information should be used to define the likelihood of realising an identified vulnerability. Much of this information will be come from the vulnerability assessment steps, and the iterations between identifying vulnerability and risk. When assessing future risk, investigations will need to consider how the characteristics of the climate variables and non-climate factors will change over the defined temporal (how far into the future) and spatial domain. Assumptions concerning changes in the mean and variance of the climate **variable** statistics will be particularly important, especially where impacts are associated with lower probability extremes of climate (e.g. changes in numbers of frost days or the **return period** of high magnitude rainfall events). Forecasting risk associated with extreme values may require, as part of a Tier 3 assessment, the application of specialist statistical modelling techniques (e.g. using generalised extreme value distributions; see Coles 2001). These might be applied to scenario-based climate ensembles or forecasts based on historical time series data, among other climate data analysis techniques.

An effective assessment can be accomplished by a variety of mechanisms, including participatory workshops, specific research and developmentand the use of consultancy support. Whichever mechanism is chosen, it should involve a full range of stakeholders, including the decision-makers effecting or affected by the decision. There should be recourse to a range of experts. These should include those with expertise in climate science, those with particular knowledge of the exposure unit(s) and how they may be affected by climate and other factors (including the consequences and effectiveness of any decision) and experts in the application of the analytical techniques to help decision-makers assess options.

Tier 1: Preliminary Assessment of Current Climate Risk

A preliminary current climate risk assessment can be helpful in ensuring that all potentially significant climate-related risks that are affecting or impacting on a unit of analysis are identified at an early stage. This provides a better understanding, when identifying adaptation options, of the factors that may affect their consequences. A preliminary current climate risk assessment may benefit from some degree of information gathering. The intention, however, should be to limit the time and effort spent on data collection at this point. The goal of a preliminary risk assessment is to provide an indication (not involving quantification) of the areas where current climate risks are influencing the performance of the unit of analysis. Completing a checklist, such as Tool 4, will help identify whether or not climate change-related impacts may be important to the selection of options, a task that will be facilitated by consideration of the questions in the box below.

TOOL 4: Key Questions for Tier 1 Current Risk Assessment

1. Which climate variables are likely to be significant in relation to meeting the required performance (decision criteria)?
   - Does information on past variability and trends in climate or past extremes of weather indicate potential vulnerability?
   - How have past changes in mean climate (temperature, seasonal shifts in precipitation, etc.) impacted the units of analysis or decision criteria?

2. How have climate variables affected performance relative to identified decision criteria?
   - Are certain climate variables of greater significance than others?
   - Have there been changes in historical variability or in the frequency and magnitude of extreme values of climate variables that are important or have impacted decision criteria?

3.If an initial portfolio of options exists, is it possible at this stage to judge the potential significance of the impacts of the current climate, including its variability, to the options?
   - Is the risk posed to certain units of analysis likely to be of key importance to the choice of option?

4.Is there uncertainty regarding current climate and its variability, or their associated impacts?
   - Can the level of confidence associated with particular climate risks and their impacts be determined?

5. Can any climatic variables or impacts be screened out at this stage?
   - For example, because they are not likely to affect the choice of option or would apply equally to all possible options.

6. What other current, non-climate factors, such as landuse development plans or trends in markets, could also be relevant in relation to identifying the risks and meeting the identified decision criteria?

The matrix of climate variables for preliminary risk assessment (Tool 5) provides an example of a **checklist** that can be used in preliminary climate change risk assessments. The rows and columns of the table together provide an overall checklist of climate variables and their associated characteristics, which can be used to help describe potential climate pressures, slow-onset changes or hazards. Using this checklist should

TOOL 5: Matrix of Climate Variables to be Considered in Preliminary, Current Climate Risk Assessment

Variable	Characteristics of variable				Sensitivity of decision criteria / system to variable	Confidence in assessment of link between variable and decision criteria / system
	Means and variability, including extremes	Statistical basis of variability and trends	**Averaging or sampling period**	**Joint probability events and variables**		
	Mean, Maxima and Minima, including Seasonal, Annual, and Inter-annual information	Averages, Cumulative Variability/ frequency - including Percentile, Extreme values and Trends	Instantaneous, Hourly, Daily, Day/ night, Monthly, Seasonal, Yearly, Decadal,	Consecutive occurrence. Coincident occurrence		
PRIMARY						
Sealevel						
Temperature						
Precipitation						
Wind						
Cloud cover						
SYNOPTIC						
Weather Types						
Pressure						
Pressure gradient						
Storm tracks						
Ocean climatology						
Lightning						
COMPOUND						
Humidity						
Evapo-transpiration						
Mist						
Fog						
Growing season						
PROXY						
Soil moisture						
Water run-off						
Wave climate						

ensure comprehensive identification and screening of potential future climate hazards on receptors, and facilitate the definition of climate variables for consideration in more formal Tier 2 and 3 risk assessments (including the development of impact assessment models). The outcome of applying the checklist in Tool 5 should be a well-reasoned description of those climate variables to which different receptors may be sensitive.

Some other tools include **brainstorming**, which can often give a good initial overview of impacts. **Process influence diagrams can** also help at this stage by identifying the causal pathways that link the impacts of both climatic and non-climatic factors to the receptors that form the important components of the decision. Further tools that may help are shown in Tool 6. A decision-maker, and other key stakeholders, may have greater or lesser confidence in his or her knowledge of how each climate variable affects his or her

TOOL 6: Techniques for Tier 1 Risk Assessment (Current or Future Risk)

Tool/technique	Qualitative and/ or Quantitative	Complexity	Data requirements	Comment
Checklist	Qualitative	Easy to use	Minimal	Tool 5 is an example checklist
Brainstorming	Usually qualitative	May require specialist	Minimal	
Problem-mapping tools	Usually qualitative	May require specialist	Minimal	
Process influence diagrams	Qualitative	Easy to use, may require specialists	Minimal	
Consultation exercises	Either	May require input from experts	Low	
Fault/Event trees	Either	Requires specialists	Potentially high	Data requirements high to inform precise estimates of probabilities
Expert judgment and elicitation	Either	Requires input from experts	Low	Various methodological approaches, including: Structured questionnaires and encoding methods Facilitated workshops Delphi technique
Scenario analysis	Either	Easy to use with guidance	Medium	
Climate change scenarios	Either	Easy to complex	Medium to high	Both formal and modified versions in use
Cross-impact analysis	Either	Easy to use with guidance	Medium for simpler versions	Supports interpretation of expert judgment
Deliberate imprecision	Qualitative	Easy to use with guidance	Minimal	
Pedigree analysis	Qualitative	Easy to complex	Low	

decision criteria. It is important that the knowledge on which the assessment is based is systematically described. Tool 7 provides some qualitative terms that can be used within risk assessments and during the next phase, adaptation options identification, prioritisation and implementation, to describe different types of knowledge and the associated probability, uncertainty and confidence of that knowledge.

TOOL 7: Qualitative Terms That Can Be Used to Describe Risk, Uncertainty and Confidence (See Willows and Connell 2003: 26)

Qualitative Descriptor	Subjective Descriptor		
Probability of event or outcome, Confidence or Relative frequency	**Probability of event or outcome**	**Risk – including consequence and sensitivity**	**Confidence or Uncertainty**
Greater than 99% chance	Virtually certain to certain	Extremely high	Extremely confident Virtually certain Known, established
90 – 99% chance	Highly probable Very likely	Very high	Very confident Highly certain Very reliable
66 – 90% chance	Likely Probable	High	Confident, Quite certain, Reliable
33 – 66% chance	Possible	Moderately high	Plausible, Debatable, Medium confidence, Unreliable
10 – 33% chance	Unlikely	Moderate	Low confidence, Uncertain, Not reliable
1 – 10% chance	Very likely Improbable	Low Small	Very uncertain Very unreliable Doubtful Very low confidence
Less than 1% chance	Virtually impossible to Impossible	Very small to Negligible	No confidence Extremely doubtful

Tier 2 and Tier 3: Qualitative and quantitative climate change risk assessment

A Tier 2 or 3 assessment can be undertaken by:

- Decision-makers and other key stakeholders addressing a climate adaptation decision problem;
- Decision-makers and other key stakeholders who have already identified a range of options, and are interested in knowing how climate change might influence the choice between them, whether the options need to be amended, or new options considered.

Quantitative climate change risk/impact assessments (Tier 3) enable evaluation of risk quantitatively, including the sources of uncertainty, and the influence of factors on the probability and magnitude of the risk. This tier of analysis also allows for a more detailed, quantitative assessment of the prospective performance of a particular well-defined portfolio of options under the range of uncertainty concerning current climate

and non-climate factors. As with other steps in the decision-making process, the outputs of risk assessment may require other stages to be revisited. Similarly, risk assessments may need to be reviewed in the light of outputs from options appraisal.The selection of the appropriate risk assessment tool for a particular circumstance is not always straightforward but consideration of the questions in Tool 8 should provide some help. Tool 14 lists some tools and methods for conducting various aspects of a risk assessment.

TOOL8: Key Questions for Tiers 2 and 3 - in Addition to those Key Questions in Tier 1

1. Given the various options identified previously, what are the risks of failing to meet your criteria:
   - Posed by the current climate variability and extremes?
     Posed by non-climate factors?
   - What level of uncertainty is associated with both current climate and non-climate factors?
   - What are the confidence levels in each?
2. What are the most important consequences? Which are the key vulnerabilities and risks? How are the consequences dependent upon the climate risks?
   - Risk assessments, including estimates of probability, will be contingent on the datasets of historical information (socio-economic damages and losses, climate data, etc.) upon which they are based, in particular, the quality, completeness and credibility of the data upon which they are based.
3. Are some of the options more vulnerable to these factors than others?
4. What methods and techniques should be used to analyse risks? Do these reflect the scale of the problem, its complexity and data availability?
5. Could other tools be adopted that would allow more explicit consideration of current climate risk, including estimates of probability, analyses of uncertainties and the significance of key assumptions?
   - In-depth detailed quantitative studies (Tier 3) will usually depend on further data collection and the development of risk assessment models.
   - What would be the advantages or disadvantages of adopting alternative risk assessment tools?

The assessment of current climate variability risk can include the development of metrics that broadly encapsulate the most important of the consequences. These can then be used to target adaptation actions, as well as identify data sets and data needs for monitoring and evaluating the effectiveness of the implemented adaptation actions. A selection of metrics should be chosen to provide a balance across various criteria. The types of metrics must be:

- Sensitive to the occurrence of a hazard event but also allow the disaggregation of the effects of the hazard from effects caused by socio-economic change;
- Can be presented at all required geographical scales and time periods;
- Datasets that provide consistency (e.g., government agencies and emergency responder situation reports)
- Able to reflect the social consequences of the hazard events, including consideration of equity though specific social vulnerability metrics
- Relevant to government policy and are legitimate to stakeholders

With all such metrics, it is important that they have been cross-checked through interviews, surveys and focus group discussions with representatives from vulnerable communities, with businesses, hospitals and schools and with emergency responders who have experienced storms (police, firefighters, city water/waste water managers, electricity managers, etc.). These broader sets of stakeholders can provide context and background information that provide meaning to the metrics, and reveal discrepancies in official datasets. With respect to data, there is a need to secure information that provides a clear and comprehensive picture of the consequences of a disaster, including loss of life, assets, working days, etc. for the poorest and most marginal communities. As government data do not always capture this type of information, it will be necessary to use participatory research techniques, such as conducting semi-structured interviews and/or surveys, to augment the government data.

