PROVIA guidance on Assessing Vulnerability, impacts and adaptation climate change

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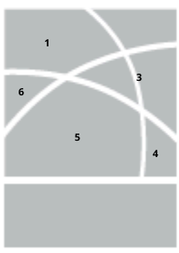

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Preface

In 1994, the Intergovernmental Panel pre-Climate Change published ***Technical guidelines for Assessing climate change impacts and adaptations***. These guidelines are outlined in a series of zones that are the generic steps to be followed when designing and con- ducting a climate change impact and adaptation assessment. The guidelines were complemented by in 1996 ***Ten of the UNEP handbook on methods for climate change impact assessment and adaptation Strategies***. UNEP IPCC guidelines and The Handbook of the country were applied to a range of stud- ies during the decade following their publication. They also inspired the publication of additional guidance, including the ***International Guidebook for vulnerability and adaptation Assessments*** carried out as part of the US country Studies Program and ***Adaptation policy Frameworks for climate change: Developing strategies, policies and measures***, published by UNDP.

The past decade has seen a shift from centralized guidance for climate vulnerability, impact and adaptation assessment to the development of specific, often sectoral and place-based approaches. There has been a proliferation of assessment methods and tools, and it has become increas- ingly difficult for potential users to understand the utility, benefits, requirements and tradeoffs of those methods and tools. Stakeholders' demand for knowledge on the vulnerability front, impacts and adap- in from the supply needs to be matched with the research community clear of the technical guid- ance that takes into account both the academic developments of the past 20 years as well as user needs at the local, national and international levels.

The global programme of research on Climate Change Vulnerability, impacts and adaptation (PROVIA) has responded to this challenge by revis- ing and improving existing guidance for assessing climate change vulnerability, impacts and able to adjust- tion, covering the range of available approaches, methods and tools. This document is the result of this effort, which has been a pleasure for me to coordinate. The business PROVIA Guidance meant to be informative rather than prescriptive's on top; its intended users are researchers, adaptation practitioners, decision-makers and those involved in the project, programme and policy formulation. The guidance business conceived as a "living document": the current version of the consultation document that will bene- fit from feedback from users.

The PROVIA Guidance has been prepared by a ten-strong author team, supported by a large group of experts and reviewers (see opposite page). The conceptual basis of the decision trees and the meth- ods and tools included PROVIA Guidance of preliminary research conducted within the project build MEDIATION: Methodology for effective decision- making pre-impacts and Adaptation. MEDIATION was funded by the European Commission's 7th Framework Programme under contract number 244012. The Provia guidance of the preparation was funded by UNEP with additional support pro- vided by the government of Sweden.

October 2013

To Fatoumat Keita-Ouane

Chief Scientific Assessment Branch

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Summary

Climate change poses a wide range of risks - and, in some cases, opportunities to human and natural systems around the world. In order to understand and address these risks and opportunities, stake- holders need a clear technical guidance that com- bines robust science with explicit consideration of user needs at the local, national and international levels. This document responds to the challenge by improving and updating existing guidance for assessing climate change vulnerability, impacts and adaptation, covering the range of available approaches, methods and tools.

Business structured guidance along a five-stage itera- Tief adaptation of the learning cycle:

1. *Identifying adaptation needs*: What impacts may be expected under climate change? What are the actors' vulnerabilities and capacities? What major decisions need to be addressed?

2. *Identifying adaptation options*: How much do you know the specific risks and opportunities that were identified to be addressed? There may be several options available to achieve the desired goals.

3. *Appraising adaptation options*: What are the pros and cons of the different options, and the best fit adaptation in which the actors' objectives?

4. *Planning and implementing adaptation actions*: After an option is chosen business, the impleme- in can begin. On Facebook the focus here is on practical issues such as planning, assigning responsibil- ities, setting up institutional frameworks, and taking action.

5. *Monitoring and evaluation of adaptation*.

As measures are implemented, the business process is monitored and evaluated to ensure that it goes as planned, identify any problems, document the outcomes achieved, change course as needed, and draw lessons from the experience.

This is an idealized model of adapting to climate change; "real-world" adaptation processes may may not be linear, and in fact, may require refinement through iteration. This guidance therefore pro- vides multiple entry points highlighted in boxes throughout the document, to allow readers to enter and re-enter) or Feb at various stages-stages process.

All of these tasks are complex, and many need to be carried out by experts. There is no "one fits all" approach, and this document emphasizes the diversity of adaptation challenges and the variety of methods and tools available to address them. We use decision trees to identify key criteria that may be a particular kind of speed for the next analysis or method, but never prescribe moment approach as the only valid one. The aim of the document is the business to provide an overview of the range of activities that make up climate risk assessment and be able to adjust- tion, and a coherent and integrated structure for addressing them.

Generally, this document is targeted at Business profes- sionals, such as researchers, consultants, policy analysts and sectoral planners who have some prior knowledge pre-climate risk assessment and adaptation. Some of the material, technical and business requires some relevant experience. The guidance should also use those initiating or leading to collective and planned adaptation, such as com- munity-based organizations or NGOs. Below, we provide brief overviews of the four sections of the document, with the front section, with an emphasis 2 , which guides readers through the adaptation cycle and suggests approaches to different tasks.

Section 1 : Introduction

This section introduces the basic structure and ter- minology used in the guidance, including how to frame the adaptation process, how to differentiate adaptation challenges based on different criteria, and how to identify the most relevant (salient) tools and approaches to address those challenges. In differentiating adaptation challenges, we rear- empirical you two key criteria: the stage of the adaptation cycle, the adaptation to the type of situa- tion: public or private, individual or collective. Those are situations in which private individual Thu- The Sons of the act in the interest of their own, such coastal dwellers flood-proofing their homes. Collective Private sit- uations are those groups in which people take action together in the interest of their own, and may involve interdependence and sometimes conflict- ing interests. Those are situations in which Public public actors, such as governments take action with a fiduciary duty to act in the public interest - seeking to influence either the individual or collective actions, or coordinating collective actions.

The guidance also highlights the other three key sets of empirical criteria: the characteristics of cli- mate risks (or opportunities) are involved, such as whether they are already present; the characteris- ICs of the affected actors, such as whether they are aware of the risks and have the capacity to adapt; and the characteristics of the available adaptation options, such as their relative cost and flexibility. In addition, we note that other types of criteria may inform the choice of approach, including the theoret- ical criteria, such as whether methods from eco- social psychology theory or other preferred; normative criteria, or the values and priorities that what are the options acceptable treasure; and pragmatic ■ criteria, such as time, skill ■ or funding constraints.

Finally, we stress the importance of stakeholder participation at all stages of the adaptation of learn- ing cycle, which should cover the full range of affected groups, including women and marginal- ized populations. This is particularly the case for collective adaptation to situations, to understand and take steps towards harmonizing the diverse and potentially conflicting perspectives of different actors. ■

Section 2 : Choosing approaches for addressing climate change adaptation

This section goes through each stage of the adap- cycle and identifies tasks that may arise in different approaches that may be applicable.
We start by explaining how we use the term "vul- nerability" here in the most general sense, as the propensity to be adversely affected by climate change, rather than adopting any of the more specific formulations in the literature. We describe methods to model climate change impacts as "impact analysis", and methods that analyse the vulnerability of institutional context, including political, social and economic factors - as "was ins- tutional analysis". The latter include methods for assessing "social vulnerability", considering this,rights, entitlements and power analysis. Finally, we use the term "indication" to describe methods that use indicators (individually or in indices) to MEA- time climate impacts, adaptive capacity, or both.

Identifying adaptation needs

Identifying adaptation needs involves two equally important and complementary Feb-tasks: 1) to Ana- lysing observed or expected ***impacts*** climate change (with and without adaptation); and 2) to ana- lysing the potential ***capacity*** to prevent, moderate or adapt to these impacts. Adaptation In most situations, both types of analysis are likely to be relevant. but resource constraints and/or the char- acteristics may challenge the adaptation of it to make it necessary to prioritize the analysis of one type over the other.

In choosing approaches to impact analysis, we identify several decision nodes: preliminary studies Are available for future impacts? Are the available stud- ies comprehensive and credible? The results of these studies are ambiguous regarding impacts? If you need to be projected future impacts, impact are models available to do so? Adaptation Should the projection included? Monetary values Are involved and not known? Impact models are not available, a trend bell be detected and attributed to climate change? Impact studies, or When no models are available and no trend can be detected and attributed to climate change, then the iden- tification of adaptation needs and opportunities indication must rely on methods - impact indica- tion, capacity indication, or vulnerability indica- tion, both of which application.

Capacity analysis, meanwhile, explores the avail- ability of a wide range of resources - such as natu- ral, financial, cognitive, social, and institutional cap- ital - that may be mobilized for adaptation. Several assessment methods are available, depending on the type of adaptation to the situation. In public situa- Po, a public actor may wish to understand the adaptive capacity of private actors in order to influ- ence their actions at later stages of the adaptation process. Towards this end, capacity indicators or indices are used. It is important to note that adap- tief capacity indicators and indices only provide a rough and rapid assessment of the actors' potential capacity to adapt. Whether this potential capacity is realized in the context of a specific threat climate work depends on many institutional contextual and cognitive factors, which may need to be explored through behavioural and/or institutional analysis.
Private adaptation In collective situations, organ- zational self-assessment methods may be relevant.

Identifying adaptation options

First, specific adaptation needs have been Iden- tified, the next step is to work to identify ways to address them. For example, a climate impacts and vulner- ability analysis might have found that due to sea- level rise and changing weather patterns, coastal communities will be exposed to major flooding during storm surges. We refer to the different path- ways that can be taken as ***adaptation options***. For example, a municipality, protecting the coast

this might involve building new infrastructure, such as a sea-wall, or working to restore natural barriers such as dunes and mangroves, or both. Individual homeowners might consider raising or fortifying their houses, or getting better insurance. The public sector might consider that financial incentives to encourage individuals to pursue those measures it considers a better option or if you retreat, it might provide incentives to leave, or change zoning laws to prevent further development.

For this task, the nature of different private and public actors. Private actors act in their own interest, and bells narrowly focus of the adaptation options available to them. Public actors, on the other hand, are mandated to act in the public interest, and thus the need to consider a much wider array of measures and criteria, such as the distributional effects and potential conflicts that may arise. In collective situations, some of the options that are theoretically possible - say, choosing to further note that there is also a high-risk coastal zone - might may not be feasible without first building consensus. At the same time, actors' awareness of the limits of their influence might lead them not to even consider measures beyond their immediate control.

Landed In identifying options for influencing public- vidual action, two key factors must be considered: actors' ***potential capacity*** - the resources, including material resources, skills and networks or social capital available to them - and their ***actual capacity*** - whether they can actually go through the whole cycle of adaptation. Actual capacity may be enabled or constrained by institutional and cognitive factors, which are referred to as ***barriers to adaptation***. Another key consideration whether the business adaptation would conflict with private interests. If so, considering the relative costs of action may help identify appropriate policy instruments to encourage adaptation. If adaptation does not conflict with private interests should be behavioural analysis should be undertaken to identify the relevant cognitive and institutional barriers. Possible approaches fall into two broad categories: economic (e.g. utility maximization or bounded rationality) and Social psychological (e.g., protection motivation theory posits that actors are motivated by it which the perceived severity of a threatening event, the per- ceived probability of the occurrence of the efficacy of the recommended preventive behavior, and their perceived self-efficacy).

In many situations, conflicts can arise between private actors of individual preferences and social welfare, such as a common pool resource is over-exploited. In order to identify appropri- ate policy measures, one needs to understand the nature of conflicts and the interdependences between the actors. This can be done through the ins- tutional analysis, looking not only at formal laws, policies and governance structures, but also at informal norms, customs, and shared strategies. Different approaches can be used to identify a coordination solution, or to try to design institu- PO or policies to achieve the desired goal.

Appraising adaptation options

There are many methods that can be applied to appraise adaptation options from the fields of organizational learning, Decision Analysis, policy analysis, and behavioural and institutional analy- sis. First Choice business whether a key to apply a formal approach, a deliberative/participatory approach, a combination of both, or none - and the universe is a decision based on intuition. Appraisal a formal decision methods are based on formalising the decision by applying mathematical reasoning and then landed- cate which of the options ***should*** to be chosen. Examples of such methods are multi-criteria analysis, cost- efit analysis or robust decision-making. In con- the Col, deliberative approaches to appraise options by eliciting information from the actors involved and harmonizing their preferences. Intuitive decision-making that relies on the front cognitive processes

have been developed through a great deal of experience and learning.

A formal decision-making requires a well-defined decision with a specific set of options known outcomes of implementing each option (computed using either the present risk assessment methods for residual impact of climate extreme event risks or for future climate projection methods, and one or several metrics by which to compare options, which involves at least one of the costs of planning and implementation.

Only a limited set of adaptation decisions can be formalized due to, among other factors, the inten- putting in the time, resource and capacity requirements of a formal decision-making methods. For individ- ual decisions, there is good evidence that when business information Limited or ambiguous, some infor- mal patterns that consistently lead to better decisions than more formal attempts to apply methods. For collective decision appraisal, informal methods may be more deliberative. For example, consen- sus-based decision making involves discussing options to familiarize everyone with the issues and build a shared understanding and a sense of shared control over the decision - which, in turn, can lead to more effective adaptation.

Options For formal appraisal of key factors in choosing whether to approach the moment the options are all short-term, or include also long-term ones; whether residual impacts can be projected; whether there are risks (or opportunities) due to current climate variability and extremes; and what are the relative costs of options. In general, short-term and lower-cost options, and options that address current risks, provide more room for experimentation and learning - that is, to take adaptation action, the outcome of the monitor and make adjustments as needed. What is this called adaptive management.

If an option of the relative costs are high and/or long-term options are involved, experimentation less desirable. Instead, it would be useful to eval- uate the adaptation options upfront, before imple- menting one of the following standard approaches for decision-making under uncertainty, such as cost-benefit analysis or cost-effectiveness analysis. (Cost-benefit analysis, as its name suggests, weighs the costs of implementing a measure against its expected benefits. Cost-effectiveness analysis starts from the premise that action - for example, by address- ing the risk of a dole - business desirable, and looks for the most cost-effective, or lowest-cost way to achieve the desired goal.) These formal decision-mak- ing methods, probabilistic having information about the risks crucial to calculating the expected business outcomes.

The farther into the future a climate risk lies, the greater the uncertainty involved. Not only the expected costs and benefits would have to be calculated for an ever-broader range of climate scenarios, but also for different non-climate vari- Ables the user, such as development and policy choices (e.g. how a coastal area zoned, or whether it's a business built hydropower dam. Alternative methods have been developed to support the decision-mak- ing under deep uncertainty. Unlike cost-benefit or cost-effectiveness analyses, which aim to find the optimal solution within a fixed set of parameters, these approaches look for solutions that are robust (don't fail) under many possible future scenar- ios. Such "robust decision-making methods can appraise the robustness of the criterion using options alone, or both robustness and flexibility.

Planning and implementing adaptation

First, climate impacts and vulnerabilities have been assessed, and adaptation measures to address them have been identified and evaluated to choose the best option, the next step is to make a plan to implement the chosen measures - and

then do it. This is a complex and challenging pro- cess, and very often, the analytical work is not translated into concrete plans and actions. Key constraints that can arise at this stage include the lack of common purpose and motivation; concerns that the desired adaptation measures are not actu- ally feasible; and lack of clarity around objectives or priorities on agreement.

Recognizing these common obstacles, this section focuses on not only the technical tasks of planning and implementing adaptation measures, but also the work needed to support those efforts after com- munications, consensus-building, integration with non-climate initiatives (especially in development, and capacity-building for key actors and institu- po to ensure that they can successfully plan and implement adaptation. A key question REME I- ber business throughout the process "***What are we adapting for?*** "(the desired outcomes). For example, if a coastal area is being protected from sea-level rise and storm surges job priority to protect the build- ings, ecosystems or both? And there is a consensus about the desired outcome, or does The agree- ment at a stop, "protect the coast", but break down when it comes to specifics? The scoping phase of the work thus clarifies and sets the parameters for what it was intended to achieve, and who needs to be involved. Often adaptation is not the only reason for the change, and the measures that may be implemented as part of other initiatives, such as development projects. For example, upgrading a water supply system in a coastal community, which currently has no access to fresh water could provide both adap- development and benefits.

Creating the moment of engagement of stakeholders adap- plan - and well before that, when identifying and assessing options - this means the business plan is much more likely to be accepted, especially if the stakeholders are also willing to become advocates or Champions of the plan. In designing participatory processes, it is important to define the scope of the issues that stakeholders will be addressing. Stakeholder engagement approaches can vary from fairly pas- ligament interactions, where the stakeholders simply provide information to the "self-mobilization", where the stakeholders themselves and initiate the design process. Stakeholders must understand how they are being involved, how the information they provide will be used, and what opportunities they have to influence decisions. When designing the engagement, it is valuable to take into account the stage at which the engagement is occurring in terms of the policy-making process, what deci- sions has already occurred, and what positions are already fixed.

Adaptation decisions need to be implemented within existing governance and legislative constraints, which will inevitably influence responses, which are considered to be feasible. Understanding as much as possible about the context of the wider landscape to a balance that allows this to be struck between ensuring that the actions within feet of those existing structures, and moment creating and enabling environment that is appropriate to support adaptation decision-making in the future. This complexity

it means a greater challenge to ensure that adap- in-one area does not increase the vulnerability of another, and that "windows of opportunity" and "win-win" opportunities are maximized. It is by no means a given that the people and institutions charged with implementing adaptation minute plan you will have the capacity to do so. Thus, it will also be important to identify any gaps and capacity incor- porate capacity-building into the Adaptation plan.

Capacity involves not only knowledge and skills, but also having the necessary tools and resources, as well as the necessary institutional framework. The best-trained experts adaptation will accom- plish their adaptation little if they must cram into already full workload at the moment, duties, or they lack crucial software, or money to buy supplies, or the support of their supervisors. Agencies with competing mandates can bring one another to a standstill, and lack of enabling legislation or regulations that adaptation measures can keep from being implemented. Thus, there is a broad range of capacity-building work that may need to occur before the actual implementation process.

Monitoring and evaluation

Adaptation can involve a significant investment of resources and effort, and as discussed in previous sections, it often planned amide with uncertainty , incomplete knowledge, and may require from subs- tial learning, capacity-building and institutional change. All this makes it crucial to monitor adaptation activities as they are implemented, make adjustments as needed, and evaluate the results at the end.

An adaptation of the Monitoring project may have a number of purposes, such as to assess the progress of the achievement of stated tasks; to determine whether the tasks are fulfilling the aims of the adaptation initiative; to assess the functioning of the team and individuals within it; to examine the process of engagement of other people; to gather stakeholders' perspectives of the nature of that engagement (both the process and content); how well learning is occurring, or to understand the next steps and inform.

Monitoring and evaluation that goes beyond it now includes a value judgement on how adap- intervention in performing work based on the monitored criteria. Funding for ace, national, sec- toral, and project-based adaptation projects has increased, so has the need to understand what makes an effective adaptation actions, demonstrate value for money, protect investments, identify best practices, and judge which efforts are after suitable for scaling-up. Although initiatives that focus solely on the front are still relatively recent adaptation projects in which a component of adaptation have been in place for some time. In many cases, adaptation activities can be evaluated well by reflex- ing existing monitoring and evaluation (M&E) frameworks, rather than building entirely new frameworks.

Adaptation initiatives may have features that make them more challenging to evaluate, such as a longer than usual time horizons for business develop- ment projects; this means different kinds of landed- cators, baselines and targets may need to be set up. It is also important to get different perspectives on "success", focusing not only funders' priori- ties, but also the intended "beneficiaries" and their perspectives. The early planning stages of evaluation of the moment, it is important to clarify the reaso for undertaking the evaluation and ensure that all participants are in agreement. The two funda- mental questions are, "we have done things right?" (that is, the things we said We would do in the adaptation plan) and "were they the right things?" (how relevant were they? they will enable us to better adapt or less vulnerable?). A third question might be, "how should we measure these things?"

Ideally, evaluations bring in a mixture of different types of information (scientific, political, legal, technical as well as local knowledge). It is useful to provide opportunities to compare these different perspectives - for example, through a science-policy dialogue. Indicators should also be chosen carefully, for distinguishing between process and outcome indicators (e.g. number of workshops pre-dangers of heat stroke, etc number of heat-related deaths avoided), including both quantitative and qualitative data and disaggregating as relevant (e.g. by location, gender, income level or social group). This section also describes commonly used approaches, such as results-based management and logical frameworks - both widely used by funders - and the outcome mapping and most signif- cant change in common development.

Finally, this section emphasizes the value of learning as part of the M&E process. Monitoring and evaluation processes can be designed to enhance learning by encouraging the use of all insights in order to adapt to the current plan, improve the design of the next project, or compare with other evaluations of the cycle win either. Learning needs to be consciously built into it if the process to be effective. This requires thinking through who needs to be learning, how people can provide insight and feedback, what kind of things can be learned (facts, skills, stories) and what level of challenge available to move people beyond "business as usual". It also requires making "spaces" available for learning and feedback. Lastly, it is important to provide both a fast (short-term) and slow (long-term) learning. For example, it might take 10-15 years to learn to be a measure meant to reduce vulnerability to increasing water scarcity (e.g. planting trees) does or does not work well. We need quick ways to check our assumptions about what needs to change and how it will change you - for example, farmers are adopting new practices actually, after the moment, intervention, and if not, why not? while also building up our knowledge over time.

Section 3: methods and tools

This section provides in-depth guidance on the approaches discussed in Section 2, as well as the name was- tional methods and tools, often with examples from the literature. Rather than try to summarize the entire chapter, which might read like a laundry list, here we focus on an overview of pre, providing a sort of Table of contents annotated to highlight materi- als that might easily be found through pointers note of Section 2.

Participation and engagement

This section builds ten ideas introduced throughout Section 1, but goes into much greater depth, discussing the principles behind participatory processes, ethical, and social justice considerations, and a possible engagement by a wide range of stakeholders: from the one-shot the discussions to elicit local knowledge or preferences to the sustained par- ticipation, ownership and leadership in adaptation processes. We also discuss what makes a good facilitator - strong interpersonal skills, a commitment to ensuring all voices are heard, to awareness of the factors that might discourage people from speaking freely.

We then present several tools to help you identify the stakeholders who should be engaged, analyse and understand social networks and participation (e.g. "ladders," and show different levels of engagement). Next we describe several methodologies, guidance documents, the trademark and the individual tools to help readers work with stakeholders at all stages of the adaptation cycle. Although the approaches we discuss are geared specifically to adaptation, they draw from existing practices and knowledge Development, Disaster Risk Reduction and other fields. We also present tools to help ensure participation of people who are often excluded - such as women, Indigenous groups, and people who are not literate and participatory tools for

Conflict Analysis and resolution, as well as a few generic tools useful (e.g. H diagrams).