It should be noted that some metrics may be quantified, and some may be monetised but others will be qualitative, such as the extent of valued habitats affected or any disproportionate consequences for disadvantaged groups in society. In some data-rich areas, metrics may exist that also incorporate more sophisticated aspects of the risk, such as the changing frequency of events, or both changes in probability and consequences (such as changes in Expected Annual Damage (AED) estimates used in flood risk management). Examples of risk metrics include:

- Average number of people affected per storm event per year (could focus on number within vulnerable groups)
- Number of 'vulnerable' people living in a defined floodplain
- Demand for health care during and following storm events (extra (number or percentage) morbidity or mortality)
- Number of vulnerable people within the area of particular emergency services (calls on emergency services)
- Homes lost or damaged
- Workplaces lost or damaged (could also use average number of workplaces closed following storm events)
- Average time during and following storm events that vulnerable groups are without critical services
- Average time during and following storm events that critical services are not available

Figure 8: Source: China Voice-Inner Mongolia, 2013.

TOOL 9: A Checklist for Developing Vulnerability and Risk Metrics

Once the list of consequences has been selected, a draft list of a range of possible metrics is identified for each consequence. The following considerations and actions should be completed during metric identification.

1. Potential metrics are discussed with experts and with vulnerable populations, explaining how they relate to the impacts. This list is then reviewed, including adding any important metrics that through further review have been missed.

2. The examination of potential metrics takes a number of factors into consideration, including explicitly examining the advantages and disadvantages and how the metrics can be defined (either qualitatively or quantitatively). Specifically, the following format is used to help this process and clearly recognise that no single metric is a magic bullet:

- What is the metric?
- What is the consequence of it being used?
- What advantages does it offer?
- What are limitations of the metric?
- What is the data that is the basis of the metric (that has been or will need to be collected)?
- Are there possible counter arguments to the selection of this metric?

3. Explore the practicality of each metric in terms of data availability and the complexity of the metric. If the metric requires original research it should be noted and recorded as a research gap.

4. Risk metrics should be reviewed by policy makers to incorporate any policy-relevance perspective.

5. Selected metrics are written up, including the rationale for their selection; sources of data including quality assessment; the calculation method; key assumptions and caveats; and the metric's sensitivity to climate and socio-economic variables.

Step 3: Identify Future Vulnerability and Non-Climate Stressors

A comprehensive assessment of current vulnerability consists of both quantitative and qualitative measures of current vulnerability and capacity. These provide the starting point for building scenarios of future vulnerability, and help identify interventions that can reduce both current and future vulnerability. All of the components that contribute to vulnerability and capacity will change in the future, but, like climate, it is not possible to be 100% certain as to how conditions will change. At best, only estimates can be made of changes in future vulnerability and capacity components for a particular unit of analysis, and in turn how these can act directly or indirectly as non-climate stressors impacting other groups of people, sectors or systems.

Scenario creation generates estimates of future vulnerability/capacity components, and can encompass both quantitative and qualitative methods and techniques. Scenarios are visions of possible futures based on assumptions of human activity such as agricultural practices, land use and development, population increases and demographic changes

and increased standards of living. Scenarios of future vulnerability and capacity are NOT predictions or forecasts. Frequentist probabilities cannot be assigned to the scenarios because no one can exactly know what the future will be. They ask what the unit of analysis' vulnerability/capacity to future climate hazards and mean change might be, given changes in biophysical and social components. Assumptions must be made, based upon consultation with a broad array of stakeholders, careful review of information and data on current vulnerability and capacity components, reviews of socio-economic trends and policies. These assumptions are necessary for the creation of both quantitative and qualitative scenarios.

These scenarios involve thinking about the following:

1) Future Stressors: This includes both future climate changes and those caused by social/economic/environmental changes. In addition to local stressors, consideration should be given to those caused by distant areas or flows of resources dependent on distant areas (e.g. water, energy, food, markets) that may affect vulnerability.

2) Additional Future Vulnerabilities and Capacities: New or worsening vulnerabilities created by future stressors (some future stressors will be new, or in addition to changes in current stressors) and/or if society and ecosystems begin responding in a different manner to changes. As conditions start to change, new strategies and capacities will emerge that lessen future vulnerability and risk. Scenarios of future vulnerability should try to anticipate likely changes in capacity.

3) Links to other Sectors: How vulnerabilities of the group/sector/system may be linked to other key sectors, which may be important for consideration in resilience strategies. The vulnerabilities of one group or sector may be indirectly related to those in another area. For instance, the City of Manila, Philippines, imports a significant amount of rice from Viet Nam to feed much of the city's population. Viet Nam is likely to experience warmer temperatures and greater precipitation variability, which will contribute to greater variability in rice crop amounts. Any losses in Viet Nam's rice crop will lead to greater food insecurity for many of the most vulnerable of Manila's population.

4) Clearly Articulating Assumptions: Scenarios are explorations of possible futures. Developing scenarios will require making assumptions about potential changes in vulnerability and capacity factors. It is important to document all the assumptions that went into developing each scenario, the reasons for making those assumptions, and any supporting evidence, analysis and information. Documentation will assist key stakeholders later to identify future climate risks and in the next phases of the programme – developing and implementing adaptation options, and then monitoring and evaluating the performance of the options. The assumptions can be formed into

metrics for monitoring and evaluation. Furthermore, the assumptions will be important for future stakeholders in future adaptation programmes to be able to evaluate what worked, what didn't, why, and how conditions have changed.

5) Explore Confidence: Many futures are possible from today's conditions but some futures are more plausible than others. Furthermore, it is not possible to explore every scenario during the assessment phase. Through an array of techniques, stakeholders will have to establish the level of confidence in each scenario, using agreed upon definitions of confidence to decide which scenarios to investigate further. These definitions of confidence may be semi-quantitative or purely qualitative statements such as "most likely" or "most serious".

6) Explore Uncertainty: In addition to clearly articulating and documenting the assumptions associated with a particular scenario of future vulnerability or capacity, and confidence levels, stakeholders should also describe the levels of uncertainty surrounding that scenario. Documentation of uncertainty can be purely descriptive (qualitative) to quantitative if done through modelling.

Some methods and techniques for scenario development are listed in Tool 10. This list is not comprehensive.

TOOL 10: Some Methods and Techniques for Developing Scenarios of Future Vulnerability

Method	Qualitative	Semi-Quantitative	Quantitative
Cross-Impact Analysis	X	X	X
Decision Trees	X	X	
Delphi Methods	X	X	
Econometrics			X
Influence Diagrams		X	X
Futures Wheel	X	X	
Gaming and Simulation	X	X	X
Morphological Analysis	X		
Scenario Planning	X		
Social Network Analysis		X	X
Storytelling	X		
Timelines	X		
Time Series Forecasting			X
Trend Extrapolation Analysis	X	X	X
Visioning	X		

Figure 9: Source: China Voice - Guangdong and Ningxia, 2013.

Step 4: Assessments of Future Risks

An assessment of future risks should follow similar steps to that taken for current risks,except forthe need to consider the implications of future climate and non-climate conditions. As such, a climate change risk assessment has the following key steps:

1. Identify and define a set of climate and non-climate variables or factors for the unit of analysis;
2. Use climate scenarios or projections to determine the climate change-dependent risk to the units of analysis;
3. Use non-climate scenarios (the scenarios of future vulnerability and capacity) to determine the nature of the non-climate-dependent risk.

When assessing future risk, investigations will need to consider how the characteristics of the climate variables and non-climate factors will change over the defined temporal (how far into the future) and spatial domain. Assumptions concerning changes in the mean and variance of the climate variable statistics will be particularly important, especially where impacts are associated with lower probability extremes of climate (e.g. changes in numbers of frost days or the return period of high magnitude rainfall events). Forecasting risk associated with extreme values may require, as part of a Tier 3 assessment, the application of specialist statistical modelling techniques (e.g. using generalised extreme value distributions; see Coles 2001). These might be applied to scenario-based climate ensembles or forecasts based on historical time series data, among other climate data analysis techniques.

A preliminary assessment of future climate risk (Tier 1) can be helpful in ensuring that all potentially significant climate-related risks that may affect or impact on a decision are identified at an early stage. This provides better understanding, when identifying options, of the factors that may affect their consequences. Information gathered during the course of the assessment of current and future vulnerability, as well as from the analysis of current climate risk, will assist in preliminary investigations around future risk. However, the intention should be to limit the time and effort spent on data collection at this time. The intention is to provide an indication (not involving quantification) of the areas where climate change risk could significantly influence the unit of analysis. buCompleting a checklist will help identify whether or not climate change-related impacts may be important to the selection of adaptation options – a task that will be facilitated by consideration of the questions in Tool 11.

TOOL 11: Key questions for Tier 1 of Assessment of Future Risk

1. What is the lifetime of your decision? Over what period are the benefits of the decision expected to be realised?
   - This will inform the choice of climate scenarios or projections to be used in future analysis, and how they are interpreted.

2. Which climate variables are likely to be significant in relation to meeting your decision criteria?
   - Does information on past variability in climate or past extremes of weather indicate potential vulnerability to climate change?
   - Vulnerability to changes in mean climate may be less obvious, and therefore more difficult to foresee than vulnerability to changes in climate extremes.

3. How might future changes in these climate variables affect your decision and ability to meet your decision criteria?
   - Are certain climate variables likely to be of greater significance than others?
   - Judgments should be based on information contained within a variety of appropriate climate change scenarios for your area, determined through consultations with climate scientists. Climate analogues may also be helpful.
   - Changes in the frequency and magnitude of extreme values of climate variables are more difficult to project, and more uncertain, than changes in mean values.

4. If an initial portfolio of options exists, is it possible at this stage to judge the potential significance of the impacts of climate change to the options?
   - Is the risk posed to certain receptors likely to be of key importance to the choice of option?

5. Is there uncertainty regarding projections of particular climatic risks, or their associated impacts?
   - Can the level of confidence associated with particular risks and their impacts be determined?

6. Can any climatic variables or impacts be screened out at this stage?
   - For example, because they are not likely to affect the choice of option or would apply equally to all possible options.

7. What other non-climate factors, identified in the scenarios of future vulnerability, could also be relevant in relation to meeting your criteria?

Tool 12 (a repeat of Tool 5) providesan example of **achecklist** that can be used in preliminary assessments of future climate change risk. The rows and columns of the table together provide an overall checklist of climate variables and their associated characteristics, which can be used to help describe potential climate pressures or hazards. Using this checklist should make possible a comprehensive identification and screening of potential future climate hazards and their impacts on units of analysis, and facilitate the definition of climate variables for consideration in more formal Tier 2 and 3

TOOL 12: Summary Matrix of Climate Variables and Characteristics for use in Preliminary Climate Risk Assessments

Variable	Characteristics of Variable				Sensitivity of decision criteria / system to variable	Confidence in assessment of link between variable and decision criteria / system
	Means and variability, including extremes	Statistical basis of variability and trends	**Averaging or sampling period**	**Joint probability events and variables**		
	Mean, maxima and minima, including seasonal, annual and inter-annual information	Average Cumulative Frequency (Variability) - Including percentile, extreme values and trends	Instantaneous Hourly Daily (day/night) Monthly Seasonal Yearly Decadal	Consecutive occurrence. Coincident occurrence		
PRIMARY						
Sealevel						
Temperature						
Precipitation						
Wind						
Cloud cover						
SYNOPTIC						
Weather Types						
Pressure						
Pressure gradient						
Storm tracks						
Ocean climatology						
Lightning						
COMPOUND						
Humidity						
Evapo-transpiration						
Mist						
Fog						
Growing season						
PROXY						
Soil moisture						
Water run-off						
Wave climate						

risk assessments (including the development of impact assessment models). The outcome of applying the checklist in Tool 12 should be a well-reasoned description of those climate variables to which different receptors may be sensitive.