Impact analysis

Building on the explanation of the first stage of the adaptation cycle in Section 2, this section describes key tasks and applicable in Impact Analysis meth- ods, with examples: describing the current impacts of climate change; detecting, via the statist trends- cal methods; attributing impacts; and modelling of future impacts, including how to project future climate change and how to represent the adaptation of models.

Next, we provide an overview of the vulnerability of indication, which starts from the assumption that individual or social capacities and external climate drivers are at least partly responsible for climate change impacts, but their interactions cannot be reliably simulated using computational models.
The key question addressed in the business, which combina- po variables give the most reliable indication of how climate change may affect the study unit? Basic tasks are indicating the potential to select variables based on the literature, and aggregate based on the variables indicating the theoretical and normative arguments. We also highlight concerns about several experts have raised vulnerabil- ity indices.
Feb Another section focuses on ten different ways to elicit knowledge, including community vulnera- bility assessments, expert judgement, participa- tory development, and emerging user-controlled learning tools.

Capacity analysis

This section focuses on ten methods and tools for assessing the capacity of individuals, communi- ties, systems and institutions to adapt to climate change.
The job typically done in the capacity analysis the first stage of the adaptation process, identify- ing adaptation needs, but it is also relevant in appraising adaptation options and planning and implementing adaptation measures. We describe several approaches to capacity analysis, starting with the notion of "adaptation functions" and institutions to support adaptation - based framework for assessing Bellagio countries' adap- tief capacity, which identifies planning, manage- ment and service delivery functions needed for effective adaptation. We also describe frameworks that focus on the characteristics of institutions or orga- nizations that support adaptation, such as learning capacity, ability to understand different perspec- tives, and fair governance.

We also discuss the links between adaptive capac- ity and social vulnerability, which can be seen as the "flipside" of adaptive capacity in some respects: for example, people who can read and write may have a greater capacity to adapt than those who are illiterate - and thus the latter may be more vul- nerable. Social vulnerability, adaptive capacity business dynamic, varying across time and space, and the array is now shaped by economic, social, cultural, institutional, environmental and other factors. Therefore, like vulnerability assessments, capacity capacity analyses only reliably tell about us ***here and now*** but not necessarily in the future, or under different circumstances. We stress that, although the use of indicators to measure adap- tief capacity (and/or social vulnerability) can be problematic, as discussed above, this does not negate the importance of the socio-economic context in assessing adaptive capacity. Instead, we need a recognition that analyses and better adap- tief capacity cannot be easily quantified and that have been com- pared across countries or populations.

Scenario analysis

This chapter provides an overview of the extensive use of pre-impact data and climate scenarios

and vulnerability assessments, focusing on the most useful resources, and highlights important issues to consider when using scenario analysis in the context of adaptation. It also provides a list of data portals that provide global-, national - and regional-level data that can be used in scenario analyses.

We discuss how different kinds of information can be incorporated in such analyses, including climate data; quantitative data about the physical, eco- need for social or technical aspects of the system being studied; and qualitative descriptions of past, present or future conditions (storylines). We also explain the different approaches to using scenarios for future climate and future environmental and societal conditions that may influence vulnerability, impacts and Risk Management in general. Lastly, we note that using common sets of scenarios can help bring consistency and comparability of climate impact and adaptation assessments.

Behavioural analysis

Behavioural research uses a variety of methods - e.g. laboratory and field experiments, econometric analysis to try to understand how people make decisions and how those decisions vary according to contextual factors. Able to adjust to climate change- tion, impact and vulnerability analysis behaviour analysis can be used to explain how actors (orga- nizations or individuals) adaptation to make deci- sions on the assumption that such knowledge is necessary to advance adaptation. For example, understanding the factors that shape household decisions pre-flood protection can help improve the design of flood risk communication strategies. It also shed light on the limits to adaptation, leading to more realistic assumptions about the auton- omous models in economics climate adaptation and adaptation plans.

We focus on three main approaches: one from Social Psychology, protection motivation theory, which assumes that individuals take action based on the perceived risks and their perception of front effec- tiveness of acting to reduce risks; and the two from economics: utility maximization, which assumes that individuals maximize utility, the action to take, and have the required information and complete analytical abilities; and bounded rationality, which assume that individuals want to maximize utility, but have limited information and/or limited cog- nitive abilities.

Institutional analysis

Assessments of vulnerability, impacts and adap- will often seek to understand the institu- tional context, including political, social and eco- structure the choices of individual factors that need it. Such methods are broadly categorized as institu- tional analysis. This section describes three main approaches: description governance governance governance design and emergence.

Description describe the approaches to Governance actors and institutions relevant for adaptation, and all around the world have been done in the context of climate change. This type of approach requires no strong theoretical assumptions on which are part of the analyst, and contributes to adaptation by providing a more comprehensive explanation of the policy context in which adaptation takes place. Design Governa meanwhile, addresses the question of how to design effective, for whatever reason, in front the theoretical assumption that the link between institutions and outcomes can be understood and predicted with some confidence. Governance One design approach that has been applied exten- sively in the literature, the adaptation of business policy analyst- analysis, which is used to improve the design of poli- cies, programmes or projects. Finally, governance, business approaches strive to understand the emergence of the existing institutions, particularly addressing contextual factors which give rise to a particular institutional arrangement in a given case. Within

in this category, a distinction is made between those approaches that assume that it is possible to gen- eralize beyond a single case, and those that do not (such as ethnographic approaches).

A formal decision-making

This section describes and discusses the formal decision-making methods, explaining and providing examples of six different approaches. The first business cost-benefit analysis compares the options based on a single metric (net cost or benefit), calculated as the difference between the present value of cost and the present value of the benefits for each and the option with the highest net benefits or benefit cost ratio. Cost-effectiveness analysis, meanwhile, both their costs based on the options and compares different metric describing a desired outcome (e.g. number of endangered species can be saved, and picks the option with the highest cost-effectiveness ratio.

Multi-criteria analysis applies if multiple metrics of comparison, computes a weighted sum for each option, and picks the one with the highest score.

We also discuss robust decision-making, which is particularly useful when making decisions amide uncertainty (see Section 2 Summary), and multi-shot the robust appraisal, which is useful finished the set of options includes options with long investment horizons, or a decision when considering the business adap- in a mid - to long-term hazards, and when the options are considered flexible. In such cases, flexible options may be favoured over non-flexible ones, and decisions are delayed to keep future options open. Adaptation of "tipping points" may be identified which is beyond some strategies are no longer effective, other options need to be considered. Finally, we discuss the adaptive manage- ment, for another method of decision-making under uncertainty. Adaptive management allows for the updating of the basis on the actions of the new information as it becomes available. In this sense, adaptive management, an ex-post evaluation of options based on the preferences of the decision-maker. Adaptive management requires the availability of new information on the effectiveness of an adap- action, and therefore closely related to the business monitoring and evaluating and learning.

Valuation methods

This section focuses on that front at the moment, the important task is essential to many kinds of formal decision-mak- ing: computing a monetary value of an option to pre - the basis of its non-monetary outcome attributes. Business valuation is necessary in situations in which mone- tary values of outcomes are considered important, and it is also important in the impact analysis in order to identify adaptation needs.

Business valuation point of departure for those goods that people buy and sell on the market, such as bread, butter or bicycles. Their value can be established by

observing that the average prices people pay for them. Ace prices change over time, with a base year links cannot be established, and a correction can be made for inflation or estimated values obtained in the past for the future. From the simple case, there are sev- eral characteristics of the outcomes that can make it more difficult to assign monetary values. We discuss different approaches applicable to situations where non-market outcomes are involved, where there are indirect outcomes, where there are inter-tem- poral outcomes, or where outcomes are uncertain, and we note important considerations, such as the implications of different discount rates.

Finally, we discuss (a) the valuation of tasks and methods we have described, which are largely based on the approaches of neoclassical economics of welfare economics. Some critics have focused on unrealistic assumptions are made about the actors' choice processes, which can ignore a well-known cognitive biases. Others have criticized valua- tion methods for enabling trade-offs to be made between outcomes should be seen as incommen- surable, such as assigning a monetary value to human suffering.

Tools for adaptation planning and implementation

This section begins by highlighting the impor- tance of understanding the context in which adaptation to take place - societal priorities, economic interests, governance structures, etc. - tailoring and adaptation actions that context. We also discuss different guiding principles that have been proposed for effective adaptation plan- ning and implementation, such as the need to be participatory and inclusive, and to recognize both local and scientific knowledge, and to encourage the stake- holders to make their own choices and take the lead in the adaptation.

We can then present to the moment of the array of resources and tools that support adaptation planning and implementation, including both generic, widely applicable materi- als, and tools designed specifically for local and regional-level planning, for specific support, and for businesses and organizations. We also briefly describe several techniques that have been Crime- cessfully used in other settings and adaptation, such as participatory mapping, "mental model" approaches, and soft systems technology.

Methods for monitoring and evaluating adaptation

This section begins with an overview of the differ- ent reasons for doing monitoring and evaluation (M&E), and the potential benefits of doing it well - from the learning opportunities to the transpar- ency and Accountability Act that they can provide to both funders and intended beneficiaries. We note that although adaptation practitioners funders and researchers have been designing now, analys- ing and testing, M&E frameworks for several years, this is still a relatively new field to adjust the climate for able- tion, and still many challenges to address, such as how to account for adaptation benefits that occur over a long time scale.

We provide an overview of M&E methods, which range from fairly technical and theoretical frame- works, often developed in academia to the practical, step-by-step guides geared to ten people working on community-based adaptation and Disaster Risk reduction. And we identify several common traits of effective M&E systems, such as starting with a clear, agreed-upon understanding of what con- stitutes success, and how to measure it; and tracking progress over the course of the project, rather than just looking at the end result; not just considering ***what*** the job done or achieved, but ***how*** it done - the content as well as the quality process; and recognizing that not everything can be measured,

and thus including qualitative assessments as well as quantitative ones.

We describe three useful online resources, summarize moment array of critical reviews of adaptation M&E to date, to discuss two frameworks that provide step-by-step guidance for adaptation M&E, and briefly list several other commonly used evaluation methods and tools.

Tools for learning and reflection

This section examines the different perspectives in front of adaptation in learning, and emphasizes the impor- tance structuring of adaptation activities in ways that promote learning and reflection. Learning to we argue from our own experiences and from others' - the business is crucial to successful adaptation, and helping people become better learners and critical

an important aspect of thinkers building adaptive capacity. Doing this well requires understanding ***what needs to be learned***, ***by whom***, and ***how***.

We also discuss the emotional, and relational aspects of learning, and how people can support learners as we evolve from depending on others to "hand down the truth" becoming aware of multiple perspectives, and having the confidence to form and express their own ideas. This kind of evolution is an important aspect of the building adaptive capacity and encouraging autonomous adaptation; in the long run the people exposed to climate hazards cannot depend entirely pre-others' help and expertise to avoid the worst impacts. In this discussion closely linked to the concept of adaptation as a social learning - learning on a larger scale than just individuals or groups, up to a societal scale, as a result of social interactions

learn,

and processes. Through social learning, successful adaptation strategies and lessons learned from individual projects and actions become part of the collective knowledge base, building adaptive capacity across entire organizations, communities or support it.

The chapter ends with a listing of several tools and resources to support learning and reflection, as well as cross-references to relevant external resources cussed in the previous sections of the guidance. ■

Section 4 : example cases

In this section, we provide three case studies of how an adaptation of the characteristics of the situation can be mapped to specific tasks to be addressed, and specific approaches. Each case study begins with a description of the situation of complex narrative, which describes the actors adapting to the hazards of climate and geographic location. Next, the key is the Char- acteristics of the situation are analysed in order to identify critical tasks. Finally, a schematic diagram which illustrates the sequence of work presented the questions to be addressed within a given case.

Adaptation research we describe two cases: the first focused front dwindling water resources in the upper and middle Guadiana River Basin, in Spain and the second pre-drought impacts and neglected agricultural irrigation infrastructure in central Serbia. We also describe one policy case examin- ing the implications of climate change for ground- level ozone pollution in the UK, where the ozone job is already a public health concern, especially during heat waves. ■

1 Introduction

1.1 purpose of this guidance and how to read it

This document provides methodological guidance for pre-assessing climate change vulnerability, impacts and adaptation as well as implementing pre, mon- itoring and evaluating adaptation. Unlike many previously published documents and tools, which focus on specific approaches, this guidance covers a wide range of approaches, integrating them into a coherent framework. We thereby emphasize the adaptation challenges of diversity that exist, as well as the variety of approaches and methods with the trash or needed to adjust to the effects of cli- mate change.

This guidance identifies that it is a feature of business the principal approaches and methods for addressing adaptation challenges of different kinds. Selecting appropriate methods for climate Risk Assessment and adaptation requires a series of methodologi- cal choices, and this guidance presents the criteria and decision trees to assist the reader through those choices. Note that decision trees provide guid- ance through the methods of selection, and not through adaptation decision themselves. First, the appropriate methods have been identified, we explain how to apply them.

The methodological choices we organized accord- ing to five general stages of what we call the adap- learning cycle, which are 1) identifying adap- needs, 2) identifying adaptation options, 3) appraising adaptation options, 4) Planning and implementing adaptation and 5) monitoring and evaluation. This is an idealized model of adapting to climate change; "real-world" adaptation pro- cesses may note be linear, and in fact, may require refinement through iteration. This guidance there- fore provides multiple entry points highlighted in boxes throughout the document, to allow readers to enter (and re-enter) or at various stages Feb- stages process.

We should stress that if we only consider methods for assessing impacts, vulnerability and capacity insofar as they are embedded into the wider the pic- advancing to the round of adaptation. Assessments for other purposes, such as setting mitigation targets, are not discussed here.

1.1.1 *this document is not What*

This guidance material, not a guideline. Assessing vulnerability and impacts and implementing adap- are complex processes, and many of the tasks involved need to be carried out by experts. There

there is no "one fits all" approach, and this document cannot cover the myriad issues that may arise for any given context. We present decision trees that are meant to be indicative - they do not prescribe specific methods as the only valid ones. The aim of the document to provide an overview of the business activities that make up a widely diverse climate risk assessment and adaptation, and a coherent and integrated structure for addressing them.

While some aspects of climate risk assessment and adaptation to specific support regions and hazards, this document does not provide sector- or region-specific information. The current state of knowledge for specific regions, and issues that support the business discussed extensively by the Intergovernmental Panel pre-climate change (IPCC) in its ***Fourth Assessment Report*** (IPCC 2007a), and updated information will be available in March ***Fifth Assessment Report***. Instead, this document focuses on methodological guidance applicable ten generic IT support across regions and hazards.

1.1.2 *how does this differ from previous guidance?*

Adaptation of this guidance brings together insights generated from very different perspectives into one coherent framework. Many methods are available, often focused on particular aspects of front climate risk assessment and adaptation, but there is little guidance on Business, Business method, which is appropriate in a given situation, or how to use the different meth- ods in a complementary way. The IPCC technical guidelines (Carter et al. 1994) focus primarily on the front impacts, focus on risk management frameworks (formal) decision-making, and community-based and ecosystem-based guidelines focus on building adaptive capacity. The decision trees in this guid- ance integrate these different approaches.

The recent literature has emphasized the need to both recognize and overcome barriers to adaptation (Edgar et al. 2009; Moser and Ekstrom 2010). This document offers guidance on how to identify the pre-bar - riers to action, how to conduct research to better understand those barriers, and how to select and apply methods to overcome them.

1.1.3 *structure and content of this guidance*

Section 1 introduces the basic structure and Ter- minology used in the guidance, including how to frame the adaptation process and how to differ- entiate the type of adaptation challenges in terms of climate change impact situation, the actors involved, and the adaptation options available.

Section 2 describes the process of assessing impacts and vulnerability, as well as planning, implementing and monitoring the adaptation. IT Pro- vides guidance on which methods and approaches are applicable when confronted with a particular adaptation challenge. This work is done in the form of Decision Trees, which guide the user in identifying appropriate methods based on relevant empirical, theoretical and normative criteria related to local circumstances.

Section 3 provides guidance on appropriate methods and tools for addressing these tasks along with some examples.

Section 4 presents case studies from research and policy guidance to illustrate this approach to characterizing adaptation challenges and identify- ing salient methods and tools.

1.1.4 *who should read this?*

Generally, this document is targeted at business profession- als, such as researchers, consultants, policy analysts and sectoral planners who have some prior knowl- edge front-climate risk assessment and adaptation. Some of the material requires some technical and business relevant experience. The guidance should also

initiating and leading or planned to use those of collective adaptation, such as community-based organizations or NGOs.

1.1.5 *where should one start reading?*

This document provides multiple entry points to allow readers to go directly to material that meets their immediate needs. Suggested entry points are marked by boxes at the beginning of the subsections.

If you are interested in guidance on how to approach climate risk and adaptation assessment in general practice, you should introduce this read- tory section to understand the basic concepts. Next, or if you don't need an introduction, you can proceed to Section 2, which is structured around the five stages of the adaptation cycle. Each stage is a potential entry point for Business readers.

If you are interested in the technical details of a par- ticular method or tool, you can jump directly into the respective subsections of Section 3. The links between identification of a task in Section 2 and in Section 3 the application of a method are made explicit in the decision trees, so it is not nec- essary to read the chapters sequentially. Section 4 presents the case study provides examples and further links to the relevant sections describing the methods that have been applied to the cases. ■

1.2 Mapping adaptation challenges to salient approaches

The main objective of this guidance to help business ana- lysts choose approaches that are salient for address- ing specific ***adaptation situations*** - challenges that actors face in connection with the expected, perceived or experienced climate change impacts (Hinkel and Bisaro 2013 b). Climate change affects When cou- pled ecological (or natural) and the social (or human) systems, actors have to find ways to adapt, and interact with one another in the process at various levels of decision-making. For example, climate change may reduce the snowfall in mountain regions. Ski resort owners, the adaptation challenge work then to try to understand the extent of the snowfall decline, the implications for their business, and the costs and benefits of different options for meeting the immediate and long-term goals.

We use the term ***salient*** defined by Ace Cash et al. (2003): relevant to the needs of decision-makers. Many approaches might reveal interesting insights, but not all of those insights would be useful to actors trying to address the adaptation challenge at hand. Our focus is on the front of the business approaches that have the potential to advance adaptation practice on the ground. In this context, we do not consider the moment leads to maladaptation salient approach to make - choices and adaptation measures that increase climate risks (Barnett and O'neill 2010). While this guidance does not explicitly address maladap in- tion, the literature pre-maladaptation has informed its development, as it raises the important point is not that the actions that are effective in the TWA note may be in the long term.

The choice of salient approaches based on a number of criteria, starting with ***empirical criteria.*** These criteria are characteristics that describe the basic situation and thus the adaptation of the con- ditions that must be met by the chosen approach or method. For example, an institutional analysis

might be useful to a policy-maker looking for identify policy measures to influence others' adaptation actions. Evaluating the potential of a planner infrastructure investments, on the other hand, you might find a cost-benefit analysis more useful. There might also be situations in which both of these methods are applicable. We discuss these empirical criteria in more detail in the next subsection.

Empirical criteria are important, but they are not the only relevant criteria in choosing the moment approach. Methods may also differ with respect to their underlying theoretical assumptions, which may reflect the assumptions of the scientific discipline, the school of thought or the front of a computational model on which they are based at. Thus, ***theoretical criteria*** also inform the choice of approach. For example, to analyse and predict how actors adaptation might make the decisions, an analyst apply the methods could be based on socio-psychological theory, which can cognitive variables of the behaviour of an adapting actor. Alternatively, a method in economics from employing assumptions of utility maximization could be applied to the same task. A further example be the analyst's choice moment between applying model in which adaptation occurs the moment of impact, or one in which no adaptation occurs. That choice is not an adaptation based on the situation itself, but rather a preliminary judgement about what assumptions are likely to lead to useful insights.

Both research and decision-making, choice of approaches are also strongly influenced by ***normative criteria***. In the range of options that are considered acceptable is defined by values and business priorities: for example, whether a coastal zone threatened by sea-level rise must be abandoned or somehow can be protected, whether now or endangered species must be saved or can be allowed to go extinct. This guidance cannot solve a dilemma of this sort, but it can help you how to make some of the explicit criteria that should be considered in climate risk assessment and adaptation, and outline the fact that normative readers choices must be made by selecting and applying the methods contained in this guidance.

Finally, there are ***pragmatic criteria*** associated with the analyst carrying out the work. The scope or terms of reference adopted for assessment- tion approaches the same work is often consid- considered to be relevant. Many of the methods require expert knowledge, and the skills and expertise of the analyst and thus are relevant for choosing appropriate if the methods. So are the resources available; some of the computational and empirical methods in particular require substantial data, time, personnel and technical resources. This might be relevant in considering terms of the costs of generating new information, versus acting in front of the disadvantages of incomplete information. These are fundamental decision-making problems, and we do not address these kinds of choices. Pragmatic criteria have not been used in building decision trees, which recommend the best approaches available from the risk assessment of climate adaptation Research and practice. However, we provide information about the different methods and tools that may help would the readers make their own pragmatic choices. ■

1.3 Empirical criteria for choosing salient approaches

1.3.1 *Stages of the adaptation process*

A salient criterion for choosing a ball empirical approach to the adaptation process of the stage at a particular moment which needs to possession of the actor adap- in problem. There is wide agreement that adaptation to either win the learning process involv- ing a number of stages, from the definition of the adaptation challenge, monitoring and evaluat- ing adaptation progress. For two prominent exam- ples, see climate adaptation framework for the UK climate impacts Programme (willows and Connell, 2003) and the adaptation support tool of the European Commission and the European Environment Agency (EEA and EC 2013). Here we name the stages was as follows:

1. *Identifying adaptation needs*: The goal at this stage is to gain more knowledge about the business risks and opportunities facing the adaptation challenge. What impacts can be expected under climate change? What are the actors' vulner- abilities and capacities? Vulnerable actors Are aware of potential threats? What major deci- sions need to be addressed?

2. *Identifying adaptation options*: How the specific risks and opportunities that were identified to be addressed? There may be several options available to achieve the desired goals.

3. *Appraising adaptation options*: The goal at this stage the business to weigh the pros and cons of different options and identify those that best fit the adaptation actors' objectives.

4. *Planning and implementing adaptation actions*: First, an option has been chosen, implementation can begin. The focus here is on Business ten practical issues, such as Operation, assign- ing interests, setting up institutional frameworks, and taking action.

5. *Monitoring and evaluation of adaptation*. As measures are implemented, the business process is monitored and evaluated to ensure that it goes as planned, identify any problems, document the outcomes achieved, change course as needed, and draw lessons from the experience.