Climate scenarios can also be used at this stage to provide the basis of a list of potentially significant climate variables, together with a range of anticipated future values from climate projections. While future climate scenarios include an increasing number of potentially important climate variables, they may not be presented in a form, or at a level of detail, most relevant to certain problems. It is important not to constrain the preliminary climate change risk assessment because a potentially relevant variable is not included in a particular **scenario** or report. Hence it is recommended that checklistsshould either precede or accompany consideration of the climate variables and changes described in climate scenarios. For Tiers 2 and 3 climate change risk assessments, similar techniques and tools as those used in the current climate risk assessment can be used. The selection of the appropriate risk assessment tool for a particular circumstance can be informed by consideration of the questions in the Tool 13 and from Tool 14.

Statistical models may be of considerable value within risk assessments, but results need to be interpreted with care. Potential applications include: models based on empirical

TOOL 13: Key Questions for Tiers 2 and 3 - In Addition to those Key Questions in Tier 1

1. Given the various options identified previously, what are the risks of failing to meet your criteria:
- Posed by projections of climate change?
- Posed by scenarios of future non-climate factors?
  What are the sources of uncertainty and the assumptions associated with each?
- Criteria will be represented by a number of defined metrics and assessment endpoints.

2. What are the most important consequences? Which are the key risk factors? How are the consequences dependent upon the climate risks?
- Risk assessments, including estimates of probability, will be contingent on the particular scenarios or projectionsupon which they are based.

3. Are some of the options more vulnerable to these factors others?

4. What tools should be used to analyse risks? Do these reflect the scale of the problem, its complexity and data availability?

5. Could other tools be adopted which that allow more explicit consideration of climate change risk, including estimates of probability, analyses of uncertainties and the significance of key assumptions?
- In-depth detailed quantitative studies (Tier 3) will usually depend on further data collection and the development of risk assessment models.
- What would be the advantages or disadvantages of adopting alternative risk assessment tools?

TOOL 14: Methods and Techniques for Tiers 2 and 3 Future Risk

Method/ technique	Complexity	Data requirements	Comment
Uncertainty radial charts	Easy to use	Low	
Fault/event trees	May require specialists	High	Also suitable for Tier 1
Decision and probability trees	May require specialists	High	
Expert judgment and elicitation	Requires inputs from experts	Low	Various methodological approaches, including: Structured questionnaires and encoding methods Facilitated workshops Delphi techniques
Scenario analysis	Easy to use if appropriate scenarios are available	Medium Medium to high	Also suitable for Tier 1,
Climate change scenarios Cross impact analysis	Easy to complex Easy to use with guidance	Medium for simpler version	Also suitable for Tier 1 both formal and modified/simpler versions in use
Monte Carlo techniques	Easy to use with guidance	High	
Modelling tools: process response models statistical models	Requires specialists	Low, medium or high	Deterministic or stochastic models may be used, but methods for sensitivity and uncertainty analysis will need to provide estimates of risk
Development and use of specific sophisticated modelling tools	Requires specialists	High	
Climate typing	Requires specialists	High	
Downscaling	Requires specialists	High	
Bayesian methods	Requires specialists	High	Can be used to determine the value of additional data or alternative models, and for reviewing risk assessments
Markov chain modelling	Requires specialists	High	Can be applied to event and fault trees and similar models to examine propagation of uncertainty
Intervals analysis	Requires specialists	Low, medium or high	

relationships between past variations in climate and impacts on the exposure unit; relationships between projected and observed climate variables at different spatial scales (e.g. statistical downscaling methods); and projections of the historical or prospective return periods of low probability events, such as intense rainfall events or extreme river levels, using generalised extreme value distributions. There are often three further considerations to take into account when selecting a tool for risk assessment:

- Regret, or the consequences and costs of being wrong (decision errors). The more that is at stake, the more important it is to reach a decision that is robust, and thus greater care should be taken in selecting the best tool or, possibly, combination of tools.
- The complexity of the problem. The ability of mathematical risk models to handle a large number of complex interrelated issues is well tested. However, problems may be so large and complex that they cannot be resolved through the use of sophisticated models, although such models can still be of help in understanding the problem. In principle, simple models may provide a better basis for projecting climate changeand assessing the level of confidence associated with the projections.
- The adequacy of the data. The output from any assessment tool will always be constrained by the quality of the available data. An estimate of the uncertainty in the input data should be provided when possible, as uncertainty will be propagated through each of thescenarios, projections and models.The consequences of uncertainty on decisions and assumptions should also be included in investigations of vulnerability and risk.

Summary and Moving to the Next Phase: Adaptation Options Identification, Assessment and Implementation

The assessment phase will provide the evidence needed to inform the identification and assessment of adaptation options. This includes information on who or what is vulnerable to current climate variability and extremes and future climate change, and why they are vulnerable. Other evidence collected during this phase will provide insight into the potential evolution of vulnerability with time, and how direct and indirect non-climate factors interact to exacerbate vulnerability or enhance capacity for particular units of analysis or areas of concern. Evidence based on true integration of the results of the biophysical impacts and socio-economic vulnerability assessments will provide a broader perspective of the vulnerabilities and risks that will require attention. Stakeholder engagement is key to this assessment phase and to the next phase of identifying and implementing adaptation options. Stakeholder engagement can be used to develop a clear articulation of these vulnerabilities and risks, increasing the relevance and utility of the evidence for subsequent phases of this assessment and subsequent assessments and adaptation planning processes. Just as importantly, their engagement throughout the assessment will lead to ownership of the vulnerabilities and risks identified.

Prior to moving on to identifying adaptation options, it is important to assess the quality and quantity of the evidence derived relative to that needed to support identification of adaptation options. This evidence assessment should be undertaken with stakeholders who will be engaged in the adaptation option identification phase. Identified deficiencies will have to be examined in terms of whether they can be addressed and the implications of this evidence gap for the ability to identify (and assess) the options. Such gaps may require a further iteration of the assessment phase or, where these are confirmed as true evidence gaps, areas where further research or data collection are needed.

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and http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=241&Itemid=9

Phase 3: Identification, Prioritisation and Implementation of Adaptation Options

Once socio-economic and biophysical vulnerabilities have been integrated and risks have been identified and prioritised, adaptation options can be identified, prioritised and implemented. The identification and prioritisation of options will occur within the context of an adaptation planning programme, but the actual implementation of them can take more time, depending on the types of actions or policies to be adopted. Elements of the final phase – namely the development and implementation of a monitoring and evaluation system – should occur in parallel with the identification and prioritisation of adaptation options. This chapter discusses various tools and techniques for identifying and prioritising adaptation options based on the outcomes of the assessment phase, while linking to the development of a monitoring and evaluation system while phase 3 is underway.

Step 1: From Risk Prioritisation to Adaptation Option Identification

The identification and prioritisation of adaptation options is dependent upon how risks are identified and prioritised in the assessment phase. The prioritisation of risks should be informed by the objectives, criteria, principles and values that were identified by key stakeholders during the scoping phase. During the assessment phase, stakeholders should have re-evaluated their risk preferences based on reflection of the knowledge and data emerging from the integrated vulnerability analysis and the initial staging of the tiered risk approach (refer to the assessment chapter). In this sense, the very first step of the adaptation options phase is actually a continuation of the risk analysis of the previous assessment phase – the two phases overlap.

As stakeholders reflect upon the assessment outcomes, they will begin to prioritise the risks that emerge to decide how and when to address each risk. Risk prioritisation includes a consideration of the magnitude and likelihood of the consequences of climate change, non-climate stressors and factors and the urgency, or how soon a particular risk needs to be addressed. The consequences of various units of analysis – groups

of people, sectors, or systems – will have been investigated in the assessment phase, and will be categorised according to the objectives defined by stakeholders during the scoping phase. The prioritisation of risk should be done through expertconsultationand broader stakeholder engagement, including using the results of these to inform a further assessment if it becomes apparent that further analysis is needed. Broad stakeholder engagement around all phases and steps of the adaptation planning process, including risk, is more likely to lead to the identification of a more robust range of adaptation options than without engagement.

One example of a risk assessment that can be used to identify relative priorities of risk is that taken within the UK Climate Change Risk Assessment (UK CCRA; see reference). The UK CCRA approach used a simple, multi-criteria assessment based on the available evidence of risk to a number of sectors in the UK. In this example, criteria for magnitude, likelihood and urgency were developedas narratives and semi-quantitative descriptions of what constituted 'high', 'medium' and 'low' magnitude consequences in three categories and urgency according to a broad range of stakeholders. In the example of the UK CCRA (Defra, 2010), the criteria were:

- Magnitude of consequences, where total consequence is the sum of
  - Economic consequence,
  - Social consequence, and
  - Environmental consequence.
- Likelihood of the impact occurring.
- Urgency with which a decision needs to be made.

The CCRA semi-quantitative criteria are listed below in Tables 1 through 4 and can be used together as one possible tool for defining magnitude. The actual values and numbers in these criteria, as well as the categorisation of consequences, will need to be adjusted for a particular adaptation planning programme according to stakeholder preferences. Links to other tools and techniques are provided in the references at the end of this chapter.

Table 1: Examples of classification of relative magnitude: qualitative descriptions of high, medium and low classes (UK CCRA). Examples of particular consequences are italicised.

Class	Economic Consequences	Environmental Consequences	Social Consequences
High	- Major and recurrent damage to property and infrastructure - Major consequence on regional and national economy - Major cross-sector consequences	- Major loss or decline in long-term quality of valued species/habitat/landscape - Major or long-term decline in status/condition of sites of international/national significance - Widespread Failure of	- Potential for many fatalities or serious harm - Loss or major disruption to utilities (water/gas/ electricity) - Major consequences on vulnerable groups - Increase in national health

Class	Economic Consequences	Environmental Consequences	Social Consequences
	- Major disruption or loss of national or international transport links - Major loss/gain of employment opportunities: *~ £100 million for a single event or per year*	ecosystem function or services - Widespread decline in land/water/air quality - Major cross-sector consequences: *~ 5000 ha lost/gained* *~ 10000 km river water quality affected*	burden - Large reduction in community services - Major damage or loss of cultural assets/high symbolic value - Major role for emergency services - Major impacts on personal security, e.g. increased crime: *~million affected* *~1000s harmed* *~100 fatalities*
Medium	- Widespread damage to property and infrastructure - Influence on regional economy - Consequences on operations & service provision initiating contingency plans - Minor disruption of national transport links - Moderate cross-sector consequences - Moderate loss/gain of employment opportunities: *~ £10 million per event or year*	- Important/medium-term consequences on species/ habitat/landscape - Medium-term or moderate loss of quality/status of sites of national importance - Regional decline in land/ water/air quality - Medium-term or Regional loss/decline in ecosystem services - Moderate cross-sector consequences: *~ 500 ha lost/gained* *~ 1000 km river water quality affected*	- Significant numbers affected - Minor disruption to utilities (water/gas/electricity) - Increased inequality, e.g. through rising costs of service provision - Consequence on health burden - Moderate reduction in community services - Moderate increased role for emergency services - Minor impacts on personal security: *~thousands affected* *~100s harmed* *~10 fatalities*
Low	- Minor or very local consequences - No consequence on national or regional economy - Localised disruption of transport: *~ £1 million per event or year*	- Short-term/reversible effects on species/habitat/ landscape or ecosystem services - Localised decline in land/ water/air quality Short-term loss/minor decline in quality/status of designated sites: *~ 50 ha of valued habitats damaged/ improved* *~ 100 km of river water quality affected*	- Small numbers affected - Small reduction in community services - Within “coping range: *~thousands affected*

Risk prioritisation involves stakeholder engagement around deciding how likely each of the consequences might be within a given time period. Likelihood estimation is derived from the investigation of how the characteristics of the climate **variables** and non-climate factors of concern will change over the defined temporal and spatial domain during the assessment phase. Assumptions concerning changes in the mean and variance of the climate variable statistics will be particularly important, especially where impacts are associated with lower probability extremes of climate (e.g., changes in numbers of frost days or the **return period** of high magnitude rainfall events). Forecasting risk associated with extreme values may require, as part of a Tier 3 assessment described in the previous chapter, the application of specialist statistical modelling techniques (e.g., using generalised extreme value distributions; see Coles, 2001). These might be applied to scenario-based climate ensembles or forecasts based on historical time series data.

Table 2: Examples of Likelihood Classification (UK CCRA)

Class	Likelihood (based on confidence scores)
High	Likely that consequences will occur within the next century *(i) High confidence - greater than about 7 out of 10 chance*
Medium	About as likely or not to occur in the next century *(i) Medium confidence - between 3 and 6 out of 10 chance*
Low	Unlikely that consequences will occur within the next century *(i) Low confidence - less than 3 out of 10 chance*

As the magnitudes of potential impacts and their likelihood are investigated during the assessment, stakeholders will have to decide which impacts require action sooner than others, given resources. Deciding the urgency of decisions based on risk analysis is a difficult concept given the uncertainties related to climate and social change, as no one knows exactly what the future will bring. Stakeholders to an adaptation planning process will have to decide how confident they are about the likelihood of particular impacts based on the evidence from the assessment phase.Sometimes, a more detailed analysis might be necessary if the magnitude of a particular risk appears to be medium to high, but there are still questions related to confidence in the likelihood of the risk.

Assigning a metric of urgency to the identified risks can assist stakeholders in deciding what types of action and when are required within the timeframe of interest (e.g., the next five-year planning period) and for those groups of people, sectors or areas with low adaptive capacity and high vulnerability. However, assigning urgency to particular risks also relates to the flexibility and robustness of decisions, attempting to avoid potential adaptation pathways that restrict adaptation options as conditions change and new vulnerabilities and risks emerge. Focusing on addressing ‘urgent’ risks or imminent actions that will have long planned or effective lifetimes and therefore need to include considerations of climate risk, such as new water resources infrastructure or urban development plans, should reduce the risk of maladaptation to climate change.

Table 3: Example of Decision Urgency Metrics (UK CCRA)

Class	Summary description of urgency	Response
High	Major decisions are required within this planning period that affect future resilience to climate change. There is a significant shortfall in adaptive capacity.	Act now.
Medium	Major decisions will be required in the next 20-30 years that affect future resilience to climate change. There is some shortfall in adaptive capacity.	Watch carefully.
Low	No major decisions will be required in the next 20-30 years that affect future resilience to climate change. There is little or no shortfall in adaptive capacity.	Monitor, wait and see.

Table 4: Example of Decision Urgency Considerations

Class	Qualitative description of urgency class
High	• Major policy, investment or other decisions required within the next planning cycle that will either undermine or strengthen the future resilience of infrastructure, investments, communities, biodiversity, etc. • The objectives of these decisions may be undermined by the speed of climate consequences relative to the decision's payback period, whether measured in financial, environmental or social value. • Decisions have limited flexibility, e.g., development of 'long life' assets with 'lock in' to a specific adaptation pathway. • There is low understanding of the risks and / or of the options to adapt to them. There is a significant shortfall in adaptive capacity with a likelihood of locked-in maladaptation unless action is taken to raise adaptive capacity very soon.
Medium	• Major policy, investment or other decisions will be taken in the next 20-30 years that will either undermine or strengthen the future resilience of infrastructure, investments, communities, biodiversity, etc. • The objectives of these decisions may be undermined by the speed of climate consequences relative to the decision's payback period, whether measured in financial, environmental or social value. • There is medium understanding of the risks and / or of the options to adapt to them. • Decisions have some flexibility and there is some potential for incremental adaptation over the long term. There is some shortfall in adaptive capacity with a limited risk of locked-in maladaptation unless action is taken to raise adaptive capacity.
Low	• Major policy, investment or other decisions are not required in the next 20-30 years. • There is high understanding of the risks and / or of the options to adapt to them. • Decisions have high flexibility with potential for incremental adaptation over time. There is little or no shortfall in adaptive capacity with limited if any need to raise adaptive capacity to avoid maladaptation.

There are multiple methods for scoring and weighting risks, some of which are discussed in the various resources listed at the end of this chapter. Within the UK CCRA, the criteria were applied using a scoring and weighting method:

The following formula was then used to combine the criteria scores to identify priorities:

Criteria Score =
100 × (Social+Environmental+Economic)/9+ Likelihood/3+ Urgency/3

Criteria	Score	Weight
Magnitude: economic	High = 3; Medium = 2; Low = 1	1/3 x 1/3 = 1/9
Magnitude: social	High = 3; Medium = 2; Low = 1	1/3 x 1/3 = 1/9
Magnitude: environmental	High = 3; Medium = 2; Low = 1	1/3 x 1/3 = 1/9
Likelihood of the consequence occurring	High = 3; Medium = 2; Low = 1	1/3
Urgency with whicha decision is needed	High = 3; Medium = 2; Low = 1	1/3

Figure 1: Risk ranking (prioritisation) exercise in Neimong. Source: CASS 2011.

Continued engagement throughout the assessment phase is essential as it will guide not only the development of the criteria, but also the application and prioritisation of the risks. The team should confirm that the criteria and prioritisation of risks are consistent with policy priorities and the decision criteria first identified in the scoping phase, and also their implications relative to decision timeframes. It is through this continued engagement around the outcomes of the assessment phase that the transition to the adaptation options identification, prioritisation and implementation phase is made.

Step 2: Adaptation Options Identification

The initial criteria, goals and principles identified during the scoping phase by key stakeholders to guide the overall adaptation planning process also form the criteria by which adaptation options are identified and evaluated. To summarise what was stated in the scoping chapter:

Adaptation Planning Processes and their Outcomes **SHOULD:**

- Help a particular group, community, organisation, service delivery agency, ecosystem or urban area to adapt to and beneficially shape processes of social, environmental and climate change.
- Help prepare for and mitigate the impacts or outcomes of not only short-term shocks (e.g., as a result of extreme events like floods or landslides or when conditions are such that thresholds, coping mechanisms and sensitivities are exceeded for a critical element of a system or group of people), but ALSO long-term, gradual changes, like longer-term increases in temperature during a particular season. Long-term, slow changes may garner as much attention as specific hazard events that cause massive damage, but over time they can cause even greater damage and be even harder to recover from because their gradual occurrence may escape notice until it is difficult to change course.

Figure 2: Stakeholders in Neimong discussing options for reducing desertification. Source: PMO 2011.

- Help prepare for uncertainty. Conditions – socio-economic, environmental, political and environmental including climate – will never evolve exactly as projected. Processes and outcomes should consider uncertainty and its implications when identifying risks and adaptation options to work toward robustness against a variety of situations.

They SHOULD **NOT:**

- Make socio-economic, environmental or climate conditions worse or create newproblems.
- Undertake adaptation planning based on a single / deterministic future
- Commit to a course of action that is hard to correct or redirect later on if it turns out to have been ill-informed, when new knowledge becomes available, or if socio-economic, environmental, political or the climate drivers change differently than that projected

Iterative and reflective stakeholder engagement – for example, through workshops, focus groups and interviews – is absolutely critical to the identification and prioritisation of adaptation options. Through such engagement, stakeholders should decide on the criteria

that will be used to assess and prioritise adaptation options in a manner that reflects the desired outcomes, and the planning and cultural framing, including risk tolerance. The desired outcomes identified during the scoping phase are a good starting point, but these will need to be confirmed or updated to reflect the knowledge, data and insights gained during the assessment phase. Ideally, criteria should include the following considerations, although these may be modified to be culturally acceptable:

Legitimacy – Do people believe in, support, and provide resources/authority to enact the policy or action? Who is responsible for implementing the policy?

Equity – Who or what is being helped/harmed by the policy or action? What are the potential impacts for society or the environment?

Efficiency – Does the policy or action fit within budget, planning timelines and technical capacity?

Effectiveness – Can the policy or action do what it says it will do to reduce risk? Does it acknowledge and/or address critical thresholds? Can it respond flexibly to unanticipated changes or impacts?

Sustainability – Can the options contribute to sustainability and are they themselves sustainable?

Acceptability – Are they culturally, socially, environmentally and politically?

Urgency – Do they match the importance of timing of required action?

Costs – What are the associated economic, social and environmental costs (focus on estimates of size rather than precise figures)?

Timing – Are they consistent with policy, investment, maintenance and other planning cycles?

Coherence – Are the options consistent with other development goals and priorities (including mitigation), and not just a 'bolt-on'? Do theyinclude potential conflicts and synergies within and across sectors?

Robust – Do they reduce vulnerability under current climate? Do they include low-regret options that should be undertaken anyway, incorporate uncertainty, safety margins, and are flexible and mindful of actions by others?

Dependencies – What actions, legislation, regulatory framework, incentives (existing and gaps), investments, externalities, etc. are needed as pre-requisites to implementation? What synergies (win-win options) and conflicts exist?

Option Identification and Prioritisation in ACCC:

Although to a limited extent, some of the ACCC research did progress to the identification and assessment of adaptation options. This included working with policy makers involved in the development of the 12th 5-year plan and with stakeholders at the community level. ACCC research did influence the 5-year plans to some degree, with many of the ACCC researchers involved in drafting the National Adaptation Strategy. ACCC researchers noted that at a practical level, it can be difficult to understand the different types of options and there is a tendency to focus on those options that are within direct control. Another challenge they noted is that policy makers and experts at different levels (e.g., provincial and community), although generally consistent in their identification and assessment of adaptation options, can prioritise different options.

The final set of criteria used to identify and prioritise potential options, although drawing on the objectives and criteria first identified in the scoping phase and further refined by key stakeholders, will need to consider and be modified to reflectin put from a broader array of stakeholders engaged during the assessment and option identification phases.

These criteria also help to form the foundation of the monitoring and evaluation system to be put in place, and stakeholders should simultaneously consider developing such a system when identifying and assessing options. For example, the criteria can provide the basis for monitoring and evaluation indicators (qualitative and quantitative) and for establishing the mechanisms by which the monitoring and evaluation will occur.

Adaptation consists of measures that are able to address current and future climate impacts and vulnerabilities within the context of on-going and projected social change. In the scoping phase, the nature of the issues to be investigated was decided, including such things as thresholds, sensitivities, lifecycle and maintenance management, and dependencies and linkages. These aspects, along with such aspects as the established policy regime, programme and management mechanisms and approaches, and the regulatory, governance and business environments in which the identified options will be implemented should also be considered when identifying adaptation options.