These stages provide the primary *entry points* salient approaches for choosing this guidance (Figure 1.3.1). For example, an analyst who is con- fronted with the challenge of developing a cross-sec- toral adaptation adaptation plan would then at the stage of "identifying adaptation needs", while

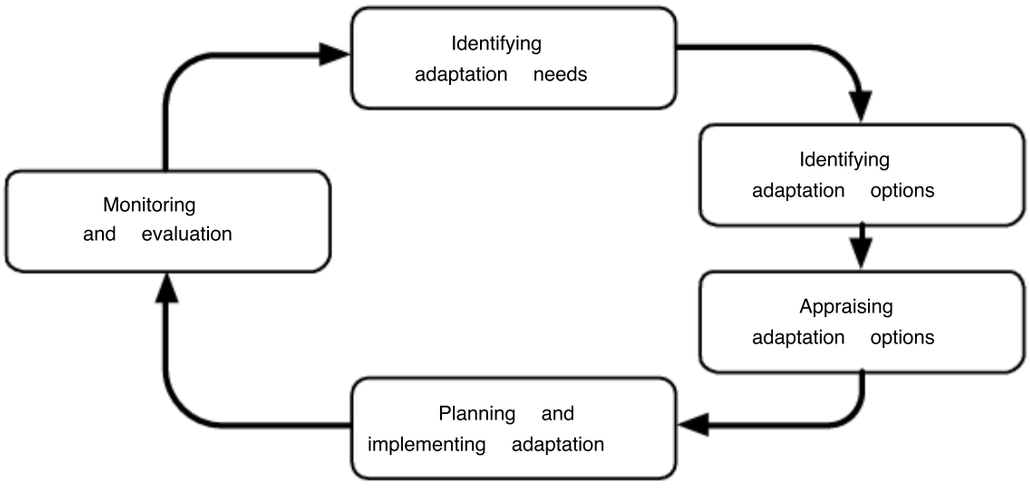


FIGURE 1.3.1 *The adaptation learning cycle.*

the moment analyst who is confronted with a particular decision, such as whether to raise a dike to reduce flood risks, then again at the stage "appraising adaptation options".

1.3.2 *types of adaptation situations*

Second, we use the empirical criterion for distinguishing actor adaptation challenges business configu- ration (Hinkel and Bisaro 2013 b), with the four basic types of adaptation situations:

1. Private individual;
2. Private collective;
3. Public influencing individual action; and
4. influencing the public collective action.

Private individual situations are those which act in the interest of persons of their own when they per- ceive foresee climate change from a threat or a benefit from this action. Examples would be farm- ers adapt their cropping patterns, or coastal dwellers flood-proofing their homes.

Private collective situations are those in which groups of people together to take action in their own interest. Collective action means that there is inter- dependence between adapting the actors, in the sense that the actor, one of the actions will affect others. Typical examples involve common-pool resource use, such as when farmers use ground water for irrigation from a common aquifer. The water limits its use by others for use of one farmer. Another example of this situation would be coastal residents to protect themselves from Never trust on sea- level rise: barriers built by individual homeowners could increase the flood risk for their neighbors, they could all work together, or restored to the protec- tief dunes or mangroves.

Public situations are those in which the public takes action actor with a fiduciary duty to act in the public interest. Local public actors include authorities, government ministries, public water boards, etc. - anyone acting on behalf of the citi- zenry. Public adaptation situations may be further distinguished into *public individual situations*, Public actor seeks to influence the actions of individuals, and *collective public situa-* *po*where coordinates public or the actor seeks to influence collective action.

The physical action may take a public actor - that is, of the act upon the physical environment where vulnerable individuals are situated. An example would be to build a dike to protect people exposed to flooding. Actor influencing public may also take the action - encourage them to adapt to vulnerable actors. This may entail providing information such as when govern- ments to sponsor campaigns to raise the awareness of people settling in high-risk areas such as floodplains or steep hills prone to landslides. Public actors may also provide economic incentives to reduce the cost of adaptive measures or note to make it expensive to adapt. Finally, the public or the actor may enact laws regulations, such as zoning rules, building stan- dards or insurance coverage requirements.

1.3.3 *Other empirical criteria*

Our guidance considers the three other sets of empir- cal criteria as well. The first relates to the characteristics of climate risks (or opportunities) involved, as shown in Table 1.3.1.

Another set of empirical criteria relates to the vul- nerable or affected actors. Finished seeking to influ- ence vulnerable actors, it is important to under- stand how they perceive the impacts of climate change and what their concerns, interests, and capacities are (Hinkel and Bisaro, 2013). Table 1.3.2 summarizes some of the relevant criteria and their implications.

A final set of criteria relates to the empirical avail- able adaptation options, as shown in Table 1.3.3. ■

TABLE 1.3.1 *Characteristics of the climate risks/opportunities being addressed.*

Empirical criteria	*Description*	*Value*	*Salient approaches the front Indication*
Current variability	Are risks or opportunities due to current climate variability?	Yes/no (If extreme weather risks/opportunities are at least partly due to events, for example, may be due to current climate variability, vulnerability cur- current variability, as well as the conditions that needs to be addressed rent whereas a slow-onset, the need to adapt to changes in climate. note	
Trend observed	Past been a unique trend observed?	that climate changes are) Unknown, Note know if the trend that has been observed in the past, it may be able, clear direction, no easier to adapt to motivate the affected actors. if the trend shows no clear direction is unknown or direc- tion, vulnerability and capacity indication may be appropriate.	
Future impacts	A given scenario, the bell impacts (or outcomes) be computed?	Yes/no	If future impacts (or outcomes) can be com- puted, this should offer a firmer basis for apply- ing quantitative decision - making methods for pre - summary of future outcomes.

Table 1.3.2 *Characteristics of the affected actors.*

Empirical	*Description*	*Values*	*Salient approaches the front Indication*
Awareness of the risks of current climate variability and ongoing climate	How well do the actors understand the climate risks they face (e.g. from floods, coastal storms, extreme heat)?	High/low	If it's low, current risks, measures to communicate and raise awareness of adaptation needs are indicated.
change Potential adaptive capacity	How the actors are well equipped to adapt, s Terms of financial, human, and social	High/low	If low, to build adaptive capacity measures may be required; social vulnerability analysis may also be useful. If high
Actual or anticipated adaptation	capital? To what extent private actors are actu- ally adapting, or expected to adapt in the future?	High/low	despite low adaptive capacity, may want to institutional or conduct behavioural analysis to identify cognitive and institutional barriers. Incentives may also encourage them to be identified adaptation.

TABLE 1.3.3 *Characteristics of the adaptation options.*

Empirical criteria	*Description*	*Values*	*Salient approaches the front Indication*
Relative costs	Investment costs relative to the actors' annual income and the capital	High/low	If costs are high, the ability to experiment and learn may be reduced. If short,
Investment horizon	stock of finished time interval between the investment is made, and the finished resulting benefits are expected - as well as the duration of those	Short/long	preliminary data from current climate variability and climate trends may be sufficient; if long, decreased levels of future climate change impacts are highly
Flexibility	benefits flexible business allows you to make an option for switching to other options that might be preferable in the future, once more is known about	Yes/no	desirable. If options are flexible, then it should be summarized by the considered decisions, and multiple-shot deci- sion-making frameworks should be considered, e.g.
Conflict	the changing job climate. The degree to which individual pref- erences and social welfare are in conflict.	High/low	adaptation pathways. If high, then institutional analysis may be necessary.

1.4 Decision trees for choosing approaches

This guidance presents the relevant criteria for choosing approaches for the adaptation challenge in the form of *decision trees*, which *decision nodes* preliminary empirical, theoretical and normative criteria lead to different approaches. The analyst now enters via a decision tree *entry point*'s decision node. Intermediate tasks that are some approaches lead to subsequent decision nodes within the same decision tree. Other tasks *exit points* that lead to the next stage adaptation of the overall cycle.

The guidance document is structured as represented in Figure 1.4.1: Section 2 provides guidance for choosing the appropriate approach based on pre the adaptation challenge, and Section 3 provides more specific guidance on the approaches as well as methods and tools available.

Decision trees are accompanied by the moment The explan- atory text walks the reader through each node and its implications for identifying salient approaches.

Importantly, there are no predefined sequence of approaches. Approaches are identified and meth- ods are applied iteratively. Based on the current knowledge of the adaptation challenge, an ini- tial approach selected and applied, and new insights are gained. This, in turn, can lead to the formulation of a new adaptation for the challenge (see Figure 1.4.1). ■

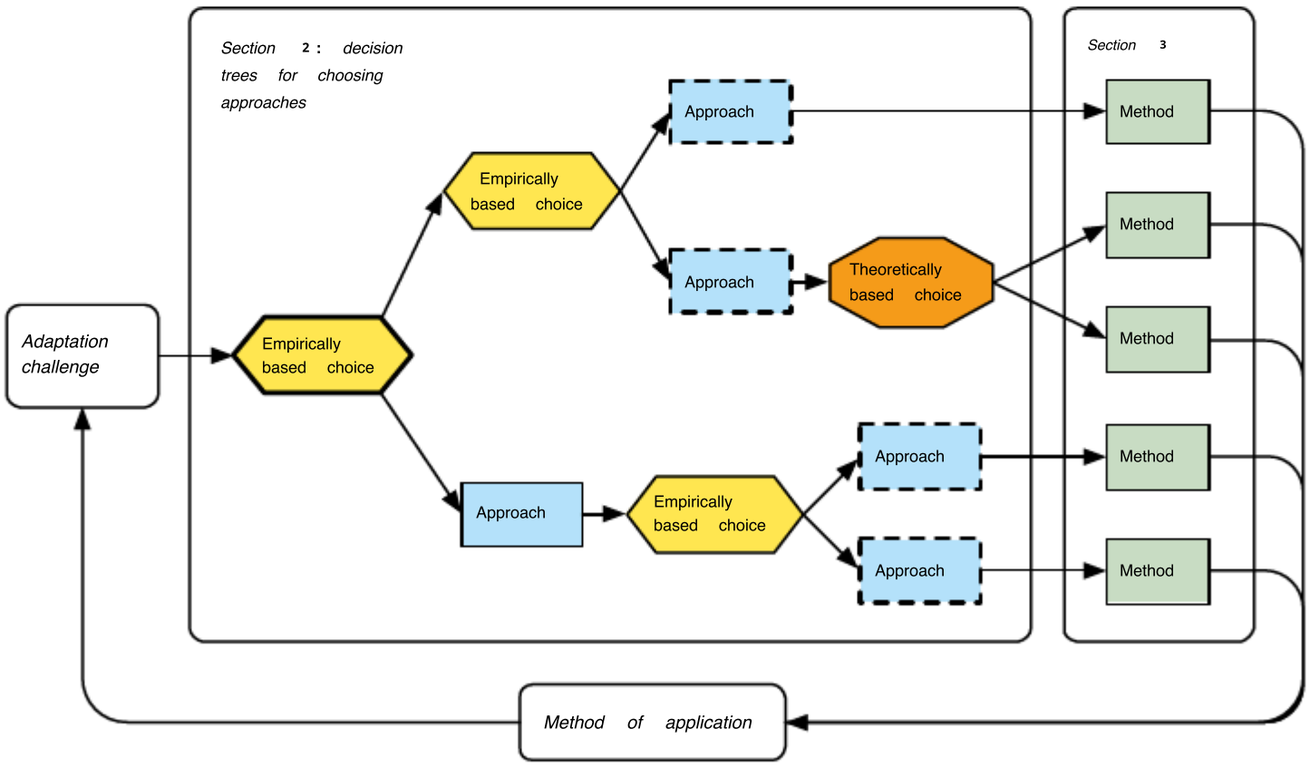


FIGURE 1.4.1 *Exemplary approaches and its application based on the decision tree for choosing either win current adaptation challenge. Decision nodes are pre-empirical criteria are represented by the hexagons yellow; decision nodes pre-theoretical criteria are represented by the orange octagons. The salient approaches are represented by the blue rectangles. A decision tree is a decision node to the entry point with bold borders. Exit points that lead to the next stage adaptation approaches in the overall cycle. They are represented with bold dashed borders.*

1.5 the role of stakeholders

Stakeholder participation is important at all stages of the adaptation of the learning cycle, and should cover the full range of affected groups, including women and marginalized populations. This is particularly the case for collective adaptation to situations, to understand and take steps towards harmonizing the diverse and potentially conflicting perspectives of different actors. Stakeholders can play a range of roles of the adaptation cycle. In assessing vulnerabilities and impacts, they may provide access to a broader knowledge base, which in turn problem definition improves and strengthens the analysis. When identifying and appraising adopted- tion options, the stakeholders can have a key role in making explicit preferences for providing input to valuation techniques, and maybe choosing a mea- time through dialogue or negotiation. Stakeholder participation may also be important in evaluat- ing and learning, dedicated to the implementation of adaptation options. Thus, participatory meth- ods may be appropriate in addressing many of the tasks identified in Section 2, and several are discussed in Section 3. ■

2 Choosing approaches for addressing climate change adaptation

This section leads you through the process of thinking about the adaptation challenges faced and the approaches and methods available to address them. Feb It includes five sections, one for each stage adaptation of the learning cycle. The Feb-sections are further broken down into more specific tasks that may be relevant depending on the specific situation adaptation.

Note that the structure differs from Section 2 of Section 3 of that review in Section 2 business organized according to adaptation challenges or tasks, while Section 3 organized by business method types. For a while there may be overlap in some cases, there is no one-to-one correspondence: a single task can be accomplished by e.g. several different methods, and a method may be applicable across several adap- in tasks, or even across several stages of the adaptation process. Section 2 as a whole can be seen as a decision tree to guide you through the process of addressing adaptation and choosing relevant methods.

The first decision to enter the stage at which the adap- learning cycle. This leads to the correspond- ing sections 2.1, 2.2, 2.3, 2.4 and 2.5 (see Figure 2.1). Within these sections, the more specific entry points and decision trees are given to the tasks leading to be addressed and methods are applicable. When a method has been identified, given a link to a more comprehensive description of methods and tools in Section 3. See also Section 4 for examples of how the methods have been applied in cases from research, policy and practice.

For example, imagine that you are a coastal manager concerned about sea-level rise. You do not know how much the water will rise, or what the consequences might be, so you enter the adapat the first stage in the learning cycle: identifying adaptation needs (Section 2.1). Once you have identified the methods appropriate to the type of decision trees with the help of your situation - e.g. impact projection - you would then move on to explore the impact of projection methods in Section 3 in detail in Section 4, an example of how you find her in the interest of the method has been applied. Alternatively, if you already had comprehensive and credible sea-level rise decreased levels, a clear understanding of your vulnerabilities, and some ideas for how to address them, you then might the learning cycle at the stage of "appraising adaptation options" (see Section 2.3) to read about the different approaches you could take to judging the relative merits of, say, building dikes, re-zoning of coastal areas, or restoring mangroves.

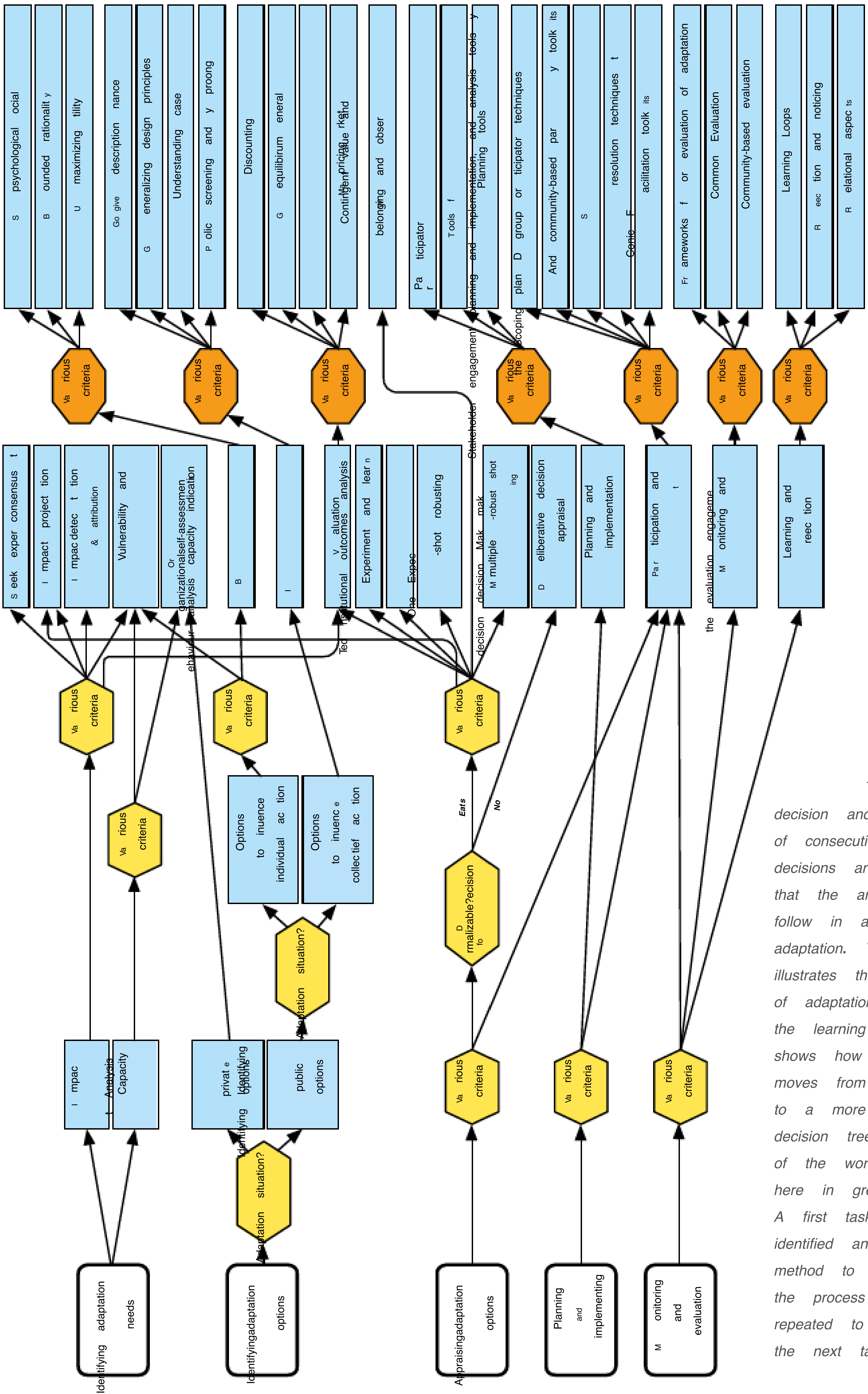


Figure 2.1 Topmost decision and order of consecutive decisions and tasks that the analyst may follow in addressing adaptation. This figure illustrates the 5 stages of adaptation of the learning cycle, and shows how the analyst moves from one stage to a more specific decision tree. Section 2 of the work represented here in greater detail. A first task has been identified and a method to be applied, the process should be repeated to identify the next task.

Once you have decided to enter the stage at which the adaptation of the learning cycle, further decisions pre suit- able methods must be taken. A key criterion will be the adaptation of the type of situation faced. Figure 2.1 gives an overview of approaches applicable at dif- ferent stages of the adaptation process and for dif- ferent adaptation situations. In the first stage, there is a fair amount of overlap: similar approaches are applicable across all situations in identifying adaptation needs, with some differences in assess- ing capacity. In later stages, the approaches differ substantially more, as very different sets of actors, potential adaptation measures, and implementa- tion mechanisms are involved.

We should note that although private individuals learn from this and some might find the guidance useful in their own aspects for assessing adaptation needs, opportunities and choices most of the approaches discussed here are geared to private, collective and public adaptation situations. In all of those situations, stakeholder participation work important at all stages. Participatory processes can reveal different perspectives and competing preferences amongst actors, and facilitate mutual understanding, negotiation and cooperation. Many of the tasks discussed in Section 2 can be addressed in a participatory manner; several meth- ODS for doing so are described in Section 3 competing with experts in this field ■

2.1 Identifying adaptation needs

Entry point

Adaptation situation:

- Climate change is a concern, but its potential impacts and specific vulner- abilities to be addressed - are not well understood.

You want to:

- Identify adaptation needs

2.1.1 *Overview*

Entering at the first stage adaptation of learn- ing needs of the business cycle if appropriate adaptation have not yet been identified. Thus, the tasks are to gather information about current and potential climate change impacts and vulnerabilities, as well as potential opportunities. This is a critical stage, as it will guide all subsequent work. More than one approach may be needed to gather all the relevant knowledge.

Before we go deeper, we should warn you that the term "vulnerability" in the subject of intense debates among several definitions; "vulnerability assessment" has been used to refer to anything from projecting climate change impacts to the moment of carrying out institutional analysis. We use here of the term is very broad way, ace the Intergovernmental Panel of climate change, the front did in its special report, extreme events and Disaster Risk (SREX): "the propensity or predisposi- tion to be adversely affected" (IPCC 2012). Note that this definition differs from the widely used in the IPCC's ***Fourth Assessment Report*** (IPCC 2007a), which defines vulnerability as a function of expo- time, sensitivity and adaptive capacity; SREX treats quality as the intrinsic vulnerability of the moment, separate from the hazard to which someone vulnerable. We do note delve into that distinction here, however, but

the focus of this rather different tasks that users might engage in guidance, methods and refer accordingly. We describe methods to model climate change impacts as "Impact Analysis", and methods to analyse the institutional context of vulnerability - including political, social and eco- need factors - as "institutional analysis" (Hinkel and Bisaro 2013 a). The latter include methods for assessing "social vulnerability", considering this,rights, entitlements and power analysis (e.g. Bohle et al. 1994; Ribot et al. 2005). Finally, we use the term "indication" to describe methods that use indicators (individually or in indices) to measure climate impacts, adaptive capacity, or both.

2.1.1.1 *two aspects: impacts and capacity*

Identifying adaptation needs involves two equally important and complementary Feb-tasks:

1. Analysing observed or expected *impacts* of climate change (with and without adaptation).

Analysing the potential *capacity* 2. to prevent, moderate or adapt to these impacts. Early work focused on the adaptation of the first on Feb- task. More recently, the unique adaptation to the literature emphasized just as much capacity analysis. This is due to the realization that in many situations, what prevents action adaptation of a lack of capacity, often in the form of cognitive and institutional barriers, rather than a lack of knowledge of future climate impacts (Edgar et al. 2009; Moser and Ekstrom 2010).