There is also a need to reconfirm the objectives for which adaptation is being considered. For example, do the identified options reduce vulnerability, increase resilience and/or increase robustness? The objectives also should be consistent with how much risk is acceptable - what an acceptable level of risk is and what the residual risk is after introduction of the different options. Engagement of stakeholders in the identification and prioritisation of adaptation options will also facilitate the identification of opportunities orsynergies and potential conflicts with other measures or policies, linking the identified options with other social, economic, environmental and political objectives. This could result in the identification of win-win options that deliver multiple benefits or the ruling out of identified options that conflict with other objectives.

When identifying and assessing adaptation options, there is a need to consider the uncertainties that are inherent in the climate, economic, social and political systems within which they are intended to operate. As such, it would not be prudent to seek to identify an all-encompassing option or set of options that would address the risks as perceived today. A more appropriate approach would be to identify options that are consistent with the continual learning that will need to occur. Adopting such an approach will allow those implementing the resulting adaptation measures to learn from experience and the introduction of new knowledge. Such an approach means identifying potential options that can be introduced incrementally or introducing alternative sets of adaptation options that define alternative adaptation pathways (Wilby and Dessai, 2010; Walker et al, 2013) that could be pursued as risks develop.

Figure 3: The government is proposing to relocate a number of villages in Ningxia due to desertification and decreasing water supply. Source: CASS 2011.

A range or package of adaptation options should be identified for each of the identified risks, as no single option by itself is likely to be able to sufficiently address a particular risk. This should include consideration of :

Strategic and policy options (making, implementing and reviewing policies) - linked to key strategic intentions.

Technical and structural options – asset management, sustainability and enhancement of resources and investments in operations and health and safety procedures.

Non-structural options - raising awareness, demand management efforts, monitoring and data, skills development and early warning systems.

Consideration of these types of options recognises that options should be developed in the context of an overall adaptation strategy that includes measures that both:

Build adaptive capacity (BAC) – establishes the necessary enabling conditions for adaptation actions to take place such as: gathering the required information, establishing supportive social structures and developing supportive governance structures to build the foundation for delivering adaptation actions;

Deliver adaptation actions (DAA) – tangible actions undertaken to help reduce vulnerability to climate risks and to exploit opportunities such as:

- Accepting the impacts and bearing the losses that result from those risks (e.g., manage retreat from sea level rise).
- Offsetting losses by sharing or spreading the risks or losses (e.g., through insurance).
- Avoiding or reducing one's exposure to climate risks (e.g., build new flood defenses, or change location or activity).
- Exploiting new opportunities (e.g., engage in a new activity, or change practices to take advantage of changing climatic conditions).

Step 3: Prioritising Adaptation Options

There are a number of methods available for helping to prioritise and assess the identified adaptation options. The outcomes of the vulnerability and risk assessments, and methods used therein, can help in assessing the identified options. In undertaking such an option assessment, the following questions (Tool 1) should be considered:

Techniques, such as multi-criteria analysis, costing techniques, technical feasibility studies and environmental impact assessment can be useful in assessing the different

TOOL 1: Questions to Ask for Options Prioritisation

- How do each of the options or set of options rate in relation to the criteria and established risk assessment endpoints?
- Can different levels of confidence be attached to the likely performance of different options? If so, what are they?
- Can particular options be confidently excluded because they are unlikely to meet the acceptability criteria?
- Are more precise definitions (policy or operational definitions) of these criteria needed to appraise the options?
- Would other criteria have led to a different form of options appraisal?
- Would more detailed assessments provide a basis for improved discrimination between options, or help develop better options?
- Have the risks associated with implementing each option been identified?
- Could the options being considered possibly constrain other decision-makers' ability to adapt to climate change (i.e., contribute to climate mal-adaptation)?

options. Where there are multiple criteria, multi-criteria analysis techniques based on qualitative indictors can help assess and prioritise the different options. Many of the tools and methods used to assess vulnerability and risk can also be used to explore how these might be reduced if certain adaptation options are implemented, and thus assist in the investigation of various adaptation options. There is also the possibility to understand adaptation synergies and trade-offs, including through portfolio theory (Crowe and Parker, 2008) and real option analysis (HM Treasury, 2009) approaches. As in all aspects of the adaptation planning process, stakeholder and other expert judgement is also important, including in the evaluation and confirmation of the adaptation options. This is particularly the case where options require specialised technical, political or other expertise to appraise them, making it important that the right people are engaged in the process. Some of the resources listed at the end of the chapter contain links to various types of methods and tools that can be used for analysing adaptation options.

Further considerations to be integrated into the analysis of options include:

- Understanding the limitations of the proposed adaptation options, including the associated uncertainties as to their performance and effectiveness.
- Identification of the incremental components and dependencies of proposed measures–i.e., requirements to implement specific options such as training and supportive policies and procedures.
- Identification of contingencies as part of the strategy, related to risk tolerance and what is in place should the risk actually occur - e.g., implications for emergency services, infrastructure, food systems, etc.
- Consideration of coping, low-regrets and win-win options, but also understanding their limitations and when this may mean transitional and transformational adaptation.

- Identifying mechanisms and responsible parties for monitoring and measuring the qualitative and quantitative performance of the identified options, which are linked to the monitoring and evaluation phase.

The question as to how much adaptation is required will need to be considered, as there is always the risk of under-adaptation or over-adaptation. In addition, understanding the risk associated with under-adaptation relative to risk tolerance, particularly in the case where socio-economic and other considerations could limit what adaptation is possible, will inform the assessment of adaptation options.

What can lead to over- or under-adaptation? The following figure depicts the general situations under which adaptation may be greater or less than required to address the risks.

Methods Typology for Gathering Information Needed to Identify and Prioritize Adaptation Options

Legitimacy:	**Equity:**
Stakeholder Methods: • Interviews • Focus Group Discussions • Sankey Diagrams • Problem/Decision Trees • Delphi Methods • Vision Sheets • Ranking Exercises • Scenario Construction • Qualitative Multi-Criteria Analysis • Surveys	*Vulnerability Assessments* *Risk Assessments* *Stakeholder Participatory Methods* *Policy Review* *Environmental Impact Assessments* *Social Impact Assessments*
Efficiency:	**Effectiveness:**
Costing Techniques: • Real Options Analysis • Quantitative & Qualitative Cost-Benefit Analysis • Cost-Effectiveness Analysis • Sankey Diagrams • Socio-Economic Scenarios *Technical Feasibility:* • Environmental Impact Assessments • Risk Assessments • Engineering Reviews • Policy Reviews • Systems Analysis • Climate Thresholds Analysis	*Sensitivity Analysis* *Vulnerability Assessments* *Risk Assessments* *Stakeholder Methods* *Policy Reviews* *Environmental Impact Assessments* *Climate Threshold Analysis* *Monitoring and Evaluation:* • Development of Indicators • Process of M&E • Responsibility for M&E

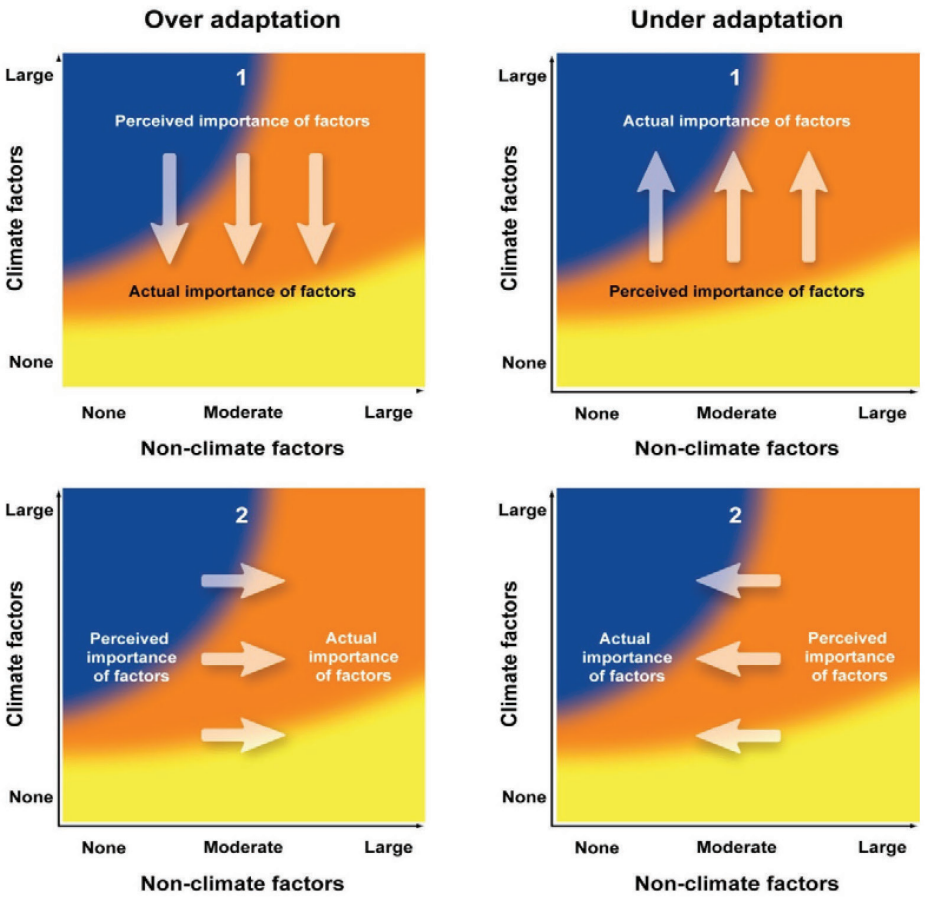

Figure 4: Adaptation options in relation to climate and non-climate risks. Source Willows and Connell 2003.

Fundamental to the analysis of adaptation options is capturing the thinking behind the criteria. Documentation of the criteria and their rational and traceability of the decisions will impact how options are investigated. Being able to justify and document the criteria will prove valuable in further justification and seeking support for the decisions, the evaluation of the implemented measures and the support of subsequent assessments.

Step 4: Implementation of Adaptation Options

Once adaptation options have been prioritised, implementation must occur. Depending upon the scope – for example, a national-level policy or an infrastructure project – it may take a while for the suite of adaptation options to be fully implemented. Sometimes, a suite of smaller scale options implemented through pilot testing allows for further testing and evaluation of the potential effectiveness and scalability of a wider set of proposed options.

Pilot testing also allows for more time to further develop and implement a monitoring and evaluation system. While consideration of monitoring and evaluation will occur throughout all phases of the adaptation planning process, it is a mechanism by which reflecting and learning from the tiered steps and previous phases occurs. It is an important phase for ensuring the success of the process and the options outcomes.

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Phase 4: Monitor and Evaluate

In order to make more informed decisions and strengthen future adaptation planning processes and resultant options, it is vital that governments, funders, partners and stakeholders are able to learn what aspects of the process and options work well (or not), under which circumstances and why. Furthermore, as socio-economic, policy, environmental and climate conditions change, it is necessary to have mechanisms in place to monitor how implemented adaptation options are performing in reducing risk and continuing to meet criteria. Well-planned monitoring and evaluation (M&E) systems can help achieve this understanding. Such systems are an important phase of the adaptation planning process, enabling decision-makers and other stakeholders to determine whether they have chosen the optimal adaptation options and whether these have been implemented effectively.