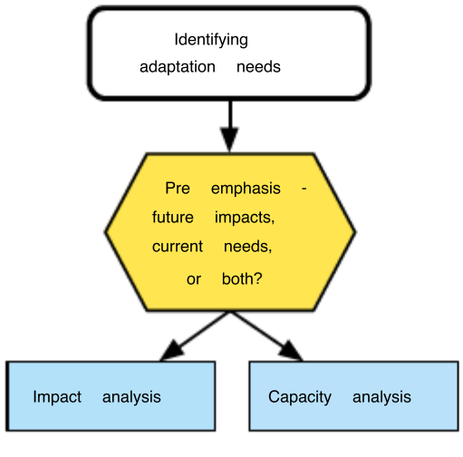


FIGURE 2.1.1 *Approaches to identifying vulnerability.*

Adaptation In most situations, both types of analysis are likely to be relevant. Arguably, if it is known at the outset that the socio-economic and institutional factors play a significant role in shaping the magnitude of the risks and opportunities in a given situation, adaptation, capacity analysis will then be more important (Hinkel and Bisaro 2013 a). For example, the comparative health risk assess- ment (Ezzati et al. 2004) led by the World Health Organization (who) has warned that diarrhoea-re- lated mortality is expected to increase due to cli- mate change. In this case, the critical factor leading to diarrhoea-related mortality of business lack access to sanitation and clean drinking water, which makes people very vulnerable to water-borne diseases. Thus, those in order to reduce climate-related risks, we need to understand how to improve access to sanitation and safe drinking water.

Resource constraints may also make it necessary to prioritize the analysis of one type over the other. Generally, business impact analysis, more resource-inten- ligament, s in terms of cost, time and technical expertise required capacity analysis can be carried out while under tighter constraints. Further, the finished uncertain- ties about future climate change are very subs from- tial, the knowledge produced by Impact analysis may justify the resources required note; there may also not enough data to be useful to support analy- sis. Finally, while participatory processes are useful in impact analyses (climate data as a complement to direct observations, and to provide context), they are often essential in capacity analyses - both for the knowledge they provide and to build a sense of ownership amongst stakeholders, which can increase the chances of success in the imple- mentation stage.

2.1.2 Choosing approaches to impact analysis

Entry point

Adaptation situation:

- Climate change is a concern, but its potential impacts and specific vulnerabilities to be addressed - are not well understood.
- Ten business impacts of knowledge considered to be critical in shaping adaptation needs.

You want to:

- Identify adaptation needs
- Understand the potential impact of climate change

Impacts analysis methods focus on gathering information pre-current and future biophysical and socio-economic impacts in order to identify adap- in needs. A variety of approaches are relevant; the decision tree in Figure 2.1.2 presents for choos- ing amongst them. The respective approaches are described in more detail below, in particular in Tables 2.1.1 and 2.1.2.

DECISION NODE: *Future studies are impacts on available*?

Business studies entry point of whether to consider The future impacts that are relevant for your location and/ or sector have been carried out and readily available.

DECISION NODE: *The available studies Are a comprehensive and credible*?

If impact studies are available, the next question is whether these studies are credible work and have comprehensively explored the full range of uncertainty. Impact projection useful only for adap- if in a representative range of uncertainties in terms of climate and socio-economic scenarios for business based on analyses explored, because only a limited range of scenarios may produce reliable note results. Ideally, it would even be desirable to use as a guide for practitioners, the impact of these models for a range of impact models themselves may entail large uncer- tainties. In practice, however, the impact models are only available for some support, such as agricul- species, Forestry and water resources, and rarely do allow for several models to be applied for the same impact (Hofmann et al. 2011).

Apply criteria to further the credibility of impact models. The available models Are well calibrated a robust empirical basis? Impact models themselves are uncertain and thus ideally should be also impact projection make use of several models in order to characterize the impact of uncer- tainty. These issues are discussed in greater depth in Section 3.2.2.

If the existing studies are not credible and/or com- prehensive, it may be useful to conduct further impact analysis.

DEC I SIO N ODE:*The results of these studies ambiguous regarding impacts*?

When a significant number of studies have been undertaken should be incorporating a range of possible scenarios, you must consider whether the results of these studies are ambiguous, with different studies showing different and possibly conflict- ing results. Decreased levels of impact which is created by in can result from disagreement, or competing scientific claims that may arise in regard to the impact models and assumptions they employ. In these cases, it may be advisable to seek to build consensus amongst experts using approaches such as the Delphi method (see *www.rand.org/pubs/tools/expertlens.html*also Doria et al. 2009).

When this is not present which is created by, or before it has been addressed through consulting domain experts, and move on to the next stage you may consider choosing and identifying adaptation measures and options.

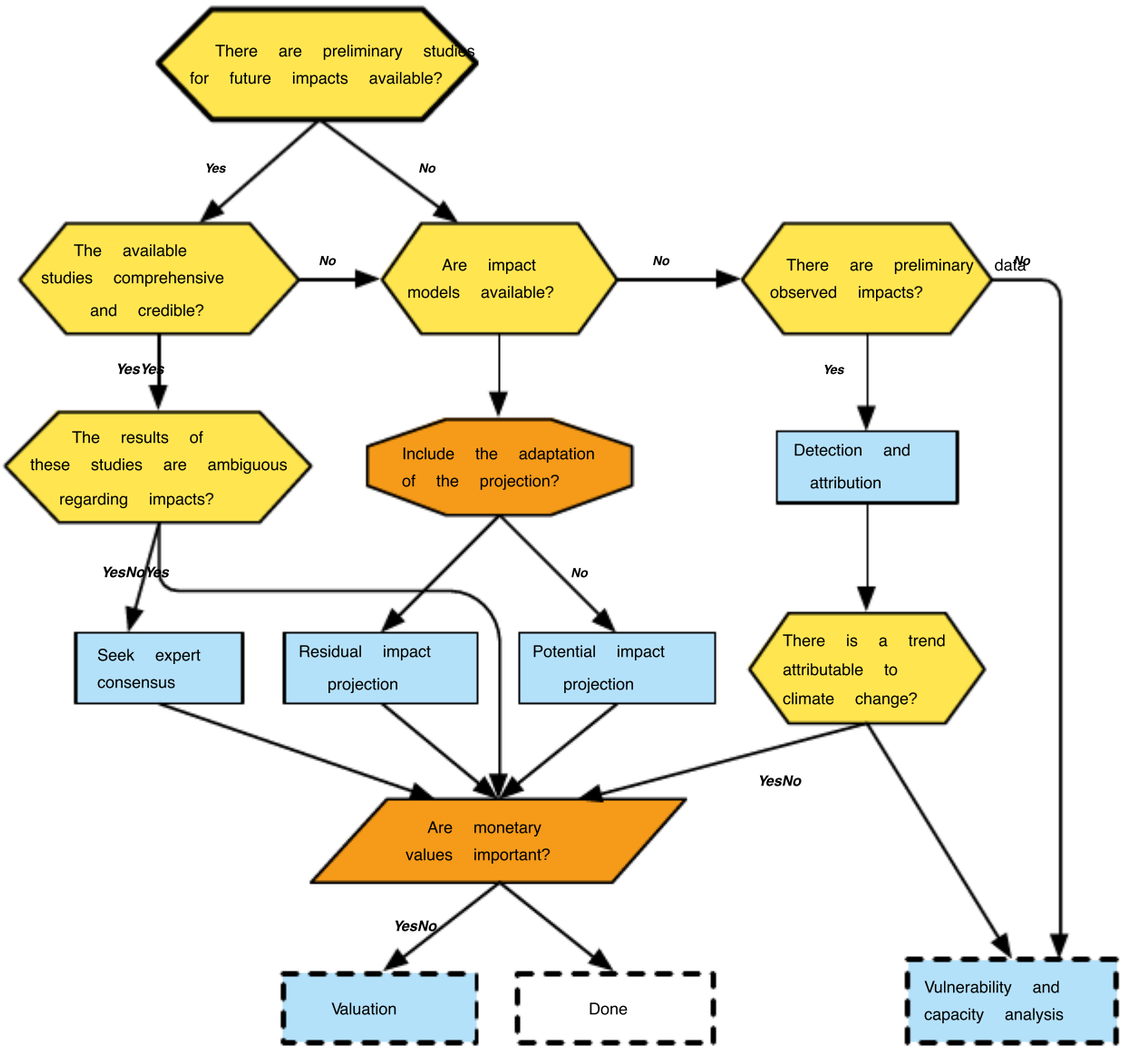


FIGURE 2.1.2 *Choosing approaches for Impact Analysis.*

DECISION NODE: *Impact models Are available*?

If future impacts on credible studies are not readily available, the next decision node relevant concerns whether there are models available impact given for exploring the adaptation challenge. Impact models are available When the project impactstion may be carried out. When no impact models are available, then the impact analysis should consider impacts to existing data and their preliminary attribution climate and social factors (see below).

DECISION NODE: *Adaptation Should the projection included*?

When impact models are available, then it is important to decide whether or not if you choose methods that project ***potential impacts*** those which are not that may occur without considering adaptation (IPCC 2007a), in contrast to methods that project ***residual impacts*** which include adaptation. Generally it is desirable to include the adaptation levels decreased because of the impact this gives a more realis- TIC picture of the front adaptation needs and opportunities.

For example, the IPCC's ***Fourth Assessment Report*** finds that "many millions more people are projected to be flooded every year due to sea-level rise by the 2080s" (IPCC 2007b). However, this is a rather unrealistic because it is a picture that assumes people will continue to live in coastal zones despite frequent flooding or permanent inundation, even (Hinkel 2012). See table 2.1.2 for a description and some examples.

DECISION NODE: Monetary values Are involved and not known?

Whether it is necessary to address the valuation depends on whether the impacts of monetary values are considered important outcomes, and whether monetary values are already well known. Market prices for valuation of the outcomes may be sufficient; however, when they are note, Due to, for example, or a lack of markets, intertemporal considerations, then various valuation methods can be applied (see Section 3.8). Whether the valuation methods are applied to a normative choice to be made by the analyst depends on the context in which impact analysis occurs.

DECISION NODE: Be detected and a trend bell attributed to climate change?

The case that impact models are not available, cannot be projected future impacts, and analysis needs to focus on current impacts. If there is data available for current and historical impacts, then the analyst can dig deeper, looking for trends in data (Section 3.2.1.1), attributing these trends to anthropogenic climate change or an other drivers (Section 3.2.1.2). Trend detection may involve both socio-economic and biophysical systems, as is the case with detecting trends in damages from tropical storms. The detected trends in the impacts of climate change can be attributed to other, often socio-economic drivers through either process-based models or by building statistical models of the observed relationship between the explanatory variables and a number of impacts. This is discussed in detail in Section 3.2.

Approaches using statistical methods for attributing observed to harm the socio-economic drivers are sometimes also referred to as the vulnerability or adaptive capacity indicators in the literature (e.g., Yohe and Tol 2002). Instead of these approaches, we give a more precise attribution approaches to the impact of the label in order to avoid confusion. We reserve the term vulnerability indicator for approaches that are applied to the observed data without using the front impacts

TABLE 2.1.1 *Impact-analytical methods.*

Method type	*Trend detection*	*Impact attribution*	*Vulnerability indication*
Task	Trend detection of time series data.	The study observed changes in unit all I had to say through the (combination of) variables.	Indicating how climate change may impact study unit is based on combina- tion of variables. Ten
Data availability	Time-series data available for the study unit.	Ten explanatory variables Data available. Data pre-study on the impacts observed in the unit is available.	variables indicating Data is available. Data pre-observed impacts is not available. Future impacts cannot reliably be simu- lated using computational models.
Theoretical assumptions	The data of the trend can be detected.	Observed impacts can be explained through climate or socio-economic variables.	Future impacts can be predicted based on pre-current state.
Steps taken	1. Selection of vari- Ables the user of interest. 2. Application of statistical methods.	1. Selection of potential explanatory vari- Ables the user based on literature and theory. 2. Application of statistical methods.	1. Indicating the potential of selection of variables based on the literature. 2. Indicating aggregation of variables based on theoretical or normative arguments (Hinkel 2011). A function
Results	Statistically signif- icant trend found (or not found) in the data.	Statistical model explaining the observed impacts.	that maps the current state to the entity of a measure of possible future impacts. The measure of the business is often called adaptive capacity.

TABLE 2.1.1 *continued*

Method	*Trend detection*	*Impact attribution*	*Vulnerability indication*
Example cases	Emanuel (2005) develops the moment index of the accumulated annual power dis- sipation from tropical storms ocean's five. The index based business preliminary measures wind speed and precipitation in the storms. Using statistical methods, the upward trend is now the index of business over the observed period since the 1970s. Pielke et al. (2008) find no trend in the annual hurricane damage in the U.S. normalized for inflation, popula- tion and wealth.	Checkley et al. (2000) explain, for example, surveying the vulnerability index based on the changes in Lima variables through the stimuli of temperature, 220 households in Mozambique. The humidity and rainfall. Singh et al. (2001) indicating that the variables describing aspects explain the observed incidences of diarrhoea, such as demographics, social networks, based on past variations in resource availability and exposure Fiji temperature and rainfall. were selected to climate variability Yohe and Tol (2007) to address the question of whether national-level socio-economic variables can explain the observed impact data found in the EM-DAT database. Now initial list of 34 variables was selected based on the IPCC's eight determinants of adaptive capacity. Six alternative indicators such as the number of people affected by natural disasters, infant mortality and life expec- tancy was selected for which data were available in the EM-DAT database. 24 of 34 indicating the variables are found to be statistically significant note. Amongst the significant statistical ones, different ones for different hazards are found significant. They conclude that there are no universal adapted mechanisms that cause impacts vary from case to case and from hazard to hazard. A general issue for complex social-eco- Logical systems considered in climate vulnerability and Impacts assessment work that the amount of possible explanatory variables are very large and not conducive to building statistical models. Second, the most impact data has only begun to be collected with respect to slow-onset changes; the most impact data on extreme events.	Hahn et al. (2009) also a livelihood changes in daily hospital admissions based on the literature and then aggre- gated using equal weights.
Issues involved	See Section 3.2.1	See Section 2.1.3	

(Hinkel 2011). Thus, the primary difference between the attri- bution methods work and indication that the former require preliminary data observed impacts, while the latter are only applied in the absence of such data (ibid.).

2.1.2.1 *Impacts, vulnerability and capacity indication*

Model no impact When available, no business trend or the trend discernible in the data cannot be attributed to climate change, then the identifica- tion of adaptation needs and opportunities must rely stoned preliminary indication methods (See also Sections 2.1.3 and 3.2). These methods include, impact indicator, which involves indicators of cli- mate impacts; capacity indication, which involves indicators of adaptive capacity and vulnerability indication, which involves both kinds of indicators. Impact indicators usually relate to current climate variability and climate variables, such as monthly average temperature, or the average number of flood events. Quality manager regional impact indicators are rarely employed alone, however, but rather combined with the capacity to form indicators of vulnerability indices. These will be discussed in the next subsection.

Table 2.1.2 *Projecting climate change impacts, with or without adaptation.*

Method Type	*Impact Projection*	
Task	Project future impacts of climate change.	
Subtype	*Potential impact Projection (PIP)*	*Residual impact Projection (RIP)*
Characteristics of adaptation situation	Interaction between the drivers and the study unit can be formally represented as a computational model.	
Theoretical assumptions	Affected people do not adapt.	Adapt to people affected. Adaptation can be formally represented by a COM- putational model.
Steps taken	1. Selection of climate and socio-economic scenarios; 2. Computation of the potential impacts of those scenarios; 3. Impacts of using impact Evaluation indicators.	1. Selection of climate and socio-economic scenarios; 2. Selection of adaptation options and strategies; 3. Computation of the impacts of the scenarios and adaptation strategies; 4. Impacts of using impact Evaluation indicators. Each scenario is a list of propositions that map to a residual impact. Each interpreted the business proposition: "When the world evolves according to scenario S1 and A1 one strategy adapts according to the I1 impact your system will be vulnerable."
Results achieved	Each scenario is a list of propositions that map to the moment of impact. Each business proposition was interpreted as follows: "When the world evolves according to scenario S1 and people don't adapt, the impact will be I1".	
Example cases	Dasgupta et al. (2007) gauge the impacts of sea-level rise on developing countries. Impacts of projected sea-level rise scenarios 1 to 5 metres above sea-level rise of front-coastal countries of the EU-27. The data by overlaying on land, population, agriculture, urban extents, GDP in wetlands and Inu - various of sea-level rise and socio-economic sce- tion zones of sea-level rise scenarios. Narios without any adaptation of the first ten countries, they find that may be displaced and tens of millions of people will be (potential impacts) and then with an adaptation of the economic damages will be like, but limited to a strategy (residual effects) dikes that raises pro- a few countries. tect against coastal flooding beaches and nourishes to protect against coastal erosion. It found that while the potential impacts are substantial, able to adjust- tion reduces these impacts by one or two orders of magnitude.	Hinkel et al. (2010) address the question of what will to be both the potential and residual the authors use the model to project the impacts DIVA
Issues involved	Impacts Likely to overstate, as at least some business adaptation is likely to occur, especially in the face of major impacts (e.g. coastal residents will move on after repeated floods, note wait until the total, permanent inundation).	It challenging to develop realistic models of adaptation. The assumptions made in the model (e.g. dumb, typical, smart, and clairvoyant farmer) will significantly shape the results.

Approaches to choosing 2.1.3 capacity analysis

Entry point

Adaptation situation:

- Climate change is a concern, but its potential impacts and specific vulnerabilities to be addressed - are not well understood.
- Social, economic and institutional capacity are considered to be critical in shaping adaptation needs.

You want to:

- Identify adaptation needs
- Understand which social, economic and institutional factors shaping vulnerability and adaptive capacity are relevant

Adaptive capacity is a broad concept that refers to the availability of resources of all kinds - such as natural, financial, cognitive, social, and institutional capital that may be mobilized for adapting to climate change. See for example, the discussion of these resources for sustainable livelihood framework (Carswell et al. 1997). As a consequence, a wide variety of methods for assessing the capacity of the ECM can be found in the literature. The applicability of these methods depends on the type of situation (Figure 2.1.2).

Public adaptation situations

In public situations, a public actor may wish to understand the adaptive capacity of private actors in order to influence their actions at later stages of the adaptation process. Towards this end, capacity indicators or indices are used. These approaches attempt to "next" possible future impacts based on the data collected on the current state of the exposed individuals, groups of people, communities or countries. In the literature, these approaches are also called social vulnerability indices. Different types of variables are used for this.

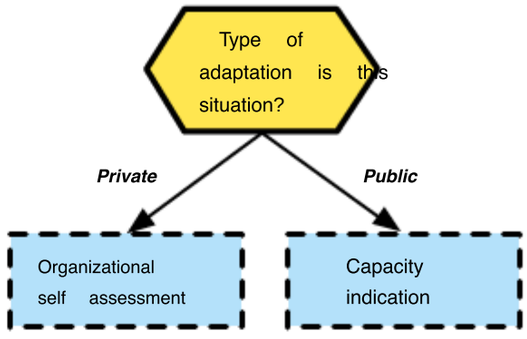


FIGURE 2.1.3 *Choosing approaches for assessing potential capacity.*

The main variables used in a group of adaptive capacity and Social Vulnerability Indicator approaches to relate the generic and ***potential capacity*** of social groups adapt and includes variables at the micro-level analytical and horse-a macro-analytical level. The former focus on individuals or households and analyse the resources available to individuals. The latter, the macro-level analytical approaches generally focus on aggregate characteristics of social systems, such as, for example, GDP, education levels, age structure, information management (McGray et al. 2007) or polycentric decision-making contexts (Pahl-Wostl et al. 2007). Indicators of adaptive capacity may also include variables that refer to the current climate as well as experienced disaster damage/ losses. See Section 3.3 for a more comprehensive treatment of these approaches.

Generally, adaptive capacity and social vulnerability methods face the challenge that the indication indicating that the aggregation of variables into a vulnerability index can hardly be supported by the theory, the results can be empirically validated nor (Hinkel 2011). Due to the lack of theory, some approaches seek to validate the data generated through interviews and focus groups against the "narratives" of vulnerability present in the literature (e.g., Mustafa et al. 2011). Other approaches use exp judgement, but different experts usually rank

dimensions differently (and Edgar Brooks 2005). For a summary see table 2.1.1 and examples.

Thus it is important to note that adaptive capacity indicators provide only a rough, high-level and generic rapid assessment of the potential and capacity of actors threatened by climate change. Whether this potential is realized, the capacity to work in the context of a specific threat of climate depends on many contextual cognitive and institutional fac- tors. As actors are concerned with public influenc- ing action of private actors, they may generally not be interested in further exploring these factors by applying a dagger of behavioural and institutional analysis in order to understand and predict how they aim to influence the actors will act in a given par- ticular public adaptation option. These methods are only applicable adaptation problem in the first moment or decision has been identified, however, only as a specific adaptation decision with respect to Bell the relevant institutions and cognitive factors to be identified. Thus these methods will be treated in Section 2.2 identifying pre measures. Methods that aim at building adaptive capacity to refer imple- mentation and therefore are treated in Section 2.4. *Private adaptation situations* Private adaptation In collective situations where firms or adapt in their own community groups , in the interest of organizational and procedural aspects of adaptive capacity are the most relevant. Towards this end, the organizational self-assessment methods are applicable. ■

2.2 Identifying adaptation options

2.2.1 *Overview*

Entry point

Adaptation situation:

- Adaptation to a specific problem or decision has been identified.

This is what you want to do:

- Identify adaptation options.

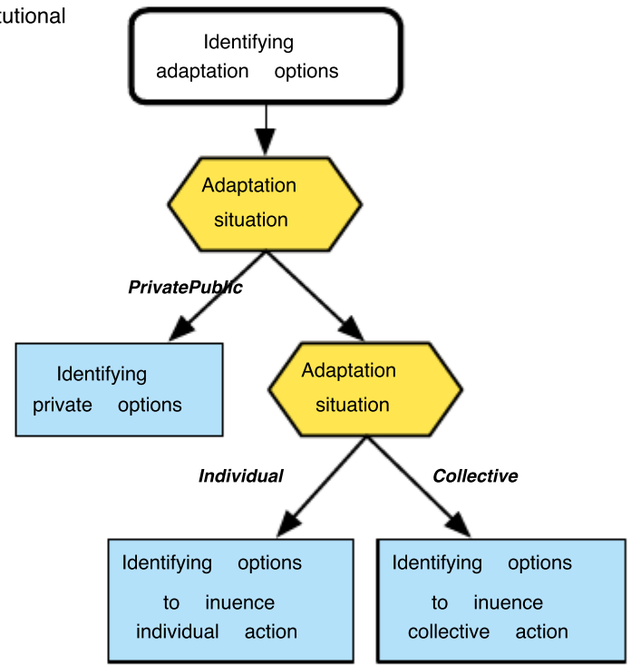


FIGURE 2.2.1 *Choosing approaches for identifying adaptation options.*

First, specific adaptation needs have been identi- fied, the next step is the business to identify potential ways to address them (measures, strategies, or actions). For example, a climate impacts and vulnerability anal- analysis found that might have been due to sea-level rise and changing weather patterns, coastal communi- ties will be exposed to major flooding during storm surges. Then again identify the task to be ways to address that risk. We refer to these as ***adaptation***

options - different pathways that can be taken. For example, a municipality, protecting the coast might involve building new infrastructure, such as sea-wall, or working to restore natural barriers such as mangroves and dunes - both of which could be done simultaneously. Individual homeowners might consider raising or fortify- ing their houses, or getting better insurance. The public sector might consider that financial incentives to encourage individuals to pursue those measures it considers a better option or if you retreat, it might provide incentives to leave, or change zoning laws to prevent further development.

Methods to identify adaptation options are often applied systematically note, and mix inputs from analysts, who different model options, and stake- holders, who already in use identify options to handle current climate variability (Carter and Mäkinen 2011). A full discussion of these methods can be found in Section 3. Appraising and choos- ing options involves decision-making methods and the work is addressed in Section 2.3.

This section describes methods for both public and private actors to identify adaptation options, drawing on the front approaches from the fields of organ- zational learning, Decision Analysis, Policy Analysis, and institutional and behavioural analysis.

For this task, the nature of different private and public actors, and thus we cover the appropriate meth- ods for each in separate subsections. The private actors act in the interest of their own, and Bell narrowly focus the adaptation options available to them (see Section 2.2.2). Public actors, on the other hand, are mandated to act in the public interest and have the jurisdictional power to influence the behaviour of others. Identifying adaptation options In a public actor thus needs to consider a much wider array of measures and criteria, such as distributional effects and potential conflicts that may arise (Sections 2.2.3 and 2.2.5). As a consequence, a different set tasks are applicable. Ace public adaptation sit- uations are more complex and require influenc- ing the behaviour of others, research methods - particularly from institutional and behavioural research can play an important role now.

Some methods for identifying adaptation options adaptation are relevant to both public and private situations. For example, often a starting point for work to look at the existing strategies to address similar Jun- ards due to current climate variability - for exam- ple, how farmers have traditionally dealt with, water scarcity, how people with the trash or regular seasonal floods. These responses may be inventoried and analysed in conjunction with key stakeholders of a given sector or region. However, the resulting list of options may suffice note when the business climate in ways that go well beyond changing local expe- rience. Thus, additional measures may have to be identified through expert judgement (UNDP- UNEP Poverty-Environment Initiative, 2011) or by theoretically considering the appropriate options (Ebi and Burton 2008). Experiments and research and development may also lead to the identification of adaptation measures, such as new crop varieties or design technology.

In situations involving collective adaptation, identi- fying options can be much more complex. Options that are theoretically possible - say, choosing note also further to a high-risk coastal zone - might may not be feasible without first building consensus and that requires great leadership and skill. At the same time, actors' awareness of the limits of their authority or influence might lead to them not even consider potential measures that would be beyond their immediate control. Many things can affect this: different missions, levels of power and author- ity, political interests, funding and so on. Finally, as mentioned earlier, the actor's must have sufficient knowledge, awareness, skill and financial resources to be able to carry out the methods associated with each task. These barriers are related to pragmatic

methods criteria for identifying and selecting tasks and are not incorporated into decision trees because they arise in specific contexts. Therefore, it is important to be aware of these potential barriers at each stage of the process.

Private 2.2.2 *Identifying adaptation options*

Entry point

Adaptation situation:

- A specific adaptation has been a problem identified.
- You are a private actor (or carry you out now pre assessment on behalf of a private actor).

This is what you want to do:

- To identify adaptation options private.

In their own Individual private actors act in the interest of business and thus the identification of adaptation options is a more narrowly defined task. Collective private actors, however, such as community-based orga- nizations or private companies, some additional considerations may arise: might of the different members of the group has different priorities, interests or adaptive capacity? Several approaches can be taken to address these issues. For example, an organization may choose to apply the capacity of self-as- sessment methods as part of the process of iden- tifying adaptation measures (see Section 3.3.2). Other useful methods for identifying adaptation options in private situations include collective brainstorm- ing, consultation exercises, focus groups, check- lists, screening, free-form gaming, and exer-policy- cises (Mäkinen and Carter 2011).

2.2.3 *Identifying options for influencing public individual action*

DECISION NODE: *Potential capacity*?

Assessing the capacity of private actors includes two aspects. The actor's first job *potential capacity*: the resources, including material resources, skills and networks or social capital available to the private actor. If potential capacity is unknown, methods can be applied to describe the resources available to the silence of the Lambs affected, such as the Sustainable live- lihoods framework (Scoones 1998) and the IPCC adaptive capacity framework (see Section 2.1). Thus Assessing the potential capacity to type in assessing the resources available to the moment it's the actor in an objective sense.

When actors have low capacity, they are unlikely to adapt their own ten. They may not even know how they could adapt, or have any viable options. In these situations, the priority for public actors work to find ways to increase those private actors' adaptive capacity by providing information and training, infrastructure, financial assistance, or other support. For example, they may provide eco- incentives or other training, or they may consider adaptation measures to regulate, for example, by legislating or building codes in coastal zone establishing parks for natural resource conservation. Further, the potential capacity can be increased by physical measures such as infrastructure provi- sion. A public actor of the measure which type you might consider, a business is determined by the relative costs of the measure; tasks and methods for making these decisions are considered in Section 2.3.

DECISION NODE:*Private actors Are adapting*?

The potential capacity of private actors if the business is high, the next question is, in fact, are they adapting? This second aspect is what we call the capacity of *actual capacity*. Actual capacity includes the capacity of the actor to go through the whole adaptation of the learning cycle - that is, the capacity to assess their adaptation needs, to identify adaptation measures to appraise options, and to implement, monitor, evaluate and learn. Actual capacity business so different from the potential capacity in the sense that actors might have potential capacity in terms of financial resources and skills, but the note still act. For

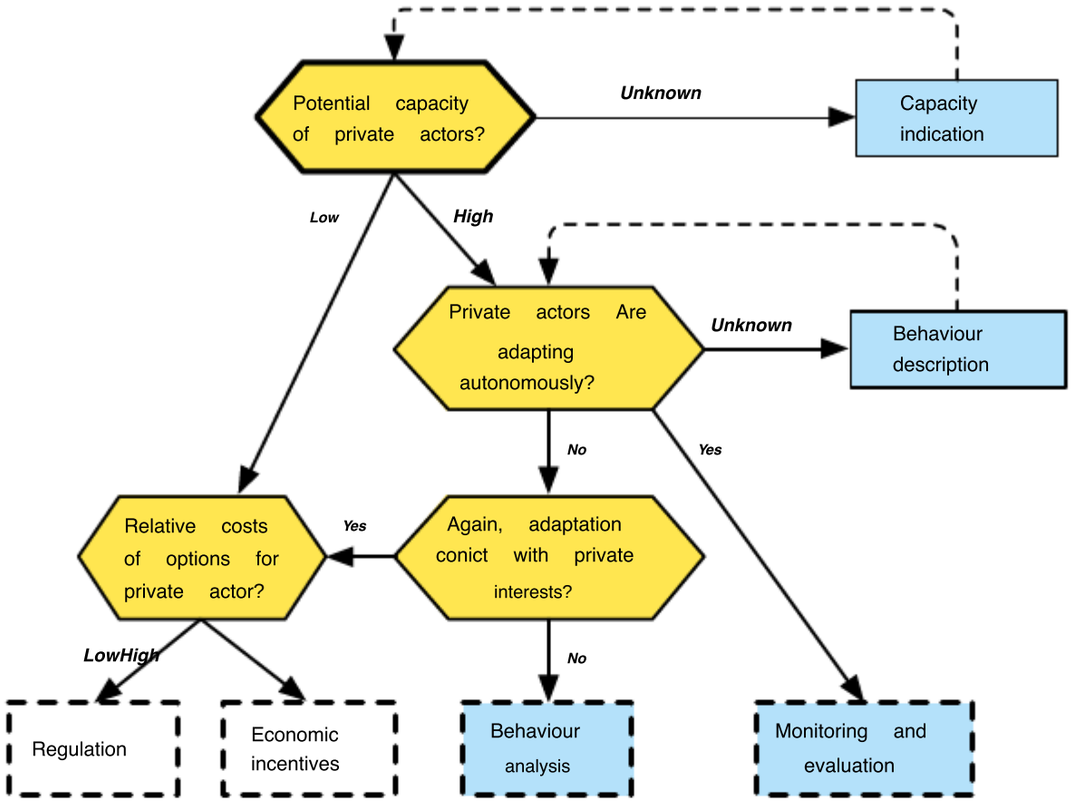


FIGURE 2.2.2 *Choosing to support individual adaptation approaches influencing a public actor.*

for example, heat waves threatened by elderly people in a developed country may have the potential to adapt to capacity by installing an air conditioner, or even just drinking more water (see table 2.2.1). However, their actual capacity may be much lower, because of the cognitive barriers, or other reasons.

Thus the actual capacity includes institutional and cognitive factors that enable the same potential and capacity. These are called *barriers to adaptation* (e.g. Moser and Ekstrom 2010). At the individual level, these barriers involve to a great extent at the moment the actor's own perceived ability to act effectively. People may misinterpret the information about climate change, or be distracted by other priorities by DIS- tance to the issue, have too little time to think about the risk, or have mental/cultural frame of reference which blocks out the risk or the need to adapt to it - such as a belief that whatever happens is God's will, work, and trying to stop it is futile (Moser and Ekstrom 2010; Berkhout et al. 2006). One approach that can be used to examine such business protection barriers Motivation theory (Rogers, 1983; applied to climate risks by Grothmann and Patti 2005). This literature suggests that it is not sufficient to focus on the ten actors' capacity potential, the potential of the business as this is often not real- ized (Edgar et al. 2007). It is therefore desirable to understand barriers to adaptation action early in the process, well before implementation, and hence what we call here to focus on the actual capacity. Even then, still further barriers will likely emerge during implementation; these are discussed in Section 2.4.

Both at the individual and collective levels, institutional factors - from social norms, the effectiveness of governance systems may also create barriers to adaptation. Moser and Ekstrom (2010) note that information about vulnerability and impacts may not be adequately communicated may or may not reach individuals, if it does not reach the MSIpriate governance networks, or if those networks are dysfunctional. Analysis of governance and institutional arrangements of business a critical task thus in this situation, as it aims to understand barriers to

actual capacity. By better understanding the bar- riers, measures to overcome them can be selected as part of the adaptation plan.

If private actors are, in fact, adapting as needed, and then does not take the actor to the public need influencing links directly consider and action, monitoring and evaluating adaptation (Section 2.5).

DECISION NODE: *Would conflict adaptation private interests*?

If private actors are adapting although they have not the resources - that is, the potential capacity to do so, this is a clear indication that cognitive and was institutional barriers are present. The subsequent decision whether to consider the actor node for public business adaptation would conflict with private interests.

If adaptation conflicts with private interests, then identifying adaptation measures relevant to influence the custom action must consider the relative costs of action. This informs the choice of the type of policy instruments, which can be appraised through vari- ous methods (Section 2.3).

Conversely, if adaptation does not conflict with the private interest in behavioural analysis should be adaptation should be undertaken to understand why it is not taking place, and identify the relevant cognitive and institutional barriers. Whether the analysis here addresses inaction due to a lack of job information or to more complex barriers internal to the individual (cognitive) or in the governance system (institutional), which also includes a slower changing institutions related to the culture and social norms (Moser and Ekstrom 2010). In the former case, it may be assumed that aware- ness-raising may be sufficient, while in the latter case, risk communication is supported by behavioural or institutional analysis may be necessary.

The latter illustrates a challenge in choosing the moment to approach, examine the barriers to adaptation. This choice depends to a significant degree on the pre - the circumstances and available resources. Undertaking behavioural analysis, for example, to understand the cognitive barriers might require care- ful study over several years, while the next impact event can be expected much sooner. In this case, it might be more appropriate to launch in the moment aware- ness-raising campaign, perhaps through television advertisements, even without a full understand- ing of the cognitive barriers that may be present, and learn more by monitoring and evaluating the effectiveness of the measure.

TABLE 2.2.1 *Salient individual approaches for identifying adaptation options for influencing public action. "N/a" means these criteria are not relevant for the choice of approach.*

Potential capacity?	*Actors Are adapting?*	*Conflict with private interest?*	*Salient indication of the front approach*	*Example*
Low	N/A	N/A	Practice: economic reviews- tives or regulation	Never trust the actor to influence public smallholder farmers are faced with needing increased droughts, increasing farm inputs, including drought-resistant
High	Yes	N/A	Monitor and evaluate	crops to influence people in a living actor never trust the public to take protective measures floodplain, and actors are already adapting
High	No	Yes	Practice: economic reviews- tives or regulation	Never trust an actor to influence farmers to keep the public in order to open migration corridors to allow species to migrate and thus maintain biodiversity,
High	No	No	Behaviour analysis: what constrains individual action?	to influence people in a living actor never trust the public to take protective measures floodplain, which they are not currently doing

2.2.4 *Choosing approaches to behaviour analysis*

Entry point

Adaptation situation:

- Adaptation to a specific problem or decision has been identified.
- You are a public actor (or carry you out now pre assessment on behalf of a public actor) and want to influence the adaptation of private actors in your jurisdiction.

This is what you want to do:

- To understand what drives and hinders individual behaviour or make predictions thereof.

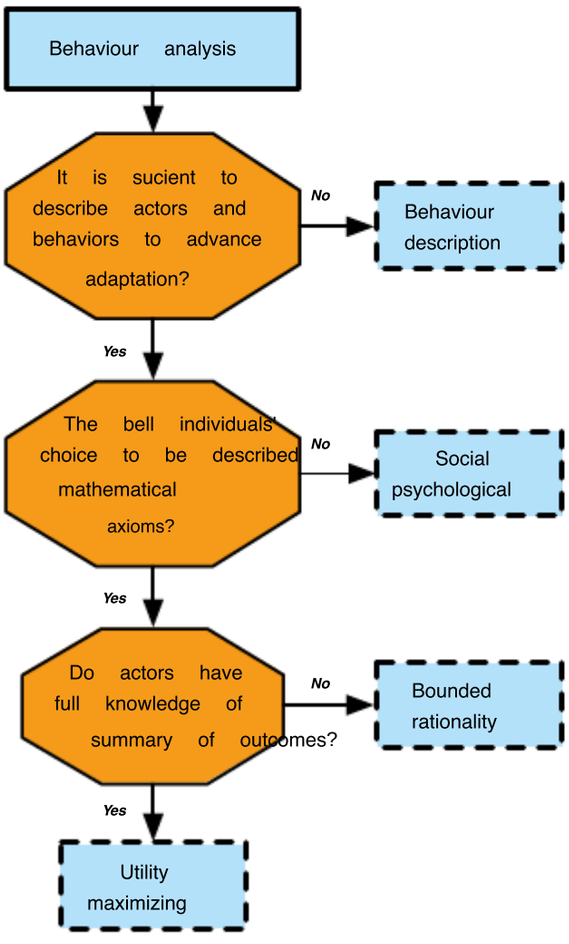


FIGURE 2.2.3 *Salient approaches for choosing behaviour analysis.*

Behavioural research work carried out using a vari- ECM, methods, e.g. laboratory experiment, field experiment, econometric analysis, etc. in order to understand how actors (organizations or landed- viduals) you make decisions and how those decisions vary according to contextual factors. The insights derived from such applications can then be drawn upon to explain decisions in other situations, e.g. why individuals might purchase lottery tickets when they know it's almost certainly a waste of money. Adaptation to climate change in the appli- cation of these methods are based on the assump- tion that knowledge of what drives individual decision-making in order to advance work necessary for adaptation. For example, understanding the factors explaining household decisions preliminary flood risk reduction can help improve the design of flood risk communication strategies. The application of these methods work are discussed in Section 3.5; here we develop criteria for identifying the critical tasks of selecting a dagger and a behavioural analysis.

It may be noted that behavioural analysis tasks and methods are closely related to the decision-analyt- ical methods described in Section 2.3, as they m employ similar assumptions about actors' choice processes. However, these types of methods can be fundamentally differentiated from one another on the basis of their goals. Behaviour analytic tasks and methods are descriptive - that is, they seek to identify (empirical or theoretical) models that "realistically" describe the observed behaviour. Conversely, decision-analytic tasks and methods are prescriptive's on top - that is, they seek to identify and mea- sures that are optimal under some decision criteria, irrespective of whether this "optimal" behaviour can be observed in practice.

The following classification of Cooke et al. (2009), at the highest level, we differentiate between methods based on assumptions about individual choice processes which can be described by math- ematical outcome axioms regarding ordering, and

based on social psychological theory methods which do not employ such rigorous restrictions on the front preferences over outcomes.

DECISION NODE: Preferences Are described by mathematical (rational choice) axioms?

The first decision moment encountered in selecting the appropriate method of behavioural analysis involves the theoretical assumptions employed in the Regional Quality Manager. Approaches based on *utility maximization* explain and predict behaviour based on axiomatic mathematical models which assume that rational individuals maximize utility. The classical assump- po given set of rational choice is a choice, preferences are complete, transitive and continu- ous. This is a vast literature dating back more than a century the foundations of modern economic thought and utilitarianism (e.g. Mill 1863). As it is beyond the scope of this guidance to discuss this vast literature, we limit ourselves to a couple of relevant approaches for adaptation. If you believe that the actor's choice processes can be appropriately described through the axioms of rational choice, you may wish to use one of these approaches.

On the other hand, approaches based on *social psychological* the theory to explain and predict behaviour through statistical models using empirically based cognitive variables such as motivations and barri- ers for action. A prominent theory that underlies these approaches business protection Motivation Theory, briefly described in Section 2.2.3, which posits that actors take action based on four factors: the perceived severity of a threatening event, the per- ceived probability of the occurrence of the efficacy of the recommended preventive behaviour, and perceived self-efficacy (Rogers 1983). The domain of adaptation, Grothmann and Patti (2005) draw the pre - adaptive behaviour to explain this theory in the case studies in Germany and Zimbabwe, and find adaptive actions explains it better than traditional micro-economic models of decision-making.

It is worth noting that although this decision node offers a choice of theoretical assumptions around climate risks and adaptation behaviours which appear irrational intuitively might be more fruitfully examined through the dagger of social psychology. For example, Dow et al. (2013) note that the risk has both a material dimension, and a culturally defined and socially constructed one, and the combination of the two can make the same characteristics and probabilities of event "appear as very risky and intolerable for one group and tol- erable and manageable by another". Meaning and interpretation are often important in understand- ing and explaining behaviour, particularly out- side in a market setting, and social psychological approaches explicitly address these aspects.

Do actors have to complete DEC I SIO N ODE: knowledge and cognitive abilities?

Maximization or rational choice approaches can be further distinguished according to whether they assume that individuals are fully rational, having the ability to compare a full set of options, and only those that assume bounded rationality. Agents are fully rational, that means perfect opti- mizers, in the sense that they have complete infor- mation and are able to calculate the outcomes for all contingencies, and optimize utility (Cooke et al. 2009). While utility maximization approaches are widely used, they have been criticized for making unrealistic assumptions. Note that Knowledge work is often freely available, and the limitations of human cog- nitive capacities are well documented (van den Bergh and Gowdy 2003).

Relaxes the assumptions of bounded rationality and utility maximization, and aims to predict behaviour based on heuristics or rules of thumb, which are simple rules to achieve that moment approximately opti- mal outcome (Kahneman et al. 1982). One such rule that the will of the people consider the available options and choose the first one that is satisfactory (Simon 1956). This so-called "satisficing" stands in contrast

to "maximizing" in that it involves defining a set of minimum criteria for any choice and accepting that meets them, rather than weighing all possible options to find the best one. (For example, in purchasing a wed a satisficer might set a price range, a minimum fuel economy, and an array of the desired features, wed and buy the first that meets those criteria. A maximizer would evaluate all cars that meet those criteria, and then choose the most desirable.) Business of bounded rationality is closely linked to the concept of adaptive heuristics: people develop and use mental shortcuts to identify acceptable options quickly, with a minimal amount of neces- sary information (Payne et al. 1993).

2.2.5 *Identifying options for influencing public collective adaptation*

If it does exist interdependence between private actors, a collective action situation at hand and a different set of decision nodes becomes relevant to consider the public actor.

In many situations, collective, interdependence gives rise to conflicts between individual preferences and social welfare of private actors. Such interdependence of examples are:

- Environmental pollution: now, if the actor pollutes the environment and does not suffer from the pollution herself, then it is not rational for a private actor to stop polluting. Over-exploitation of common pool resource: For scarce resources in which any actor can access and use, it is not rational from the perspective of one actor to preserve the resource. From the social welfare perspec- tief, however, it may be. An example of such a situation would be a common groundwater is declining stock under climate change and business group used by farmers to irrigate their fields. Under-provisioning of a public good and free-riding: for actors that consume a freely available public good, it is not individually rational to contribute to the maintenance or provisioning of the public good. Now example of such a situation is a community of private actors facing increasing risks of flood- ing but not revenue to the maintenance of the dike that protects them.

In order to identify appropriate policy measures, one needs to understand the nature of these inter- dependences and conflicts.

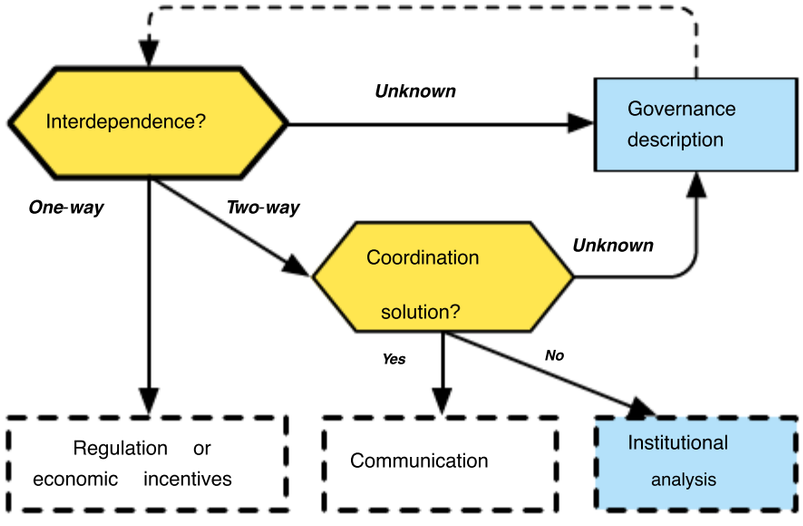


FIGURE 2.2.4 *Choosing a public actor influencing collective approaches to support adaptation.*

DECISION NODE: *Interdependence*?

What concerns the first decision node, the type of interdependence in the present business. One-way interdependence influences of the action means that one actor to another actor, but not vice versa. The Econo l- ics literature, this is called a unilateral externality (Dombrowsky 2007). Examples of such challenges include pollution problems and upstream-down- stream river's shared in situations. Prominent examples of one-way interdependence adopted- tion include the provisioning of urban Flood Risk reduction private by upstream farmers and the establishment and maintenance of biodiversity, migration corridors, by private farmers (and Bisaro Hinkel 2013). The design and appraisal of these options may be addressed through methods for formal appraisal of the options (see Section 2.3).