Monitoring and evaluation of adaptation interventions can be challenging for a number of reasons. Adaptation is often characterised by long time lags, sometimes years, between taking action and understanding the effectiveness of the action in reducing vulnerability and risk while enhancing capacity. There are also many uncertainties that can influence whether an adaptation measure is effective or not. These uncertainties include future emissions scenarios; understanding of future climate described by climate models; and how society may change during the lifetime of the adaptation. Consequently, the perceived effectiveness of an adaptation intervention is shaped by both future climatic conditions and by the dynamic socio-economic context in which these changes occur. The combination of long timescales and uncertainties can make it difficult to understand what would have happened in the absence of the adaptation measures and to determine which outcomes can be attributed to the chosen adaptation option. However, the

challenges associated with developing an effective M&E system are not insurmountable, especially if M&E is embedded within the previous phases of the adaptation planning process. Indeed, by considering M&E issues in the scoping phase, M&E offers the chance to explore what works (and what does not) and to reflect upon, learn from and improve the overall adaptation planning process. Therefore, while it may not be straightforward, the M&E phase is critical to an iterative adaptation planning process.It is the foundation for improving what we do and how we do it.

There is no single, 'one-size-fits-all' approach to developing and implementing an adaptation M&E phase. This is because adaptation occurs in different social, political, economic and environmental contexts and in response to different climate change impacts. Furthermore, M&E systems are often required to capture broader socio-economic benefits - not only those related to climate adaptation - so they must be flexible enough to meet multiple stakeholder objectives. As a result, the purpose of this chapter is not to present a universal adaptation M&E framework but to highlight some important considerations when developing and M&E systems for adaptation planning and activities.

Step 1: Stakeholder Engagement around Monitoring and Evaluation

The previous phases of the adaptation planning process, if conducted with continuous stakeholder engagement and iterative reflection upon the process and lessons emerging in each phase, can provide the criteria and means by which to develop and implement the M&E system. M&E needs to be considered as early in the adaptation planning process as possible, ideally during the scoping phase when the entire process is being designed. This enables monitoring to occur from the start and, where possible, to measure progress against baseline conditions that are initially identified in the assessment phase. Changes in baseline conditions, which will happen as climate and social conditions shift, can be identified fairly early if monitoring is place, allowing for potentially more time in evaluating the implications of these and when to initiate another cycle of the adaptation planning process.Formalising aspects of the M&E system can occur during the adaptation options identification, prioritisation and implementation phase – there can be significant overlap between the third and fourth phases.

By planning early it is possible to identify who (stakeholders) will need to be involved in the M&E process and how they should be engaged. It also helps to reveal the resources needed and available for initiating and sustaining the various elements of the monitoring and evaluation system. If there is a difference between resource need and availability, early decisions can be made regarding finding additional resources or designing the M&E process appropriately to be as effective and efficient as possible given constraints. While it is not possible to address every point related to adaptation in the first phase, the following should be discussed during this phase and reflected upon in every subsequent phase:

- Key stakeholders should clarify criteria, roles and responsibilities, and mechanisms around information management.
  - Deciding who – which government agencies, NGOs, community groups and/or experts – will have the responsibility for monitoring and evaluating the performance of particular suites of options.
  - Determining what resources – funding, equipment, computational facilities, etc. – will be available for M&E.
  - Identifying dissemination and reporting mechanisms, especially the establishment of effective, multi-media communication strategies that facilitate wider learning and capacity building beyond the immediate process stakeholders.
  - Establishing direct policy communication mechanisms to ensure that any changes in the outcomes or performance of the options will be reported to decision-makers and other relevant stakeholders, and can inform other adaptation planning processes.
- Key stakeholders should build a culture of learning from the outset; the adaptation planning process will rarely go as planned, thus offering an opportunity to learn and improve in the future.
  - Unexpected and unintended outcomes will occur - these are often where the most can be learned.
  - Understanding that successful adaptation will have trade-offs and different implications for different people and sectors. Not everyone will benefit, or benefit equally from a particular suite of options.
- Key stakeholders need to evaluate the logic, policy priorities, criteria, timeframes and assumptions that underpin the process and options as new information emerges.
  - Developing appropriate indicators against which progress may be tracked upon reflection of the above considerations.

Stakeholder Engagement: Responsibilities, Trade-offs and Perceptions

An effective monitoring and evaluation system should seek to engage stakeholders from a range of levels and relationships with the intervention. These might include policy makers, project and programme staff, direct beneficiaries and the broader community who may be indirectly affected by outcomes of the project. The success of an adaptation intervention can be perceived differently and from multiple perspectives. Adaptation can also involve difficult trade-offs, such as deciding which groups of people stakeholders think should benefit or not from a particular set of options, and who has the responsibility of deciding how trade-offs should be made. Therefore, it is important to recognise and assess these decisions, especially in cases where effective adaptation for one community may mean that a greater burden is placed on another group. The results of the vulnerability and risk assessment phase, particularly those from the social vulnerability assessment step, can assist in identifying particularly vulnerable groups that may benefit or be harmed by a particular set of adaptation options.

Figure 1: Gender-focused vulnerability assessment in Ningxia (CASS 2011). Climate change will impact women and men, girls and boys in a variety of ways because of the different socio-economic, political, cultural and environmental opportunities and inequalities along gender lines. These also influence the adaptive capacities women and men have for dealing with climate change. It is absolutely critical to consider gender dimensions when conducting all phases of an adaptation planning process.

Stakeholder engagement is necessary for determining the roles and responsibilities of particular stakeholders in performing monitoring and evaluation activities, as well as to whom they should report the outcomes of the M&E and who decides when another cycle of adaptation planning should be initiated. Stakeholder analysis – introduced in the Engagement and Scoping chapters – should be repeated during the end of the options implementation and the start of the M&E phases. The following stakeholder analysis matrix (Tool 1) can assist in deciding the various levels of stakeholder engagement around M&E. The questions in Tool 2 can assist in completing the stakeholder analysis matrix.

Stakeholder engagement around the development of all aspects of an M&E system will be critical to its success and to sustaining the M&E activities through time. In addition to covering all practical aspects of developing the system, it is important that stakeholders engage around indicator development in order to:

- Establish common understanding and language around the indicators and what each signifies.
- Agree on the appropriateness of particular indicators for M&E.
- Identify potential data issues or other barriers that might prohibit the use of particular indicators, or warrant indicator modification.
- Secure stakeholder buy-in on the acceptability of indicators. If a stakeholder group does not agree on the meaning and/or worth of a particular indicator, they may challenge whatever findings arise from the use of the indicator.Some negotiation around indicators may have to occur because of the potentially sensitive nature of the information they may reveal. Even though broader stakeholder buy-in may not be possible for a particular indicator, that indicator may nonetheless be valuable and useful.
- Agree on indicator review mechanisms and means of further discussing or probing the findings as an indicator is used to monitor and evaluate an adaptation option.

Step 2: Address Monitoring and Evaluation Logistics

In addition to establishing a) who will implement and/or monitor and evaluate a particular set of adaptation options, and b) the trade-offs various stakeholders will experience, it is important to think about the budget, time, resources and authority (policies, laws,

TOOL 1: Stakeholder Analysis Matrix for Monitoring and Evaluation

Adaptation Option Being Considered:			
Stakeholder Group(s) Impacted by Option	Potential Positive Impacts of Option	Potential Negative Impacts of Option	Capacities for Monitoring Impacts
Stakeholder Group(s) Likely to Implement Option	Authority to Implement	Expertise to Implement	Interest in the Option

TOOL 2: Stakeholder Analysis Questionnaire for M&E

This questionnaire accompanies the matrix above. Additional questions and categories might be necessary for analysing stakeholder roles, interests and perceptions around an adaptation option.

1. What stakeholder group(s) does the adaptation option explicitly aim to help? What other stakeholder group(s) will also be impacted by the option?
2. What are the potential positive AND negative impacts of that option for the particular stakeholder group?
3. What kinds of capacities does the group have for monitoring and documenting how the option is impacting them, both positively and negatively?
   - To whom (government agency, NGO, community representative, the media, etc.) can they report their observations on the impacts and effectiveness of the option once it is implemented?
   - How will those reporting the results be protected if negative impacts are observed and they report them?
4. What stakeholder groups are likely to implement the options?
5. What is their interest in the option?
6. What is their authority (legal, policy, cultural, formal or informal and/or economic) to implement the option? Can their authority survive changes in political leadership and election cycles?
7. What expertise, such as participatory research experience or environmental monitoring, does this group have that is needed for monitoring and evaluating the option?

stakeholder buy-in) that will be needed to realise the option and establish the M&E system. The following types of questions (Tool 3) can assist in thinking about these practical matters, although it is not a comprehensive checklist.

TOOL 3: Thinking About Time, Resources and Authority for M&E

1. Are the resources and time allocated to undertake the M&E proportionate to the importance and urgency of the adaptation option?
2. Are the objectives clearly defined and achievable?
3. Are the necessary expertise and data accessible?
4. Have monitoring and evaluation tasks been allocated and the appropriate resources to carry out those tasks been identified?Have sufficient and appropriate resources been allocated for continued stakeholder engagement and dissemination mechanisms?
5. What kind of structural elements (institutional arrangements, legislative/regulatory and/or community support) or programmes might be put in place to support the M&E?
   - How long are the resulting structural elements, programmes and related decisions planned to last (planned lifetime)?
   - How might both the adaptation options and the M&E system be impacted by changes in political cycles or priorities?
6. How far into the future will the M&E activities have to occur? Have sufficient resources been allocated for the full period of M&E?

Step 3: Establishing Learning Mechanisms

Learning should be central to a good M&E system. We should always be looking to improve our understanding of adaptation interventions, including what works, when, under what conditions and why. It is important to build a culture of learning from the outset, which means framing and communicating M&E as a positive process of 'learning and improvement' rather than of 'reporting and blame'. It is essential that stakeholders feel free to be able to identify mistakes without risk of punitive punishment, as this offers an opportunity to learn and improve in the future. It is also important to remember than successful adaptation will involve trade-offs and have different implications for different people and sectors. Not everyone will benefit, or benefit equally, from a particular suite of options. Learning whether these trade-offs were the correct decisions is extremely valuable.

Learning can happen within a particular adaptation project or programme, but should also be shared with other organisations that were not involved. This does not mean publishing negative messages about organisations involved in a planning process. It is possible to highlight where things may not have gone according to plan and how this will strengthen approaches in the future. Sharing and co-learning between stakeholders across multiple adaptation planning processes and programmes will help society to learn how best to adapt to a changing climate much more efficiently than working in isolation, which is a 'trial and error' approach.

Step 4: Establishing Communication Mechanisms

Sharing findings is part of the process of learning. Dissemination and reporting mechanisms are therefore important, especially through the establishment of effective, multi-media communication strategies that facilitate wider learning and capacity building beyond the immediate process stakeholders. The establishment of direct policy communication mechanisms to facilitate the improved reporting of M&E findings to decision-makers should be considered. However, it is important that M&E systems not only report upwards, but also sideways and downwards. For example, key messages and lessons should be shared with those in similar adaptation contexts, organizations or sectors who sit outside of the immediate project or programme. Community-level stakeholders may also want to understand the findings or be able to report their own findings and observations of the performance of the process and adaptation options.As with the other phases of the process, effective dissemination and reporting throughout the M&E process involves:

- Establishing a common language among a broad array of stakeholders.
- Presenting findings in a practical and accessible way, which sometimes means presenting them in different formats for different sets of stakeholders and using multiple engagement techniques such as:
  - Social media – websites, blogs, etc.
  - Newspaper, radio, television documentaries
  - Posters and visual aids as community- and public-outreach programmes
  - Art, theatre, storytelling and other performance installations
- Iterative engagement with a broad array of stakeholders to assess their knowledge and perception around the options (what has and hasn't worked), and
- Offering anonymous, safe mechanisms for reporting observations across a variety of communication formats.