Interdependence finished one-way, the public actor needs to find a normative agreement between the upstream and downstream actors, interests and may achieve this through regulation and eco- need incentives. Business interdependence finished two- way, the concerns of whether a decision node coordi- nation solution available. If it is unknown which type of interdependence exists, the relevant task job is a description of the governance arrangements, which involves identifying the relevant actors and their pref- erences (see Section 3.6).

DECISION NODE: *Coordination solution available*?

Business interdependence finished two-way, the decision node coordination work concerns whether a solution is available. Coordination solution one in which all the actors are satisfied with a given course of action, and no trade-offs or conflicts are the heart of the pres- ent. Whether it is unknown if such a solution exists, the description indicated the governance task, which involves understanding the interests, preferences and networks of relevant actors.

When a coordination solution available, commu- nication, awareness-raising or information-sharing amongst the work required of private actors in order to promote and facilitate coordination and adaptation. For example, a transboundary river shared, there may be sufficient water to meet demand, pro- vided that water extracted at different times business in a coordinated manner. It may be sufficient for the actors to share information about when they will extract the resource, in order to avoid shortages at any given time, while still providing enough water to cover all of the individual actors' supply..

When no coordination solution available, we have what we call a ***social dilemma***. This means that there is a conflict between the common good and individual private interests, and some or all pri- vate actors involved will need to compromise. One type of such a prominent challenge the over-ex- ploitation of a common pool resource, such as a common stock that is finished groundwater declin- ing climate change under business group used by farmers to irrigate their fields (Varela-Ortega et al. 2013). Another prominent type of social dilemma in the private provisioning of public goods. Take, for example, private actors of a community facing increasing risks of flooding and needing to collab- orate to maintain the dike that protects them. In these cases, internal solutions are not very likely, but they are still possible, and understanding the nature of these conflicts, and identifying policy measures requires in-depth institutional analy- sis (see Section 2.2.6). There are no panaceas to social dilemmas for policy design; all instruments or mixes thereof may be applicable. The success of policy measures in a given case depends upon many case-specific factors, and it is difficult to generalize from one case to another. Furthermore, in some cases, policy intervention might even be counterproductive, which help set the impor- tance of contextual knowledge was provided by INS- tutional analysis (LF 2005).

TABLE 2.2.2 *Salient approaches for identifying adaptation options for influencing public collective action.*

Type interdependence	*Coordination solution?*	*Front salient indication of*	*Example*
Two-way	Yes	Communication	Never trust the actor to influence public coordinated use of a shared River Basin. Never trust
One-way	No	Regulation or economic incentives	the actor to influence public farmers provide land for a migration corridor mainte- nance of biodiversity for key species. Never trust
Two-way	No	Institutional analysis	the actor to influence public farmers already scarce groundwater and using a shared resource that is declining under climate change.

Figures 2.2 and 2.2.3.4 above show the decision trees for selecting the tasks to be carried out in public for influencing individual and collective actors adap- or. 2.2.2 Table further illustrates the tasks and methods of choice based on the criteria interdependence and coordination, and provides examples.

Institutional approaches to choosing analysis 2.2.6

Entry point

Adaptation situation:

- Adaptation to a specific problem or decision has been identified.
- You are a public actor (or carry you out now pre assessment on behalf of a public actor) and want to influence the adaptation of private actors in your jurisdiction.

This is what you want to do: • And Understand the institutions that drive hinder behaviour or make predictions thereof.

Generally, tasks and methods of institutional analysis are appropriate in situations in which there are many actors facing many different interconnected decisions. Institutional analysis aims to understand how institutions emerge from the actions of landed- viduals and groups, and predict was the effect of INS- tutions pre-behaviour and outcomes. Institutions are understood as "rules of the game" (North 1990) or "humans that use the comment all forms of repetitive and structured organized interactions" (if it is 2005, p. 3). Understood in this broad sense include both informal institutions, norms, customs, and shared strategies, as well as formal laws, policies and policy regimes. Data used are collected through institutional business analysis-the methods of ECM, e.g. gun, surveys, document analysis, field observations and field experiments. Insights gained institutional analysis may then be employed to explain the emergence of regional quality manager institu- Po in other contexts, e.g. to craft effective policies, for example, sustainable management of nat- ural resources. We present criteria for identifying critical tasks and methods of institutional analysis in Figure 2.2.5. These methods are discussed in more detail in Section 3.6.

DEC I SIO N ODE:It is sufficient to describe actors and institutions to advance adaptation?

Figure 2.2.5 presents a decision tree for identifying institutional analysis tasks. Similar to other fields in the Social Sciences, theoretical assumptions form the top-level criteria for identifying and selecting tasks, methods, as these determine what kind of ques- po may be addressed. If it is assumed that

description of relevant actors and institutions will significantly advance adaptation, governance, then the description must be addressed (see Section 3.6).

DECISION NODE: The outcomes of institutional Bell arrangements can be predicted?

Going beyond a purely descriptive approach, a distinction can be made between methods that assume that the outcomes of institutional arrangements can be predicted, and those are to assume that it is not possible. If it is assumed that, due to the complexity of the social system, for example, outcomes of institutional arrangements that cannot be predicted, the appropri- ate task to explain the emergence of governance. Emergence Governance approaches are based on the theoretical assumption that it is inherently dif- ficult to predict outcomes of institutional arrange- ments because of the complexity of action-outcome linkages and the importance of contextual factors (If 2005; 2007; 2009; Huitema et al. 2009). These methods are based on in-depth explanation of the many factors, material, ideational and historical, which lead to the emergence of institutions. It is log- ically follows from this assumption that designing institutions or policies in order to achieve a policy goal (e.g. reduced climate vulnerability) cannot be meaningfully addressed before it absorbs governance- has been explained to young people. Emergence of Governance approaches, therefore, strive to understand the existing institutions, which is particularly addressing contextual factors give rise to a particular institu- tional arrangement in a given case. While these approaches can be further differentiated based on the subsequent decision node in Figure 2.2.5, under- standing and all I had to say was the emergence of the ins- tutions is a broad field, and these decision nodes only provide some high-level entry points (See section 3.6 for a discussion and examples).

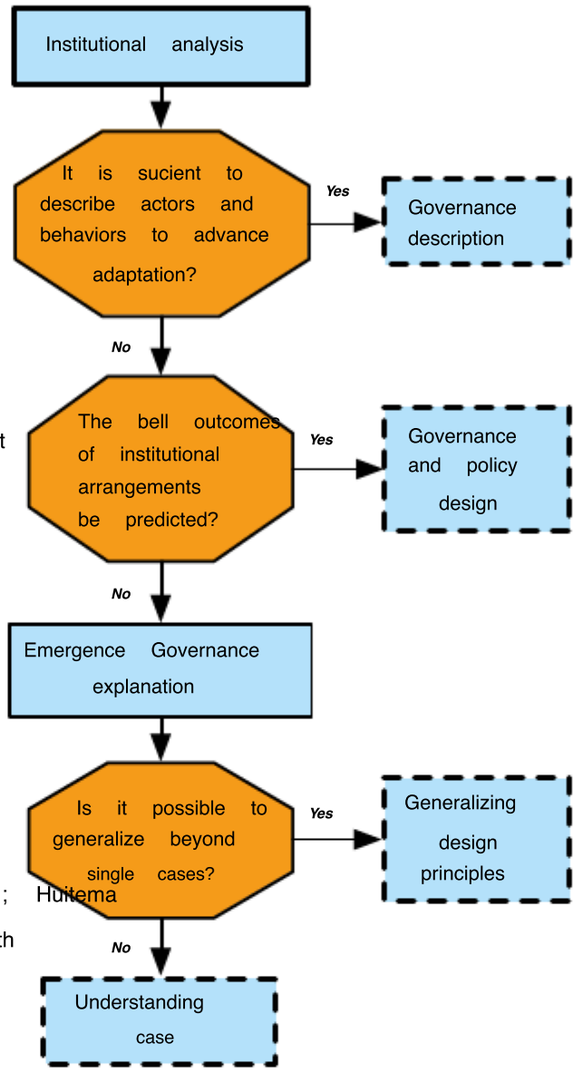


FIGURE 2.2.5 *Salient approaches for choosing institutional analysis.*

On the other hand, if the assumption is made that governance and policy outcomes can be predicted, then the task of governance (or policy) design may be addressed. Governance design approaches assume that it is possible to predict outcomes of institutional arrangements with some confidence, and on this basis they address the question of how to design effective policies and institutions. Adaptation concerns Because many different policy domains, policy design and adaptation of the task may be "mainstream" of the consideration cli- mate change risks into existing sectoral policies

(see Section 3.6). Mainstreaming approaches can be further differentiated on the basis of whether considered in a given climate policy already. If climate has not been considered, then the policy screening (e.g., portfolio screening) aimed at analy- sis of potential climate impacts threaten whether existing policies appropriate business (Klein et al. 2007). On the other hand, "climate-proofing" the business appropri- ate design policies to climate impacts which has been identified as a risk. This involves addressing risks related policy formulation for the early pro- cess to identify any obvious effects with up to ten other sec- tors, or objectives. Proofing policies of the practice is well-established other support such as health, and Rural Development (Urwin and Jordan 2008).

DECISION NODE: *Governance emergence explanation - a generalization be made*?

Governance approaches emergence within a dis- tinction is made between approaches assume that it is possible to generalize beyond a single case, and those that do not, such as anthropological and ethnographic approaches. Among the approaches assume that generalization is possible, several from new institutional economics have made sig- nificant contributions and extensive natural resource and water management literature (e.g. If 2005; Hagedorn et al. 2002; bougherar to et al. 2009). While the above-mentioned assump- tion limits the complexity of the generalizable conclu- sions from any particular study, which was about the ins- tutions, which lead to outcomes, the accumulation of evidence has led to some general conclusions about the characteristics of social-ecological systems that can be related to desirable outcomes. A descrip- tion of these methods, with examples, is provided in Section 3.6. ■

2.3 Appraising adaptation options

Entry point

Adaptation situation:

- Adaptation to a specific problem or decision has been identified.
- A set of adaptation options has been identified.

This is what you want to do

- You want to appraise the options and choose the best one.

2.3.1 *Overview*

Entering the learning cycle adaptation at this stage at the moment that requires adaptation issues and options for addressing it have been identified. Now, the task is to appraise the work of those options. There is a wealth of methods that can be applied toward this end, from the fields of organizational learning, Decision Analysis, Policy Analysis, and institutional and behavioural analysis. This section guides the reader though selecting the appropriate moment approach.

The crucial methodological choice faced at this stage of the business, whether to apply a formal approach, a deliberative/participatory approach (Renn 2008), a combination of both, or none - and the universe is a decision based on intuition (Figure 2.3.1). Formal appraisal methods are based on formal decision- izing and then applying the decision mathemati- cal reasoning, which is next to options ***should*** be chosen. Examples of such methods are multi-cri- teria analysis, cost-benefit analysis or robust deci- sion-making. In contrast, deliberative approaches to appraise options by eliciting information from the actors involved and harmonizing their preferences. Intuitive decision-making relies on pre-cognitive pro- cesses through history that have been a great deal of experience and learning.

DECISION NODE: *What type of adaptation the situation at hand*?

The business decision whether to consider a first node adaptation situation, individual or collective collective adaptations are often character- ized by the various stakeholders involved having different preferences on the front outcomes, landed for a while- vidual adaptation of this, of course, not the case. Private individual adaptation situations, the actors need to decide whether to formalize the deci- sion-making process or to decide intuitively. A formal approach has many advantages, as research has found many persistent biases in individuals' decision-making, including the overest- mating the value of low-probability, high-impact events (Kahneman and lie and lie 1983; Weber & Hilton, 1990), rebels lair strong potential losses (Kahneman and lie and lie 1979), and dental problems- counting future events (Laibson 1997; Frederick et al. 2002; Karp, 2005). On the other hand, research in psychology has shown that people's informal decision-making may be remarkably effective, and in the presence of ***highly limited or ambiguous information*** consistently lead to even better results than formal methods (Gigerenzer 2000). This is par- ticularly true in Settings peculiar to the moment where the individual had ***extensive experience*** similar decisions, and provides the decision ***immediate feedback*** and thus the moment of opportunity for learning (Kahneman et al. 1982).

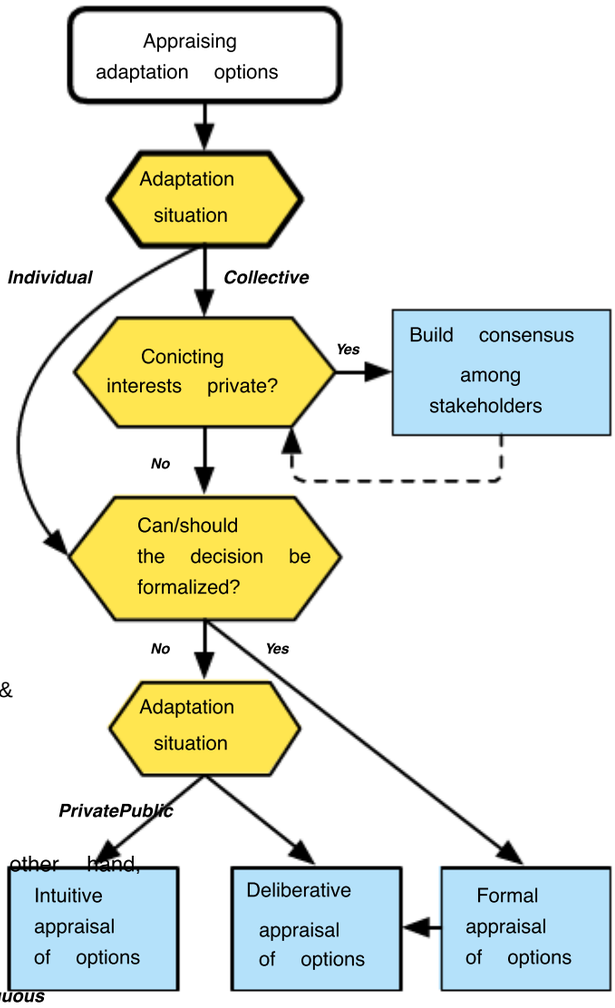


FIGURE 2.3.1 *Decision tree for appraising adaptation options. Overview*

DECISION NODE: *There are conflicting private interests*?

For situations that involve several actors, the ana- lyst must consider whether these actors have ***con- flicting interests*** ten goals, decisions, and outcomes. The inability to agree upon these links to selecting a significant barrier to create slideshows adap- options (Moser and Ekstrom 2010). In such cases, deliberative or participatory approaches may be applied to build a consensus among stake- holders. These include methods for addressing col- laborative goal-setting and consensus-building. A citizen jury, for example, a business method for obtain- ing informed citizen input into policy decisions (Crosby, 1995). Citizen juries links strengthen the democratic process and at the same time contrib- ute to informed decision-making (Raadgever and Mostert 2010). In other settings, participatory rural appraisal (Chambers, 1994) may enable community development decisions to be made on the basis of a shared understanding harmonized and interests. These methods are discussed in Section 3.1.6.

DECISION NODE: *Can/should decisions to be formalized*?

First, preferences have been harmonized, the next consideration whether to apply the job, formal approaches to deliberative approaches, or both.

There are a number of criteria that are relevant here - but it is important to note that these are not definitive, and often both formal and deliberative methods may be equally relevant within a given adaptation decision.

In order to be suitable for formalization, a deci- sion must be well-defined. A decision well-de- fined and can be formalized under the following conditions:

- A decision among a set of options has been identified. Notably, the identification of this set work not addressed by decision-analytical methods. Outcomes of implementing
- options are known - that is, they have been computed using either of the methods for the risk assessment the present climate extreme event risks or resid- ual impact projection methods for future cli- mate (both slow onset and extreme-event). In the former case, the outcomes may be expressed probabilistically either (a of occurrence) or Del scenarios (p. of occurrence). The latter case,the outcomes may only be represented Carlo scenarios, probabilities cannot be associ- ated to different pathways of socio-economic development and the associated emissions, which drive climate change and its impacts.
- Outcomes are characterized by one or sev- eral attributes (also called metrics, criteria, values), at least one attribute describes where the costs of planning and implementing an option.

A baseline, which is a "do nothing" option against the values of the attributes, which can be estab- lished. A formal decision-making methods are often prescribed by the policy or legal context. Table 2.3.1 summarizes additional criteria to con- sider in choosing whether to apply a formal deci- sion-making method, related to the feasibility and cost by formalising decision. By formalising being able to translate a decision requires "real-world" complexity into the canonical form that rely on formal methods: one decision among a set of options with each option is characterized by a set of attributes (also called metrics, criteria, values). Describe the attributes of both the costs of implementing an option as well as the costs and benefits of implementing the outcomes of options. Note that decisions for ***well-defined*** and are ***interconnected*** other decisions that might be difficult to do, or ***costs of information-gathering and -processing*** might be prohibitively high. It may is then appropriate to make individual decisions informally on the basis of intuition.

TABLE 2.3.1 *Criteria for selecting relevant or formal informal methods for appraising options.*

Empirical criteria	*Formal appraisal*	*Intuitivel deliberative app*
Which is created by ten options outcomes and	Low	High
baselines) Interconnectedness of decisions,	Low	High
information gathering and processing	Low	High
costs , the importance of money in decision	High	Low
similar Experience of ten decisions with immediate feedback.	Low	High

2.3.2 informal approaches for choosing (intuitive or deliberative) appraisal of options

Entry point

Adaptation situation:

- Adaptation to a specific problem or decision has been identified.
- A set of adaptation options has been identified.
- It has been determined that the decision which option to pursue and should not be formalized.

This is what you want to do:

- Adaptation option in your local time using the informal goods (deliberative or intuitive) methods.

Only a limited set of adaptation decisions can be formalized due to, among other factors, the intensive putting in the time, resource and capacity requirements of a formal decision-making methods. Further, for many decisions, informal appraisal decision may be preferable - and, as discussed above, may lead to better results than formal methods.

For individual decisions, there is good evidence that when business information Limited or ambiguous, some informal patterns that consistently lead to better decisions than the attempt to apply more formal methods (Gigerenzer 2000). When individual decisions are complex, and the costs of information-gathering and processing become prohibitively high, it may be appropriate to make individual decisions informally on the basis of heuristics. Heuristics and informal individual decision-making in general, are most effective in settings where the moment an individual has had extensive experience with similar decisions, and the decision provides immediate feedback, and thus learning opportunity for the moment.

For collective decision appraisal, informal methods may take more deliberative form. For example, consensus-based decision-making involves discussing the options within the group to familiarize everyone with the issues and build a shared understanding and shared a sense of control over the decision - which, in turn, can lead to more effective adaptation (Wallerstein Mink and 2010). In-person interaction is also valuable because the body language, for example, now you can play the important role of communication and help produce better outcomes (Kahneman et al. 1982). Sections 3.1.3 and 3.9.3 describe a variety of methods for collaborative goal-setting, which cannot be addressed by formal methods.

2.3.3 formal approaches for choosing options appraisal

Entry point

Adaptation situation:

- A specific adaptation decision has been identified.
- A set of adaptation options has been identified.
- It has been determined that the decision which option to pursue should be formalized.

This is what you want to do:

- Adaptation option using your local time a formal method.

There are multiple formal methods for appraising adaptation options; Figure 2.3.2 presents a decision tree to help guide the choice of such a method of adaptation for the given situations. The factors relevants that are characteristics of the decision tree for this set of adaptation options available and the type of knowledge available on the hazard, impacts and outcomes of the options.

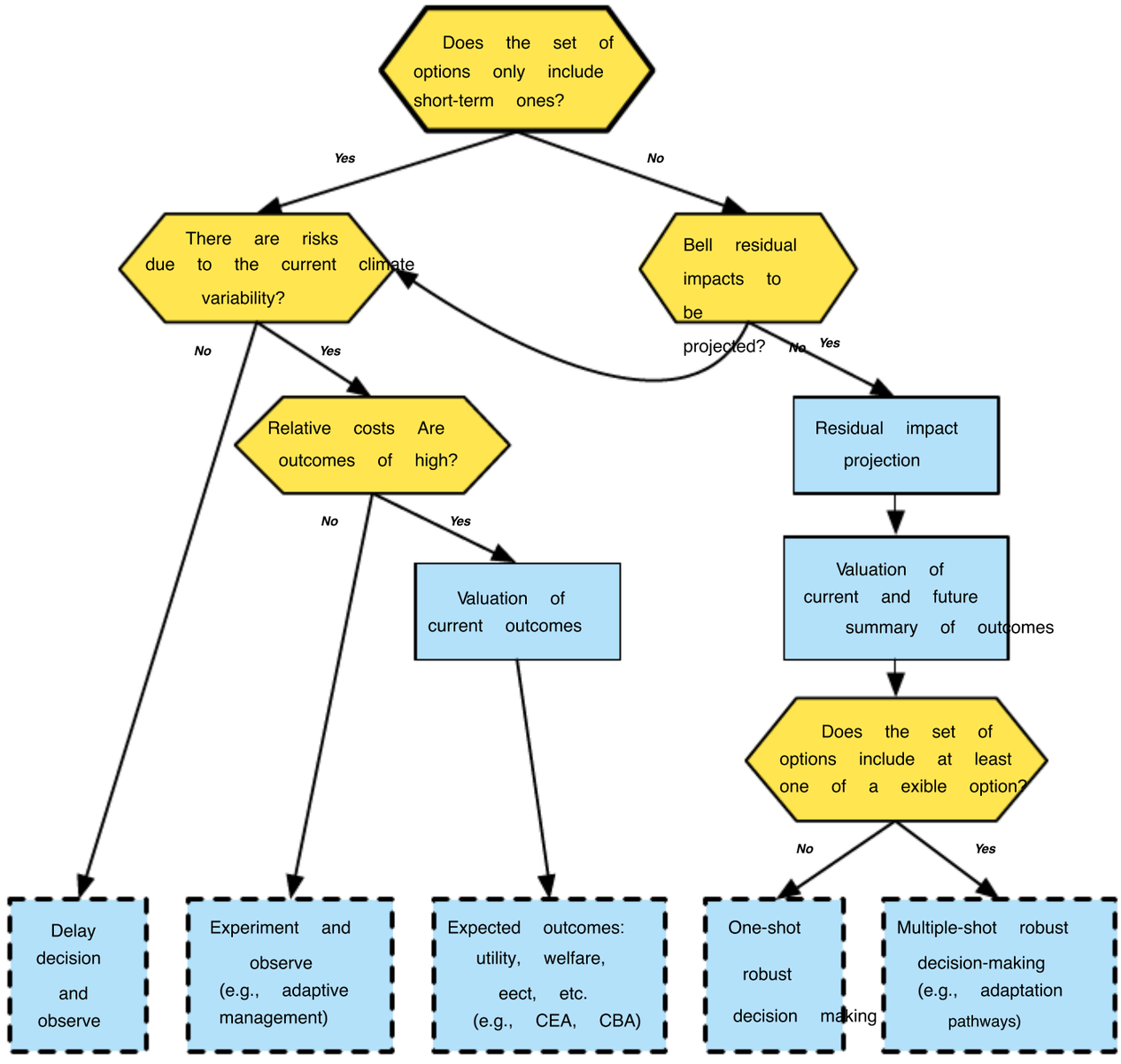


FIGURE 2.3.2 *Approaches for choosing a formal appraisal of options. Note that this type of CBA cost-benefit analysis CEA cost-effectiveness analysis. These are described further in Section 3.7.*

Decision tree business ace this complex, the three most important decision nodes are discussed together at the beginning of this section. These three nodes , determine whether the decisions are short-term, long- term or should be postponed. The decision nodes for identifying critical tasks and methods are then described in more detail below. 2.3.2 Table provides some examples of the paths through the decision tree. The different methods are presented and discussed in more detail in Section 3.7.

Short-term or long-term decisions or delaying decisions

The applicability of a formal decision-making approaches depends on whether a decision to be based on the current or future situation. The following three decision nodes are relevant for deciding this, as represented in Figure 2.3.2:

1. ***Does the set of options only include short-term ones?*** A ***short-term*** one option with a short lead time (the time from implementation effects) and a short lifetime (How long the measures are effective. For example, dike building a business is a long- term option, while planting drought-resistant crop variety has a short-term option.

2. ***Be projected residual impacts Bell?*** This requires the availability of credible impact models that consider adaptation, which is generally not only the case for some support.

3. ***Are risks (and opportunities) are currently present due to climate extremes and variability?*** Such risks may be related to extreme events such as storms, floods or heat waves, or longer-th- riod, such as climate variability, decade-scale El Niño-Southern Oscillation (ENSO).

Figure 2.3.2 presents a decision tree combining the characteristics of these three decisions. The deci- sion tree that shows some decisions it is best to postpone and observe for others, it is best to apply a decision-making method, only the current risks, and the decisions of the third class, it is best to decide based on the long-term future risks as well.

Figure 2.3.2 shows that adaptation decisions in the future when the situation should consider long- term options are also involved (1) and residual impacts can be projected for these (2). It is not the case that both of these or not and then deciding based on the current situation in a sufficient way. Take, for example, a farmer facing drought impacts (cur- rent variability) with a decision Ten changing crop types to more drought-resistant strains (short- term options); she should decide based on the current variability. If long-term options are also involved (1), but cannot be projected residual impacts (2) due to the impact of the unavailability models, then deci- sions Bell, similarly, only be based on the current situation. If there are no current risks (3), then the decision can be delayed. Below each decision node the job described in more detail.

*DEC I SIO N ODE:Does the set of options include only short-term ones***?**

Long-term options need to be evaluated in the context of how conditions may change in the future, and thus require more sophisticated levels of analysis, including projecting future impacts. Short-term options, on the other hand, can be evaluated in the current context of business risk if the imme- diate, or else the decision could be delayed to see how conditions change.

For example, consider a farmer facing increas- ing drought risk. If adaptation is the only available options are switching to more drought-resistant crop varieties, or adding more organic material the soil, the choices would be to be all short-term, as the planting has to be done every year. Then the ques- tion becomes: Does she need to adapt right away, because of droughts are already a problem, or she can wait to see what happens in a few years? In con- the COL, the moment another option would be to install if irriga- tion system - a long-term investment with the potential long-term benefits - the farmer would want to con- sider future conditions before making a decision.

DEC I SIO N ODE:There are risks **(***e.g. opportuni- ties due to current climate variability***?**

As noted in the example above, if the adaptation options are being considered all short-term, the next decision involves determining whether the node also exist risks to be addressed in the short term, or are only expected in the future. (There may also be opportunities due to climate change, which can be evaluated in the same way.) If risks exist in the short term, the decision can be based on current conditions.

Only if future risks are being considered and all options are short-term, then the best course of action may be to postpone the decision and finished

observe. This business because there would be no benefit to implementing short-term options right away, and the risks are likely to be better understood in the future. A "wait and observe" approach might also best for longer-term options if impacts cannot be reliably projected. Then again, uncertainty is too high to justify the action right away, since the risks are likely to be better understood in the future.

DEC I SIO N ODE:What are the relative costs of the options?

Deciding when based on the current situation only, the next decision involves the node ***costs of an option*** (including opportunity costs). If the costs are low, then it is possible to experiment - that is, to take adaptation action, the monitor outcome, and make adjustments as needed. The

TABLE 2 . 3 . 2 *Selecting the appropriate moment decision-making method.*

There are risks due to current climate variability?	*Given a scenario, does the set the only outcome include short term/ flexible options?*	*the options of a given option will be calculated?*	*the bell Relative costs of options*	*Example*	*Next task indicated*
Yes	Yes	-	High	Subsistence agriculture threat- by Dole for collaboration; options include switching to more drought-resistant varieties threatened by Agricultural	Cost-benefit analysis, cost effectiveness analysis, Multi-Criteria Analysis
Yes	Yes	-	Low	droughts; One option to manage the business demand through water market credits Forestry	Adaptive management
Yes	No	-	High	work is threatened by forest fires; options include emergency response measures or planting different tree species; a threat to coasts- collaboration by sea-level rise and storm surges; options include to protect the Coast, retreat, or spread the risk (through insurance) a household business is	Robust decision-making pre-current and future summary of outcomes
Yes	No	No	-	threatened by river flooding	Cost-benefit analysis, cost-effectiveness analysis or Multi-Criteria Analysis of pre - current outcomes
No	No	Yes		Business threatened species Biodiversity as habitats shift and business migration is impaired by a lack of corridors; options include maintaining hab- itat corridors, agri-environmental schemes,	of Robust decision-making pre - future options; flexibility should be included in the analysis.
No	No	Yes	High	creating a national park threatened by Dole Agriculture business; the option being considered to improve irrigation; ski-lift opera- tors are threatened by decreasing snowfall; options include artificial snow-making, building, summer, tourism, giving up	Robust decision-making pre-current and future summary of outcomes
No	No	No	Note known	or coastal fisheries affected by the migra- tion of fish stocks	Ace the direction of the trend of the risks is not clear, additional adaptation may note action is required

the above-mentioned farmer might try a few different new kinds of seeds, for example, or several new soil moisture conservation techniques, until she finds the ones that work best for every needs. This business what is called adaptive management (Holling 1978; Walters 1986), an approach that has been extensively used in ecosystem management (e.g. Walters 1997).

If an option of the relative costs are high and experimentation less desirable. Instead, it would be useful to evaluate adaptation options upfront, before implementing one of the following standard approaches for decision-making under uncertainty, such as cost-benefit analysis or cost-effectiveness analysis. (Cost-benefit analysis, as its name suggests, weighs the costs of implementing a measure against its expected benefits. Cost- effectiveness analysis starts from the premise that action - for example, by addressing the risk of a dole - desirable, and looks for the most cost-effective, or lowest-cost way to achieve the desired goal.) For these formal decision-making methods for having probabilistic crucial information about the business risks to calculating the expected outcomes. See Section 3.7 for a discussion of these methods.

DECISION NODE: Given a scenario, residual Bell impacts be computed?

As noted above, when the adaptation options being considered include at least one long-term option, it becomes important to consider future conditions. In those contexts, relevant to the next decision node whether it concerns reliable impact studies or models are available to calculate the residual impacts of climate change after imple- menting a minute adaptation option.

Residual impacts can be computed If, scenar-IO-based practitioners as a guide for future impacts (see Section 3.4) and valuation (see Section 3.8) can be carried out to calculate those impacts for each option under consideration.

Residual impacts cannot be computed If the task is dependent on whether to address the climate business risks are already present to be addressed, or whether they are only projected for the future. If the risks already exist, the decision can be made based on current conditions as described in the preceding section. Only if future risks are being addressed, the best course of action may be to postpone once again the decision and observe.

DECISION NODE: *Does the set of options include at least one flexible option*?

The farther into the future a climate risk lies, the greater the uncertainty involved, which makes it increasingly difficult to apply methods such as cost-benefit or cost-effectiveness analysis. Note that only the expected costs and benefits would have to be calculated for an ever-broader range of cli- mate scenarios, but also for different non-climate variables, such as development and policy choices (e.g. how a coastal area zoned, or whether it's a business built hydropower dam. And while it may be possible to quantify the probability that a current of extreme event risk, that's not really possible for long-term, multi-variable scenarios (Lempert and Schlesinger 2001; hallegat 2009).

Alternative methods have been developed to support decision-making in such situations, under deep uncertainty. Unlike cost-benefit or cost-effectiveness analyses, which aim to find the optimal solution within a fixed set of parameters (e.g. but 80% chance of a storm surge, which will cause X amount of damage), these approaches look for solutions that are robust (don't fail) under a variety of possible future scenarios. Thus, they are often referred to as "robust decision-making methods (e.g. Lempert and Schlesinger 2001; Lempert and Collins 2007), although a clear-cut terminology has not (yet) been established. These approaches may include participatory processes; here, however, we only discuss the formal appraisal stages methods.

Robust decision-making methods can appraise the robustness of the criterion using options alone, or both robustness and flexibility. An option business ***flexible*** it allows you to switch to other options that might be preferable in future business once more is known about the changing climate. For example, an aquifer under increasing water scarcity, an adap- in option through demand management of water pricing as a flexible option this option can abandoned Man greater storage capacity and infra- structure can be built at any point in the future. Building a reservoir would be a less flexible option is because it would require a large upfront investment costs that the reservoir would not go away if you didn't end up being needed.

The choice of which of the two approaches to use depends on whether the options of being and thus is considered a flexible one.

The options of None when the business flexible, then formal appraisal methods can focus on the criterion of ***robustness***, and a one-shot, robust decision-mak- ing appropriate work method. If an option robust business or a large share of it is effective over the full range of scenarios (Lempert and Schlesinger 2001; Lempert and Collins 2007). See Wilby and Dessai (2010) an application for Water Management in the UK and Lempert et al. (2012) for an application infrastructure investment decisions at the port of Los Angeles in the context of future sea-level rise.

Business option when the at least one flexible, the crite- rion of flexibility should also be considered, and decision-makers may want to favoring flexible options over non flexible ones, so they can better adjust to changing conditions in the future (hallegat 2009). The adaptation pathways method, for example, does so by characterizing options in terms of two attributes: i) adaptation turning points, which are points beyond which options are no longer effec- tief (Kwadijk et al. 2010), and II) what alternatives are available before a turning point has been reached (Haasnoot et al. 2012). Importantly, the exact time does not matter when business reached a turning point; it is rather the flexibility of having alternatives work options available. Prominent applications of this approach include the Thames Estuary 2100 Plan (Lowe et al. 2009; Penning-Rowsell et al. 2013), the Dutch Delta Programme (Kabat et al. 2009) and the work of New York City the front panel on climate change (Rosenzweig et al. 2011).

Table 2.3.2 supplements the analysis provided in the decision tree in Figure 2.3.2 by presenting these characteristics and their indication on the through several examples critical task. Formal deci- sion-making methods and examples described in Section 3.7. ■

CASE STUDY ***Costs of sea-level rise adaptation options under three Boston***

The business of appraising adaptation options another way to look at projected costs based on the difference in pre-adaptation of various scenarios. Climate's long term impacts pre-Metro Boston (CLIMB) a multi-sector assessment of how climate change will affect key socio-economic activities are based on preliminary estimates of the costs of potential impacts.

The three adaptation options are:

- "Ride it out" - adaptive assumes that no steps will be taken to reduce the impacts of climate change, and that facilities or systems damaged by climate change, are abandoned or rebuilt in a similar configuration. This is the world's most expensive
- scenario. "Build your way out" - limited assumes that structural measures are taken to reduce climate-related damages: reinforcing sea-walls, for example, or for home use water-sharing from different jurisdictions to deal with water shortages.
- "Green" - assumes a proactive implementation of innovative policies and technologies to prepare for and counteract the adverse climate impacts. These might include flood-proofing to reduce damage from sea-level rise, more intense storms, as well as other measures such as tree-planting and high-albedo roofs to reduce the unsustainable demand for energy on the front and on hot days.

The climb to the report, the approach was fully developed for coastal flooding, a major hazard for coastal Boston. The table below summarizes the findings. S in terms of appraising adaptoptions in your build this table shows that on the way out of the world's most cost-effective, followed by Green, with ride it out, resulting in the greatest level of costs under both climate scenarios.

Climate Event	*Scenario*	*Residential Costs **	*Commercial / Industrial Costs*	*Emergency Response Costs*	*Adaptation Costs*	*Total*
Moderate sea-level rise of One event (flood)	"Ride It Out"	3,563	13,525	2,905	0	19,993
	"Out Of Your Way To Build"	1,091	3,984	863	3,462	9,400
	"Green"	756	2,697	587	1,766	5,806
One meter sea-level rise three events	"Ride It Out"	16,140	64,250	13,666	0	94,056
	"Out Of Your Way To Build"	1,820	6,703	1,449	3,462	13,434
	"Green"	3,272	12,760	2,726	6,798	25,556

Source: Kirshen et al. (2008). All costs are in millions of dollars.

2.4 planning and implementing adaptation

Entry Point

Adaptation situation:

- Adaptation to a specific problem or decision has been identified.
- Adaptation options have been identified and appraised, and an option has been chosen.

This is what you want to do:

Design a plan of action to address the problem and implement the adaptation chosen option, and to monitor and evaluate the effectiveness of that option in reducing climate risks.

2.4.1 *getting started*

This section focuses on the fourth stage of the adaptation cycle. First, climate impacts and vulnerabilities have been assessed (Section 2.1), and adaptation measures to address them have been identified (see Section 2.2) and evaluated to choose the best option (Section 2.3), the next step is to work out a plan to make the chosen measures to implement - and then do it. This is a complex and challeng- ing process, and very often, the analytical work work is not translated into concrete plans and actions (see Moser and Ekstrom 2010; Preston and Stafford- Smith, 2009; Burton 2002). Key constraints that can arise at this stage include:

- motivation and lack of common purpose;
- desired that concerns the adaptation measures are not actually feasible; and
- lack of clarity around objectives or agreement ten priorities.

The implementation of adaptation measures can also be hindered by a lack of accountability or responsibility on the part of the relevant actors; cognitive biases, conflicting priorities or lack of will and lack of social and political acceptance.

Recognizing these common obstacles, this section focuses on not only the technical tasks of the planning and implementing adaptation measures, but also the work needed to support those efforts after: communication, consensus-building, integration with non-climate initiatives (especially in development), and capacity-building for key actors and institutions to ensure that they can successfully implement the plan, and adaptation. In this context, it is important to note that given the wide variety of situations in which adaptation takes place, there is no fail-safe "correct" formula for the moment of designing for adaptation implementation plan; the accompanying checklists provide guidance on how to sort through the different issues that may arise.

One important thing to remember is that often it is not the only reason for the change, adaptation, and adaptation measures are implemented as part of other initiatives. In many cases, it may be hard to differentiate those from adaptation actions focused on preliminary development goals such as improving livelihoods, especially at the local level. For exam- ple, upgrading water supply system in a coastal community, which currently has no access to fresh water could provide both adaptation and develop- ment benefits. Given the extent to which vulner- ability to climate change business driven by socio-eco- need factors (see Section 2.1), it stands to reason that activities that contribute to community resil- ience (improving human health and well-being, economic conditions, education, and societies) would also build adaptive capacity.

Much of the existing guidance on adaptation planning primarily focuses on pre-methods and tools, but especially in projects where the aim is to get a job, stakeholde engagement, ownership and outcomes that build capacity to deal with climate change, agreeing designing the underlying principles and an open front

business process and inclusive as important as choosing specific tools. In this part of the guidance to address both issues. The underlying motivations for the work that emerged from the scoping phases of the adaptation process should be revisited at this stage to bring new people in and the front will how well they have been addressed in the option identification and appraisal stage. This is also the moment of the opportunity to think about what might consid- considered as "success" in terms of implementation, by clarifying and developing shared principles and objec- tives. This will help in designing the details of the process, what types of tools should be used, and how the links work most effectively be monitored and evaluated (see Section 2.5).

Figure 2.4.1 shows the various questions that should be considered when planning and imple- menting adaptation, considering, in the first instance, what it's going to be implemented and how much agreement there is about it. The figure provides guidance on tools which can be used be applied to answer each question. The tools are explained in further detail in the related sections in Chapter 3, as indicated below.

The couple has been reached to date adaptation processes implementing, monitoring and evaluating stages (Moser and Ekstrom 2010), mainly because of climate adaptation as a concern has emerged relatively recently, and partly due to the difficulty in over- coming barriers of the previous stages. However, Moser and Ekstrom (2010) write:

> Option selection from moving to the imple- mentation also influenced work in import- ant ways by the governance and the larger social context, through part of its impact on the actor's perception, freedom, and capacity to do so, in part through its impact on the available resources, authorization, permits, political climate, or social norms. (p. 4)

As shown in Figure 2.4.1, in order to implement this plan effectively and efficiently adaptation of the moment, it is important to reflect the intent of the ten issues, feasibility, purpose, principles, clarity of priorities and objec- tives. The implementer of the past practices and the degree to which will be the concern of the system can be changed and also barriers. Some options are inherently more likely to be accepted than others; these include the options that are perceived to be flex- ible and even reversible, and the so-called "no-regrets" options - even if those benefits that will lead to climate impacts are not as expected.

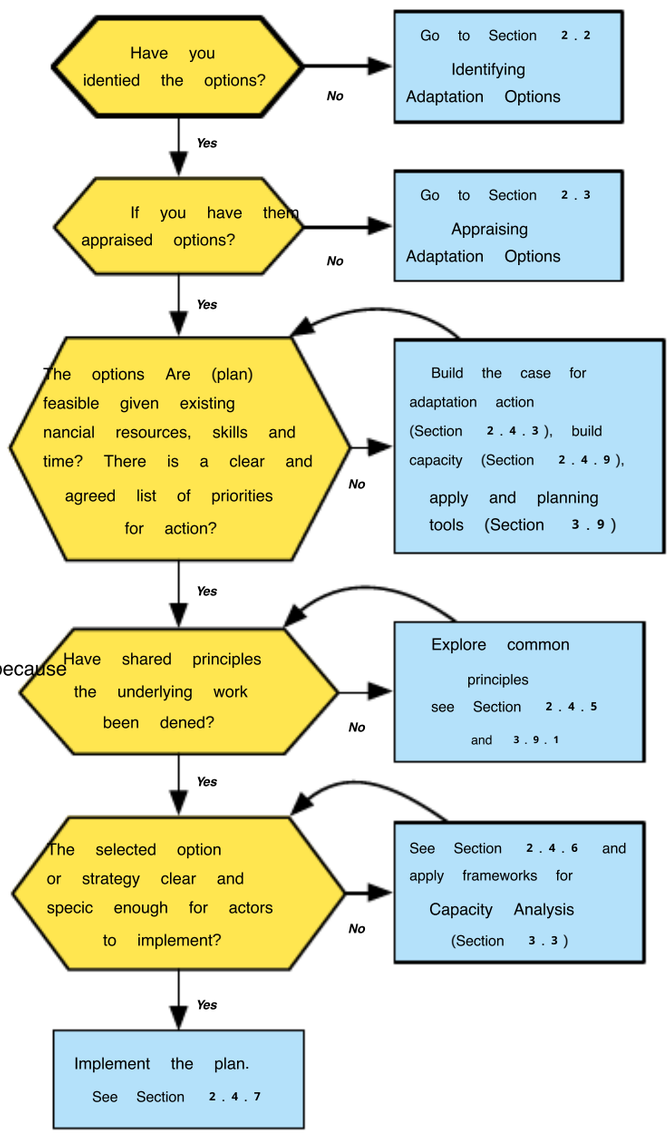


FIGURE 2.4.1 *Agreement on what is decision tree for implemented to be in business with respect to motivation, feasibility and priorities.*

Further, it can be difficult to accurately assess what constitutes a "successful" outcome if there is no agreement on pre-appropriate indicators of progress or success, or if the relevant data, methods and expertise are missing. Lack of agreement on A landed-cators may be particularly problematic for the Management - an approach in which adaptation measures are adjusted as new information or look for trends to emerge. Thus, it is important to establish a consensus upfront in advance what is to be achieved, what is to be measured in terms of progress (see Sections 2.5.5 and 3.10), and what is adaptation to changing business shall be deemed "successful" (See also Section 2.5 front moni- toring and evaluation).

2.4.2 *stakeholder engagement*

It should be emphasized, As in Section 1, stakeholder engage- ment essential business throughout the adaptation pro- cess. At this stage, we are concerned with reaching agreement on objectives, interests and Accountability Act for the implementation of adap- in plan. Well-facilitated stakeholder engage- ment can encourage creativity and new thinking, build trust and cooperation, and gather crucial feedback to ensure that the adaptation activities on the ground of the Chosen make sense. Engagement of stakeholders in the moment of creating adaptation plan - and well before that, when identifying and assessing options (Sections 2.2 and 2.3) - means the plan is much likelier to be accepted, especially if the stakeholders are also willing to become advocates or Champions of the plan. By giving stakeholders a chance to explore the current gap between real- ity and shared a vision for the future, participatory processes also encourage shared responsibility for implementation.
Participatory tools aim to build a strong sense of ownership and commitment to the resulting plan, and stakeholders, and can also help resolve issues that had previously been difficult to address.

In designing participatory processes, it is important to define the scope of the issues at stakeholders will be addressing. Stakeholder engagement approaches can vary from fairly passive interactions, where the stakeholders are simply pro- vide information to the "self-mobilization", where the stakeholders themselves and initiate the design process. They must understand how Stakeholders are involved, how the information they provide will be used, and what opportunities they have to influence decisions. When designing the engagement, it is valuable to take into account the stage at which the engagement is occurring in terms of the policy-making process what God has already occurred, and what positions are already fixed. It may be that a particular engagement activity, though not very participatory in itself, is not effective or satisfactory for the participants because the scope is too constrained and there is no opportunity for developing creative solutions.

2.4.2.1 *facilitation and conflict resolution*

Good links to add the facilitation significantly effectiveness of the process, the quality of engagement and learning that takes place and how much ownership over the outcomes the business developed. Well- facilitated processes that build capacity stake- holders, and the communities where the work is taking place of business, enabling them to respond effec- tively to change in the future. Poor facilitation, meanwhile, can lead to inadequate connections with communities and stakeholders and the larger the groups involved, potentially leading to anger and mistrust and damaging the potential for future col- laboration. Any adaptation effect and the legacy of intervention likely to be limited and work short-term if people feel they have not been treated well in the process or that their voices have not been heard. See Section 3.1 for facilitation tools and a more in-depth discussion of these issues.