It is important to acknowledge that reporting and disseminating as part of the M&E system can be perceived as challenging particular stakeholders' interests or role(s) in implementing and/or monitoring an adaptation option. There is also a possibility that weaker, politically underrepresented or socially marginalised groups may be penalised for reporting upon negative impacts.It is important to identify and address these potential conflicts during the development of the M&E system. Drawing from a variety of stakeholder engagement and participatory methods and techniques can assist in overcoming power barriers between stakeholders. Resources are listed at the end of this chapter.

Step 5: Clarify Assumptions behind Formulation of Adaptation Options

When identifying and prioritising adaptation options, assumptions will have been made regarding the nature of future climate impacts, capacities and policy priorities and cycles and the socio-economic context in which these activities will take place. This is

normal for any project or programme. However the complex, long-term nature of climate change makes it even more important to a) understand the original logic underlying the intervention and b) challenge and test these original assumptions. For example, a flood management project may assume that a certain percentage of the population can afford insurance for flooding. However, changes in the cost of insurance, the incomes of households or the severity of impacts may mean the appropriateness of this assumption changes over time. An Adaptation Logic Model (or 'theory of change' model) can be used when designing the intervention; see Pringle (2011) and Spearman and McGray (2011) for examples. Some method of investigating and reflecting upon the option assumptions is important in designing the evaluation approach, as it enables the logic behind adaptation efforts to be re-evaluated as new information emerges.

Step 6: Examine the Unintended and Unexpected

An Adaptation Logic Model or other similar frameworks (Pringle 2011) can be used to explore what was expected to happen as outcomes of the implemented adaption option the assumptions and logic for formulating that option, and what has actually has happened to date. It is also equally important to consider those impacts and outcomes which were unintended and unexpected, particularly knock-on impacts, as these are often where the most can be learned. It is vital that an M&E approach is not limited to only asking, 'Did we do what we set out to do?' but also examines those positive and negative aspects that may not have been planned but occurred as a result of the adaptation intervention. This is especially important given that adaptation planning processes and implementation is a relatively new field.

Figure 2: CASS team discussing adaptation options for grassland management. Source CASS 2011.

Step 7: Developing Monitoring and Evaluation Indicators to Measure Progress and Performance

During the adaptation options identification, prioritisation and implementation phase, stakeholders will re-evaluate and reaffirm the adaptation planning process principles, goals and criteria they established during the scoping phase. Information, knowledge and data around vulnerability, risk and capacity that emerged from the assessment phase should prompt reflection on these values. It may be that additional criteria and principles are necessary to guide the formulation and evaluation of options and/or that the original need some modification. These criteria can assist in the formulation of both qualitative and quantitative metrics and indicators for monitoring and evaluating the performance of adaptation options. While it may seem like repetition, we re-state some common principles for adaptation planning processes, as well as considerations of criteria that were initially raised in the scoping phase.

Adaptation Planning Processes and their Outcomes **SHOULD:**

- Help a particular group, community, organisation, service delivery agency, ecosystem or urban area to adapt to and beneficially shape processes of social, environmental and climate change.
- Help prepare for and mitigate the impacts or outcomes of not only short-term shocks (e.g., as a result of extreme events like floods or landslides or when conditions are such that thresholds, coping mechanisms and sensitivities are exceeded for a critical element of a system or group of people), but ALSO long-term, gradual changes, like longer-term increases in temperature during a particular season. Long-term, slow changes may garner as much attention as specific hazard events that cause massive damage, but over time they can cause even greater damage and be even harder to recover from because their gradual occurrence may escape notice until it is difficult to change course.
- Help prepare for uncertainty. Conditions – socio-economic, environmental, political and environmental including climate – will never evolve exactly as projected. Processes and outcomes should consider uncertainty and its implications when identifying risks and adaptation options to work toward robustness against a variety of situations.

They SHOULD **NOT** :

- Make socio-economic, environmental or climate conditions worse or create newproblems.
- Undertake adaptation planning based on a single / deterministic future
- Commit to a course of action that is hard to correct or redirect later on if it turns out to have been ill-informed, when new knowledge becomes available, or if socio-economic, environmental, political or the climate drivers change differently than that projected

The desired outcomes identified during the scoping phase are a good starting point, but these will need to be confirmed or updated to reflect the knowledge, data and insights gained during the previous phases. The final set of criteria for monitoring and evaluating options will be determined through stakeholder engagement. Some potential criteria for prioritising, and monitoring and evaluating adaptation options over time can include – the list is not comprehensive and must be modified for the particular context – the following which can be formulated as M&E indicators:

Legitimacy – Do people believe in, support, and provide resources/authority to enact the policy or action? Who is responsible for implementing the policy?

Equity – Who or what is being helped/harmed by the policy or action? What are the potential impacts for society or the environment?

Efficiency – Does the policy or action fit within budget, planning timelines and technical capacity?

Effectiveness – Can the policy or action do what it says it will do to reduce risk? Does it acknowledge and/or address critical thresholds? Can it respond flexibly to unanticipated changes or impacts?

Sustainability – Can the options contribute to sustainability and are they themselves sustainable?

Acceptability – Are they culturally, socially, environmentally and politically?

Urgency – Do they match the importance of timing of required action?

Costs – What are the associated economic, social and environmental costs (focus on estimates of size rather than precise figures)?

Timing – Are they consistent with policy, investment, maintenance and other planning cycles?

Coherence – Are the options consistent with other development goals and priorities (including mitigation), and not just a 'bolt-on'? Do theyinclude potential conflicts and synergies within and across sectors?

Robust – Do they reduce vulnerability under current climate? Do they include low-regret options that should be undertaken anyway, incorporate uncertainty, safety margins, and are flexible and mindful of actions by others?

Dependencies – What actions, legislation, regulatory framework, incentives (existing and gaps), investments, externalities, etc. are needed as pre-requisites to implementation? What synergies (win-win options) and conflicts exist?

Efforts to evaluate an adaptation intervention require a clear sense of what a particular action is expected to achieve or deliver, reflected in unambiguous stakeholder-defined criteria. Not all of the criteria for M&E will be given equal weight or necessarily apply to every single implemented adaptation option. Stakeholders will need to engage around deciding what criteria are most appropriate for monitoring and evaluating a particular option, and also try to identify and address any potential tensions between them. For example, are the main objectives to assess effectiveness and efficiency, assess value for money, provide accountability, improve learning, understand equity or a mix of all of

these? Stakeholders will also need to discuss the time frame of how long it is important to monitor and evaluate a particular option and the suitability of each criterion in serving as M&E metrics over the period of concern.

Indicators are an important means of tracking progress (monitoring) and reviewing performance at a given point in time (evaluation). Yet unlike mitigation projects, which can be assessed in terms of the reduction in greenhouse gas emissions, the success of adaptation interventions cannot be assessed by means of a single universal indicator. Consequently, indicators need to be developed which are specific to the criteria and objectives of the adaptation intervention in question. At times, it may be appropriate to partially formulate indicators from the vulnerability and risk indices (quantitative) and contexts (qualitative) that were developed during the assessment phase. At the most basic level, if an adaptation option cannot address critical vulnerabilities or risks or contribute to capacity, it is not likely to be an appropriate option. Therefore, developing some monitoring and evaluation indicators that can measure (qualitatively and quantitatively) changes in vulnerability and risk can be useful to the overall M&E system. Two different types of indicators should be considered with reference to adaptation option evaluation:

- Outcome-based indicators that define an explicit outcome, or end point, of the adaptation action (e.g., 'number of homes protected from coastal inundation').
- Process indicators that "define the key stages in a process that would lead to the best choice of end point, without specifying that point at the outset" (Harley et al., 2008). These types of indicators can include things like the number of households with flood protection plans in place or that are active in a community-based response team.

As we have often not yet reached the point where the outcomes of an adaptation intervention can be evaluated, it can be difficult to use outcome indicators. As a result, process indicators are often used to evaluate whether the 'direction of travel' is correct given the information available at a givenpoint in time. While quantitative indicators are essential part of M&E, they are just one part of the adaptation story. It is important that monitoring and evaluation is not reduced to a few 'headline indicators'. We must draw on both quantitative and qualitative evidence in constructing a richer, more detailed narrative regarding the performance of an intervention. This is particularly important when understanding the factors that enable or act as barriers to effective adaptation.

Resources and References

There is no single framework or set of universal indicators that can be applied when developing an approach for monitoring and evaluating an adaptation intervention. However, there are a number of frameworks and resources that provide useful concepts, ideas and approaches that may be relevant. Some of the resources were developed based on the evaluation of national or multi-national scale programmes, while others reflect

monitoring and evaluation systems developed for smaller scales. A selection of these resources is listed below.

Allen, W. et al. (2013), *Learning for Sustainability: Helping People Collaborate and Innovate,* http://learningforsustainability.net. This website contains multiple resources, methods and techniques geared around multi-stakeholder learning processes. Accessed 16 August 2013.

Anderson, S.(2013), *TAMD: A framework for assessing climate adaptation and development effects,* IIED. Publication available from http://pubs.iied.org/pdfs/17143IIED.pdf?as of 9 September 2013. TAMD is a 'twin track' framework that evaluates adaptation success as a combination of how widely and how well countries or institutions manage climate risks (Track 1) and how successful adaptation interventions are in reducing climate vulnerability and in keeping development on course (Track 2).

Ayers, J. et. al.(2012), *CARE participatory monitoring, evaluation, reflection & learning (PMERL) for community-based adaptation (CBA),* Manual, CARE and IIED. Available from:http://www.seachangecop.org/node/564as of 9 September 2013.

César, E. et al. (2013), *Climate Change Adaptation Indicators: A Logic framework assessment and indicator analysis of Sida's bilateral regional contributions under the framework of the Climate Change Initiative,* Sida Helpdesk for Environment and Climate Change: SIDA. Report available from http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2013/05/Final-Report-LFA-and-indicator-analysis-20130410.pdf as of 10 September 2013.

Cutter, S.L., C.G. Burton and C.T. Emrich (2010), Disaster Resilience Indicators for Benchmarking Baseline Conditions, *Journal of Homeland Security and Emergency Management* 7(1): 51.

Dessai, S. and M. Hulme (2007) Assessing the robustness of adaptation decisions to climate change uncertainties: A case study on water resources management in the East of England, *Global Environmental Change* 17: 59-72.

Harley, M. et al. (2008), *Climate Change Vulnerability and Adaptation Indicators*, ETC/ACC Technical Paper 2008/9.Available from http://acm.eionet.europa.eu/docs/ETCACC_TP_2008_9_CCvuln_adapt_indicators.pdf as of 9 September 2013.

Horrocks, L. et al. (2012), *Review of international experience in adaptation indicators,*AEA Report ED57591 – Issue Number 3. Report available from https://hmccc.s3.amazonaws.com/ASC/2012%20report/AEA%20Global%20adaptation%20indicators%20review%20-%20final.pdf as of 10 September 2013.

MacClune, K., S. Opitz-Stapleton and K. Hansen-Tyler (2012),*ISET Climate Resilience Framework: Training materials.* Series 3: Building Resilience, ISET-International: Boulder. Training materials from all three series available at:http://training.i-s-e-t.org/ as of 23 September 2013.

Nelson, S., et al. (2011), *Training Guide: Gender and Climate Change Research in Agriculture and Food Security for Rural Development*, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Food and Agricultural Organization of the United Nations (FAO). Accessible from http://www.fao.org/docrep/015/md280e/md280e.pdf on 16 August 2013.

Oliver, J. et al. (2012), *Adaptation made to measure: A guidebook to the design and results-based monitoring of climate change adaptation projects,* GIS: Federal Ministry for Economic Cooperation and Development (Germany). Guidebook available from http://www.eldis.org/go/display&type=Document&id=63832 as of 9 September 2013.

Participation, Power and Social Change Team [PPSC] (2013), *Participatory Methods,* Institute of Development Studies, www.participatorymethods.org. Accessed 16 August 2013.

Pringle, P. (2011),*Adapt ME: Adaptation monitoring and evaluation*,UKCIP: Oxford, UK.Available from http://www.ukcip.org.uk/wordpress/wp-content/AdaptME/AdaptME.pdfas of 9 September 2013. The material in the Phase 4: Monitoring and Evaluation chapter draws upon UKCIP's AdaptME Toolkit, which aims to help individuals and organizations to think through some of the factors that can make an evaluation of adaptation activities inherently challenging, and equip them to design a robust evaluation.

Reid, H. et al (2009), *Participatory Learning and Action 60 – Community-based Adaptation to Climate Change.* This resource is available from http://pubs.iied.org/pdfs/14573IIED.pdf as of 9 September 2013.

Schauser, I. et al. (2010), *Urban Regions: Vulnerabilities, Vulnerability Assessments by Indicators and Adaptation Options for Climate Change Impacts*, ETC/ACC Technical Paper 2010/12. Report available from http://acm.eionet.europa.eu/reports/docs/ETCACC_TP_2010_12_Urban_CC_Vuln_Adapt.pdf as of 10 September 2013.

Spearman, M. and H. McGray (2011), *Making Adaptation Count; Concepts and Options for Monitoring and Evaluation of Climate Change Adaptation,* World Resources Institute: Washington, DC. Report available from http://pdf.wri.org/making_adaptation_count.pdfas of 9 September 2013. This report provides an extremely valuable assessment of the concepts that underpin effective adaptation M&E, as well as a very practical set of 6 steps for developing an M&E system within an adaptation planning process.

Smithers, R. et al. (2011), *Climate Change Adaptation Indicators for Biodiversity,* ETC/ACM Technical Paper 2011/14. Report can be accessed via http://acm.eionet.europa.eu/reports/docs/ETCACM_TP_2011_14_CCadapt_ind_biodiv.pdf as of 10 September 2013.

Wageningen UR Centre for Development and Innovation (2013), *Participatory Planning, Monitoring and Evaluation: Managing and Learning for Impact in Rural Development*,http://portals.wi.wur.nl/ppme/?Home. Accessed 16 August 2013.

Glossary of Terms

Note: Each term has multiple definitions developed in a variety of adaptation planning and disaster risk reduction programmes, and across social and physical science disciplines. None of the definitions should be seen as the only one appropriate for that term. As discussed in many of the chapters, stakeholders to the adaptation planning process will have to negotiate terms and develop a common language. These definitions should be seen only as suggestions around which to negotiate a common language.

Adaptation: Taking action to minimise the impact of, take advantage of, or cope with changes in climate that are occurring or expected to occur. It is the ability to change strategy to respond to changes in conditions, both expected and unexpected.

Adaptive Capacity: The potential or ability of a system or group of people to adjust to changes in climate – extremes, shifts in means, increasing variability, etc. – to moderate potential damages, to take advantage of opportunities, or cope with the consequences. Adaptive capacity is influenced by social, economic, physical, environmental and human factors.

Autonomous Adaptation: The actions individuals, households, businesses and communities take on their own in response to or anticipation of perceived current or future changes, without assistance or guidance from public agencies.

Biophysical Impact Assessment: See 'Top-down' assessment.

Bottom-up: This term can have many meanings, depending on context. In planning and decision processes, it can mean actions or policies driven by a local community from the ground-up ('bottom-up'). In vulnerability and risk assessments, it can entail an assessment that begins by investigating local conditions and contexts before expanding the analysis to larger spatial scales. Also called a social vulnerability based approach.

Forecast: A statement about the "best prediction" based on experience, knowledge of all predictions, and the credibility of the person making the forecast. For example, a TV meteorologist says that there is a 70 per cent chance of rain tomorrow because 70 per cent of the weather model's predictions indicate rain. Climate models produce projections, not forecasts or predictions. See those terms for an explanation of the differences between them.

General Circulation Model (GCM): Also known as a global climate model. A model used to project changes in global climate as a result of slow changes in greenhouse gases, boundary conditions, such as land-use or solar radiation, etc. GCMs produce projections with a coarse spatial resolution on the order of a ~100 to 300km and cannot represent local (~50km or less) climate.

Exposure: The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected (IPCC, 2012)

Extreme Event: An event that is rare within its statistical reference distributional a particular place. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10 thor 90th percentile. By definition, the characteristics of what is called 'extreme weather' may vary from place to place. Extreme weather events may typically include floods and droughts (IPCC, 2007).

Hazard: The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources (IPCC, 2012)

Impacts: The effects of climate change on natural and human systems.Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts (IPCC, 2007):

Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation.

Residual impacts: the impacts of climate change that mayoccur after adaptation actions.

Interdependencies: The result of a reciprocal relation between two or more objects, individuals, communities or social groups, operations, or policies. In the context of climate change, there can be interdependencies between different impacts, consequences, vulnerabilities and/or adaptation responses.

Likelihood: A subjective statement of confidence about how probable someone believes an event to be.

Planned Adaptation: Deliberate policy decisions or programmes instituted by public agencies, i.e. governments, non-governmental organisations or formal groups and associations. It represents a top-down policy approach.

Prediction: A statement about the probability of something happening in the near future (the next day or next week) based on what is known today and has happened in the past. Weather forecasts are predictions and depend only on current and historical weather conditions – not on any scenarios of future climate or emissions. Predictions can only be made for near-term weather and cannot be used to estimate climate change.

Projection: A statement about the possibility of something happening based on what is happening today and scenarios of possible future conditions. It is an 'if this happens, then this might happen' statement. Climate models produce projections because they utilise multiple scenarios of future emissions, land-use change, etc. to see how the climate might respond. A single projection represents only one possible response. Projections cannot be used to say what if there will be a storm on a particular date in the future. Instead, they represent statistical changes to climate, such as changes in the long-term temperature means, sea-level rise, etc.

Regional Circulation Model (RCM): A climate model used to project changes in a region's climate at a smaller resolution (~10 km to 50km) than a GCM. An RCM uses input from a GCM for its simulations.

Resilience: The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways offunctioning, the capacity for self-organisation, and the capacity to adapt to stress and change (IPCC, 2007).

Risk: There are multiple definitions of risk, depending on the research tradition, such as natural hazards, climate science, or insurance and economics. Some definitions are presented below:

> Risk - The probability that a situation will produce harm under specified conditions. It is a combination of two factors: the probability that an adverse event will occur; and the consequences of that adverse event. Risk is a function of likelihood of the biophysical and socio-economic impacts being realized and vulnerability (Preston and Stafford-Smith, 2009).
>
> *Risk* encompasses impacts on human and natural systems, and arises from exposure and hazard. Hazard is determined by whether a particular situation or event has the potential to cause harmful effects. (Australian Greenhouse Office. 2003)
>
> *Risk* (climate-related) – Is the result of interaction of physically defined hazards with the properties of the exposed systems – i.e., their sensitivity or (social) vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its

consequences – i.e., risk equals the probability of climate hazard multiplied by a given system's vulnerability (UNDP, 2005)
The term 'risk' is often used in the context of climate change. However, it has not yet been defined, either by the UNFCCC or by the IPCC.

Risk Aversion: Risk aversion is the reluctance to accept a particular impact or action and related to the uncertainty associated with the implications of that impact or the costs and benefits associated with the action

Robust Adaptation: Adaptation options that are low regret, or reversible, incorporate safety margins, employ 'soft' solutions, are flexible and mindful of actions being taken by others either to mitigate or adapt to climate change (Hallegatte, 2009).

Scenario: A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent setof assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a 'narrative storyline' (IPCC, 2007).

Sensitivity: Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to achange in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency ofcoastal flooding due to sea-level rise) (IPCC, 2007).

Social vulnerability assessment: A bottom-up approach to assessing vulnerability.

Stakeholder: A stakeholder is an individual or group influenced by - and with an ability to significantly impact (directly or indirectly) - the topical area of interest (Engi and Glicken, 1995).

Thresholds: The level of magnitude of a system process at which sudden or rapid change occurs. A point or level at which new properties emerge in an ecological, economic or other system, invalidating predictions based on mathematical relationships that apply at lower levels (IPCC, 2007).

Top-down: This assessment approach begins with an understanding of the drivers of the climate system (e.g., greenhouse gases) to provide climate scenarios that are used in impacts models to identify the biophysical implications of climate change, typically on a regional or national scale. The term 'top-down' reflects the cascading of the information as inputs from one step to the next. Also called the biophysical impact approach. In climate policy terms, top-down can also constitute planned adaptation.

Uncertainty: An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgement of a team of experts) (IPCC, 2007).

Urgency: Relative timing for making a decision or taking action often in relation to planning process timing (e.g., need for decision or action within a particular five-year plan) or in relation to a perceived serious need or threat.

Vulnerability

Vulnerability is one of the fundamental concepts in an adaptation assessment. Although widely used, its interpretation varies, viewed as a residual of climate change impacts minus adaptation (an alternative interpretation of adaptive capacity) or as a general characteristic or state generated by multiple factors and processes, but exacerbated by climate change. The following definitions have some common features:

All define vulnerability as the degree, extent or magnitude to which the system is susceptible to harm/adverse effects of climate change

All state that vulnerability depends on a system's sensitivity and its adaptive capacity

Vulnerability – The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC AR4, 2007).

Vulnerability – the degree to which the exposure unit is susceptible to harm due to exposure to a perturbation or stress, and the ability (or lack thereof) of the exposure unit to cope, recover, or fundamentally adapt, that is become a new system or become extinct (Kasperson et al., 2000). It can also be considered as the underlying exposure to damaging shocks, perturbation or stress, rather than the probability or projected incidence of those shocks themselves (UNDP, 2005).

Vulnerability – The extent to which a natural system or human society is unable to cope with the negative impacts of climate change, variability and extremes. It depends on changes in climate as well as the sensitivity and adaptive capacity of the system or society (Australian Greenhouse Office, 2003).

Vulnerability – Refers to the magnitude of harm that would result from a particular hazardous event. The concept recognises, for example, that different sub-types of a receptor may differ in their sensitivity to a particular level of hazard. Therefore climate vulnerability defines the extent to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It depends not only on a system's sensitivity but also on its adaptive capacity. Hence arctic alpine flora or the elderly may be more vulnerable to climate change than other components of our flora or population. (Willows and Connell, 2003).

Vulnerability – The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. For positive factors, which increase the ability of people to cope with hazards, see definition of capacity (UN/ISDR, 2004).

Vulnerability –The degree to which an individual, group or system is susceptible to harm due to exposure to a hazard or stress, and the (in)ability to cope, recover, or fundamentally adapt, that is become a new system or become extinct (Tompkins, E., 2005).

NOTES:

The Adapting to Climate Change in China project Phase I (ACCC I) is a 'Research into Policy' project, which focuses on the development of robust inter-disciplinary research, and its inclusion into the policy-making process to result in evidence-based planning. The project aimed to improve international knowledge on the assessment of climate impacts and risks, and develop practical approaches to climate change adaptation, by helping China integrate climate adaptation into the development process to reduce its vulnerability to climate change, and by sharing this experience with other countries.