Facilitation can improve teamwork and also by improv- ing communication among team members, which, in turn, improves the quality and creativity of the work. Benson (2001) writes that a good team drivers- mance results from the interplay of three sets of needs and behaviours need to work on all that well. Inquire about Bell Facilitators to support each area of functioning team:

- Helping the group achieve the task. Here questions might be: How are we getting on with the mission? What is going well? What blocks are there? What strategies do we have to overcome
- them? Individuals within the team. Questions here might be: where do I fit in this? Are my needs being met? Am I being stretched? Am I learning? The
- maintenance team as a whole. Here questions might be: how did the team commu- nicating? What is going well and what could improve?

Good teamwork in business all important projects, of course, but supporting these three aspects of effective teams can be particularly useful when working in adaptation, where the challenge may seem daunting, and some aspects of the work may seem unclear.

Finally, conflict resolution tools can be used by facilitators presented work how to reframe an issue, create opportunities for dialogue, and encourage engagement in the dispute, even where the actors are. Issues of power, access to resources and control over the process can hinder trust-building and effective learning, and instead reproduce (or even reinforce previously held unhelpful perceptions of other actors. In such situations, people can feel that there is no point in engaging. Conflict reso- lution tools can help address all sides of such issues openly by investing in building relationships and breaking down preconceptions. This highlights the need for Speed "co-production" of knowledge through collaborative learning approaches.

Conflict resolution tools For guidance, see Section 3.1.7. For guidance on large-group and whole-system techniques, see Section 3.1.6.

2.4.2.2 *Incorporating stakeholder input*

Participatory processes do not end when the con- versation is over. Stakeholders may provide a great deal of input - form, perhaps in a very unstructured - and how that input is processed and the job incorpo- rated into the adaptation plan may greatly affect the outcome. The front Reflection material generated through a participatory process allows for patterns to be identified and prioritized issues. The people who undertake the analysis have a great deal of influence over outcomes from a process, including any recommendations made. If they process the material remotely, with no further contact with the stakeholders who provided it easy Misu the- derstand suggestive. A community map, note that you may make much sense to someone who does not know the local area or local words and symbols used. Now outsider trying to make sense of it thus may miss important aspects and make wrong judgements about what is important to local business people.

Undertaking the process of reflection and analy- sis generated with it with those who stakehold- ers (e.g., within a community), not only consider- ably increases the quality of data, ideas, and solutions that come out of the process, but also to those who participated on the LAN to gain confidence in their ability to represent their views to others. By delving deeper into the causes of the problems and understanding more about why these issues are important and the reasons behind them it becomes possible to identify realistic and relevant solutions. For more information on the front participatory analysis tools, see Section 3.1.5.

2.4.3 Building the case for adaptation action

The extent to which stakeholders have been engaged in the adaptation process, in so far, there should be a collective understanding of why adaptation work needed, and why a particular approach should be taken. However, note that everyone who might play a role in adaptation will have been involved in the process. At this stage, it is important to make the case for adaptation action to others who are vital to the process at the operational level, e.g., those who control budgets or talk to them in the maiden's songs engage with the work (or not obstruct it) and pro- vide the needed resources. This is relevant both at a local and national level.

Persuasive messages have to be:

- Clearly explain the climate risks to be addressed and supported by evidence
- how likely they are to affect the situation of interest. Explain why
- a particular adaptation option or set of measures was chosen, and how they complement other initiatives. If
- relevant, highlight the benefits of taking action rather than responding as early impacts become visible. Where
- relevant, links to draw and make ten past experience of existing weather-related changes in the situation given.

Further useful guidance on building a case for adaptation can be found in ukcip's adaptation Wizard (UKCIP n.d.) as well as in the resources Section 3.1.3.

A number of authors (Burton, 2002; Preston and Stafford-Smith, 2009) refer to "adaptation bottleneck" which happens when decision-makers have reached a high level of awareness of climate change in the general sense, understand, and case adaptation, but have not yet translated into strategy and operations. This is where it it becomes important to create opportunities to show how adaptation can be grounded in the work at hand, focusing front real decisions that are being made. This involves decisions not only about climate change, but also about major investments and policy decisions with long-term implications and the potential for maladaptation.

2.4.4 Acknowledging what makes 'usable' information

In adaptation, not that often challenge the business cli- mate information is missing, but that there are no opportunities to ground such information and make it meaningful for the particular situation, a C. In fact "information overload" may be more of a problem, and there is a need for ways to filter what is available and facilitate the transfer of information into knowledge. This could be better through boundary organizations or "infomediaries" who can translate the raw data or general information and make it accessible and relevant to different groups. This can be done by creating a "headline messages", for example, explain that in terms of climatic tren relevant to the particular group: "***A rise in extreme precipitation will bring more landslides and Road collapses, greatly increasing road maintenance costs.***" Boundary organizations can also provide safe spaces to explore the implications of informa- tion and share experiences.

Haas (2004) discusses what makes up the "usable knowledge" in a policy context - in short, "accu- Rate Information that is of use to politicians and policy-makers" and identifies several criteria in literature and prominent research organizations' own definitions:

- Legitimacy: processes were designed to
  - reduce bias? Participants Do accept knowledge? Credibility:
- do participants believe that the infor- mation is true?

- Effectiveness: does it have the capacity to influence questions of concern? Adequacy:
- it does include all the relevant information and facts? It can be mobilized ade-
- quate political support for an agreement? Bell IT solutions that generate help
- solve the prob- lem and solutions that
- can be implemented? Salience: it timely and usable in our processes? Value:
- does it contribute to the understanding?

Notably - and consistent with the discussion above - Haas (2004) emphasizes that usable knowledge also needs to incorporate effective mechanisms for transmitting knowledge to the policy world, with an awareness of the different actors' roles in the context of social learning and policy-making.

2.4.5 *Defining the nature and scope of the work*

Adaptation to climate change can be framed in a number of fundamentally different ways, and this is how you will shape perceived basic framing the issue - the same which is why it is basic evidence can lead people to different conclusions on how to respond preliminary (Dow et al. 2013). This may be influenced by past experiences managing change, perceptions of and approaches to risk, what words to be moti- vating action, who else is involved in the business and how the work process has been simplified. O'brien et al. (2007) rear- power relations that play significant role in the planning process, and implicit ways of framing adaptation - e.g. as a technological problem, a vul- nerability problem or a learning process - "allow certain questions to be asked while the others get silenced". They also shape the resulting impleme- in plan.

In this context, the question "***Adapting what are we for?***"(the desired outcomes) business as unsettling, if not more, as the question "***What are we adapting to?***" (climate impacts and vulnerabilities that have been identified). For example, if a coastal area being protected from sea-level rise and storm surges job priority is to protect valuable proper- ties and commercial activity, or to protect ecosys- TEMS, getting - or are both seen as crucial? And there is a consensus about the desired outcome, or does it stop at Agreement, "the coast guard, but break down when it comes to specifics? Ace Brown et al. (2011) write: "a lack of clarity of the desired out- comes of the bell as much a barrier to present adap- about the nature of uncertainty in future climate hazards" (p. 11).

Thus sets the parameters for the scoping phase of The work and clarifies what it is intended to achieve. Finished this stage some of the most important decisions are made in adaptation planning, such as defining the key questions to be addressed, at which negotiating the boundaries of the work and the appropriate depth of analysis, considering who needs to be involved and in what ways, and reflecting ten potential solutions and approaches to achieve them. Evidence from practice suggests that often spent very little time for pre-scoping adap- work, over which is created by this may result in conflicts when the purpose of the work and differ- ent assumptions during the work surface.

Effective scoping requires methods that enable people are clear about their underlying values, needs and motivations, and trust requires skilled a facilitation, especially where resources are scarce or disputed. It is also important to under- stand the larger context of the work. Deciding what needs to be included in the work and what lies outside it has implications for who needs to be involved, what support they might need to fully participate, and what skills and resources are needed to provide such support. There are, of course, a need to be realistic about what business support is available and what can be achieved given limited resources. Some tools and examples that can help to scope the work are given in Section 3.9.2.

Developing guiding principles 2.4.5.1

A key task at this stage a treasure related to the business guiding principles for the process. For example, one such principle might be: "foreclose avoid actions that limit or restrict future adaptations or adaptive actions of others." No single set of principles can be defined adaptation for all situations, as they are necessarily context-specific and will change depending on the scale, scope and depth of the work level work hoping to attain. The process of articulating and agreeing ten guiding principles in business should be undertaken with key actors and the moment provides an opportunity to listen and discuss shared values and different experience, and Moti- vations for participating - a valuable grounding for the work. The principles can then be used to guide the design process, for example, how the stake- holders need to be brought in to the process what is the definition of a successful outcome might be and what the indicators might be used in monitor- ing and evaluation processes. For a more in-depth discussion of these issues, see Section 3.9.1.

2.4.6 *incremental or transformational change?*

In adapting, and different levels of engagement are possible. Pelling (2011) describes three visions of adaptation: resilience (maintaining the system's structure and functions in the face of climate impacts), transition (incremental social change and the exercising of existing rights) and transforma- tion (new rights claims and changes in political regimes). Adaptation, he argues, the bell focus too narrowly avoiding climate change impacts front without addressing the fundamental drivers of vulnerability. Section 2.1 discusses these issues at some length; here we will focus on the fact that even in choosing to address those drivers, there are further choices about the extent of the desired changes and the pace at which they should occur.

Similar distinctions are made in the literature ten resilience, learning and organizational change, with different possible levels of response depend- ing on the situation and the assumptions being questioned. Along with Pelling (2011), this section all the pre insights from Bateson (1972), Argyris and Schön (1978) and Senge et al. (2005) to explain the different levels of learning. This is crucial to under- standing processes in the transformation of individu- als, groups, organizations and systems.

2.4.6.1 *incremental change, or Pelling's 'resilient' adaptation*

This type of solving problems or improving skills in a "business-as-usual" mode, without examining - or challenging underlying beliefs and assumptions - for example, through a change of the technol- ogy used in the practice or management. Much work addresses only the front this incremental adaptation to change, or what Pelling (2011) calls the "resilience", seeking only changes existing practices that allow you to persist and functions and not challenging the status quo and addressing inequalities or power. Such changes may increase efficiency, but do not fun- damentally question the assumptions underlying the activity or purpose of the organization or the wider system. This may be fine for many situations, but it might lead to inadequate or unsustainable left- po. For example, the risks, addressing food insecurity among subsistence farmers by introducing them to drought-resistant crops might make them more resilient to dole, but will not change the fact that subsistence farmers are always one failed har- vest away from hunger, the need and opportunities to diversify their livelihoods and earn cash.

2.4.6.2 *Reframing, or Pelling's 'transitional' adaptation*

This level of change requires revising activities and questioning current perspectives or frames of ref- erence, and thus usually leads to ***doing something different*** or ***in a different way***. This level of adaptation can occur when people are more open to change

potential adaptation of the increasing scope from just "tweaking" technologies and management practices within existing processes, question- ing the adequacy of governance processes or structure themselves. This entails asking questions such as: what's going on here? What patterns can we see? How do our actions - and others, of those only affect the system? Transitional adaptation, accord- ing to Pelling (2011), focuses on the governance regime "through acts that seek to assert full rights , and interests to make changes, rather than the regime itself".

2.4.6.3 *'Transformational' adaptation*

This radically new things of doing business and working in a different way. Reflecting on the assumptions that make up the specific context of the poten- tial to create shifts in the way people within the regime and see the world. All existing patterns and systems may thus come into question, allowing a gradual or sudden changes to occur. Transformation can occur within the context of creating a shift in which the organization (or system) operates. Transformational adaptation responses fundamen- tally reassess the way a system operates, with the potential to reform the overarching regimes within which a particular system operates, challenging the status quo, cultural norms and the existing power struc- tures (Pelling 2011). Note that different definitions of what constitutes a "transformative" adaptation exist; this is explored further in Kates et al. (2012).

2.4.7 *Implementing the Adaptation plan*

The plan that you have designed before, there are several criteria to consider in order to further ensure the plan will be implemented and fast, efficient, effective and inclusive way. Many of these criteria relate to ***who*** you will implement different aspects of the plan.

It is also important to have a sense of the stages of an adaptation process, while ensuring at the same time plan flexible enough to work with the trash to the "messi- ness" and "surprise" as they arise. Business Adaptation is not a linear process, although it is often presented in the way for the sake of simplicity. In practice, adaptation occurs and unanticipated elements iteratively with the challenge that inevitably partial and inadequate framing. These provide opportunities to challenge assumptions about how change happens and learn from the unforeseen consequences of interventions (Moser and Ekstrom 2010).

A good adaptation of the collaborative business process is com- posed of cycles of learning, deepen and focus of the inquiry into what support the effective adap- in a given context. Seeing adaptation as a learning process allows us to note openness to knowing precisely what will emerge. Understanding will develop during the process, especially if oppor- tunities for reflecting and refocusing reassessing are built in. Much of the most useful learning and connections between individuals happens through informal processes "shadow spaces" (Pelling and high, 2005) that provide opportuni- ties for people to connect with their own peers, build and informal links and other organizations in order to learn from one another. For guidance tools for learning and reflection, see Section 3.11.

2.4.8 *the Embedding adaptation into the plan context*

As discussed in Section 2.3, the characteristics of climate change, in particular the long time scales, uncertainty, complexity, and potential for significant consequence, mean that it would be impossible to collect sufficient information with sufficient certainty to be able to make the "perfect" adaptation decisions. Furthermore, as circum- stances change (new information, new technol- ogies, etc.) what before seemed no optimal may be longer. Clearly, adaptation decisions need to be implemented within existing governance and leg- islative constraints, which will inevitably influence

responses which are considered to be feasible. Understanding as much as possible about the context of the wider landscape to a balance that allows this to be struck between ensuring that the actions within feet of those existing structures, and moment creating and enabling environment that is appropriate to support adaptation decision-making in the future. This complexity means a greater challenge to ensure that adap- in-one area does not increase the vulnerability of another, and that "windows of opportunity" and "win-win" opportunities are maximized.

There are several useful questions when you love to embed adaptation into the plan now existing working processes. It is important to understand the cross-sec- toral impacts, for example - will know how adaptation measures in support or vulnerability affecting other areas? See Sections 3.1.2, 3.1.3 and 3.1.5 tools that can help with these challenges. It is also crucial to understand how the plan fits with the adaptation of existing processes and identify possible "windows of opportunity" - for example, if there's a major over- haul of agricultural policy being done, that might be a good time to directly address climate change impacts on agriculture and embed local adaptation plan of measures. As well to the same potential "win-win" opportunities, such as the increasing use of passive cooling in buildings (an energy-saving way to hotter summers with the trash) or combining flood protection measures with new urban green space (city of Copenhagen, 2011).

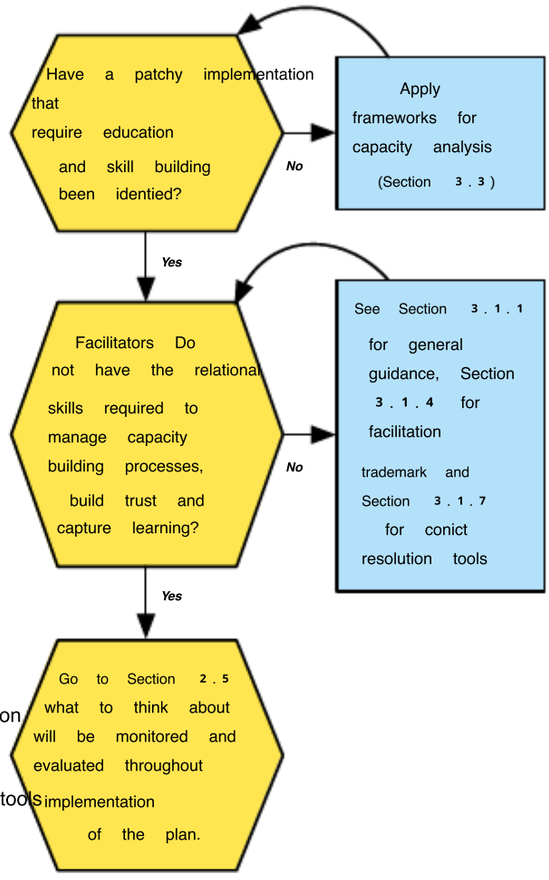


FIGURE 2.4.2 *Checklist for capacity-building for sustainable adaptation.*

because of their relative capacities of key actors to the roles of adaptation have not been assessed, that process needs to occur now; Figure 2.4.2 outlines key questions of love to such minute analysis.

2.4.9 *capacity building*

It was by no means a given that people and INS- tutions minute adaptation charged with implementing the plan will have the capacity to do so. Capacity gaps at the outset may have been identified during the Capacity Assessment (Section 2.1), or they may have become evident while appraising adaptation options (section 2.3) or developing an adaptation plan. At this point, before diving into the impleme- in is crucial to address those gaps. (If, for some

Capacity involves not only knowledge and skills, but having the necessary tools and resources, as well as the necessary institutional framework. The best-trained experts adaptation will accomplish little if any adaptation of their duties they must cram into the already full workload at the moment, or they lack crucial soft- ware, or money to buy supplies, or the support of their supervisors. Agencies competing with man- dates can bring one another to a standstill, and lack of enabling legislation or regulations can keep from being implemented adaptation measures. Thus, there is a broad range of capacity-building that may need to occur before the actual imple- mentation process. ■

2.5 monitoring and evaluation

Entry point

Adaptation situation:

- Adaptation actions are being or have been implemented.

This is what you want to do:

- Monitor the progress of actions, and ensure that they are proceeding as planned.
- Any Evaluate outputs and outcomes, and ongoing activities to improve the draw lessons to inform future efforts and after.

2.5.1 *Monitoring*

Adaptation can involve a significant investment of resources and effort, and as discussed in previous sections, it often planned amide with uncertainty , incomplete knowledge, and may require from subs- tial learning, capacity-building and institutional change. All this makes it crucial to monitor adaptation activities implemented as they are, and make adjustments as needed. Provisions for mon- itoring should be included in the Adaptation plan (see Section 2.4), but if they were Note, a monitoring plan should be developed as early as possible in the implementation process.

An adaptation of the Monitoring project may have a number of purposes, such as:

- To assess the progress of the achievement stated tasks;
- To determine whether the tasks are fulfilling the aims of the
- Adaptation initiative; to assess the functioning of the team and individuals within
- it; To examine the engagement of other people in the process; to
- gather stakeholders' perspectives of the nature of that engagement (both the process and content);
- Learning To understand how well-being cap- tured and brought into the process to inform next steps.

Regular, ongoing checking different aspects of the project if the project is important to keep the ten track and capture a surprise or unanticipated changes as they arise. Danny Burns, in his account of running death action research approaches, suggests asking the following questions at each new stage of a process (Burns, 2007):

- How is it going? That there are issues arising need our attention?
- Front track Are we still with our underlying (research) purposes? Do you
- need to alter our purposes? What
- new questions do we need to love?
- What we need to do is open up
- new inquiries? What do we need to
- collect new data? What do we need
- to take new action? What we need
- to do practices and methods to use
- at this stage? What outputs do we
- need feedback at this stage (if any)?

No sophisticated tools or methods are required to do this, although some of the visual tools described in sections 3.1.5 and 3.1.3.6 may help in drawing out more tacit knowledge sharing, understanding and prioritizing areas for further inquiry.

2.5.2 *Evaluation*

Monitoring and evaluation that goes beyond it now includes a value judgement on how adap- intervention in performing work based on the monitored criteria. Funding for ace, national, sec- toral, and project-based adaptation projects has increased, so has the need to understand what makes an effective adaptation actions, demonstrate value for money, protect investments, identify best practices, and judge which efforts are after suitable for scaling-up. Although initiatives that focus solely

the front are still relatively recent adaptation projects in which a component of adaptation have been in place for some time. In many cases, adaptation activities can be evaluated effectively by refining existing monitoring and evaluation (M&E) frame- works, rather than building a completely new frame- works. Lessons can also be drawn from the evaluations being done in other areas. Horton et al. (2003) suggest that six activities are essential in preparing for the moment for evaluation capacity development:

- Clarify why and for whom the evaluation work being done;
- Involve intended users throughout the eval-the ation process;
- Cultivate the necessary support for the evaluation; adequate
- resources are Mobilized to carry out the evaluation; the evaluation
- of the results and discuss
- possible; Agree the ten basic principles to guide evaluation.

However, adaptation initiatives may have features that make them more challenging to assess than usual for longer time horizons, such as business development projects; this means that different kinds of indicators, baselines and targets may need to be set up. In recent years, guidance for M&E specifically in the context of adaptation has begun to emerge. In late 2008, the World Resources Institute convened a technical workshop in Bellagio, Italy, to identify a shared set of critical adaptation func- po. This was motivated by the recognition of the need for shared approaches despite the huge range of ways in which climate impacts might affect different societies, and the equally wide range of adaptation strategies and measures that might need to be developed. The resulting Bellagio Framework (McGray et al. 2009) was pro- also to identify strengths and gaps in adaptation capacities in a given country, and prioritize actions to encourage investment, and serve as a reference point to assess progress pre-adaptation. This would require a set of metrics to determine the progress of how the adaptation of pre achieving performance functions was changing over time.

At a national level, in 2010, the UK Department for Environment, Food and Rural Affairs (Defra) published a proposed approach for measuring adaptation to climate change. As well as achieving maximum value for the money, this work was moti- vated by the recognition that climate change "will have the effect on our society of the moment is the most crucial areas - public health, energy supply, water supply, trans- port, etc. - [so] we need to be the action that we are taking to prepare to work having the desired effect" (DEFRA 2010, p. 3). The proposed approach recommends developing a set of indicators that could be used to provide a regular "snapshots" of the UK's progress after adaptation efforts and gauge the effectiveness of the actions taken so far.

Recent work describes the early lessons broad use of M&E specifically for adaptation (Spearman and McGray 2011):

- Defining adaptation success requires consid- which competes in the context of adaptation activities occur; the inputs
- of a diversity - including information and participants - contributes to successful adaptation M&E systems; Tracking assumptions an important compo- nent of M&E Systems for adaptation, in order to contend with the uncertainties associated with climate change.

The rest of this section goes some way to expanding these ten key lessons. Figure 2.5.1 provides a decision tree to help guide the process at the moment of designing the M&E plan for adaptation projects. As smuggled mentioned earlier, a number of barriers (Moser and Ekstrom 2010) may exist at this and the previous stages; some of these are captured by or decision trees within each entry point in this guidance.

2.5.3 *defining the purpose and principles the underlying evaluation*

Pre planning in the Early stages of an evaluation, it is important to clarify the reasons for undertaking the evaluation and ensure that all participants are in agreement. Lack of discussion about this can result in confusion when deciding what landedcators to collect, what kind of data are relevant, what methods and expertise are needed, and what could be better considered as "successful" able to adjust- tion. The two fundamental questions, "have we done the things, right?" (that is, the things we said We would do in the Adaptation Plan) and "were they the right things?" (how relevant were they? they will enable us less vulnerable to adapt or better?). A third question might be, "how should we measure these things?"

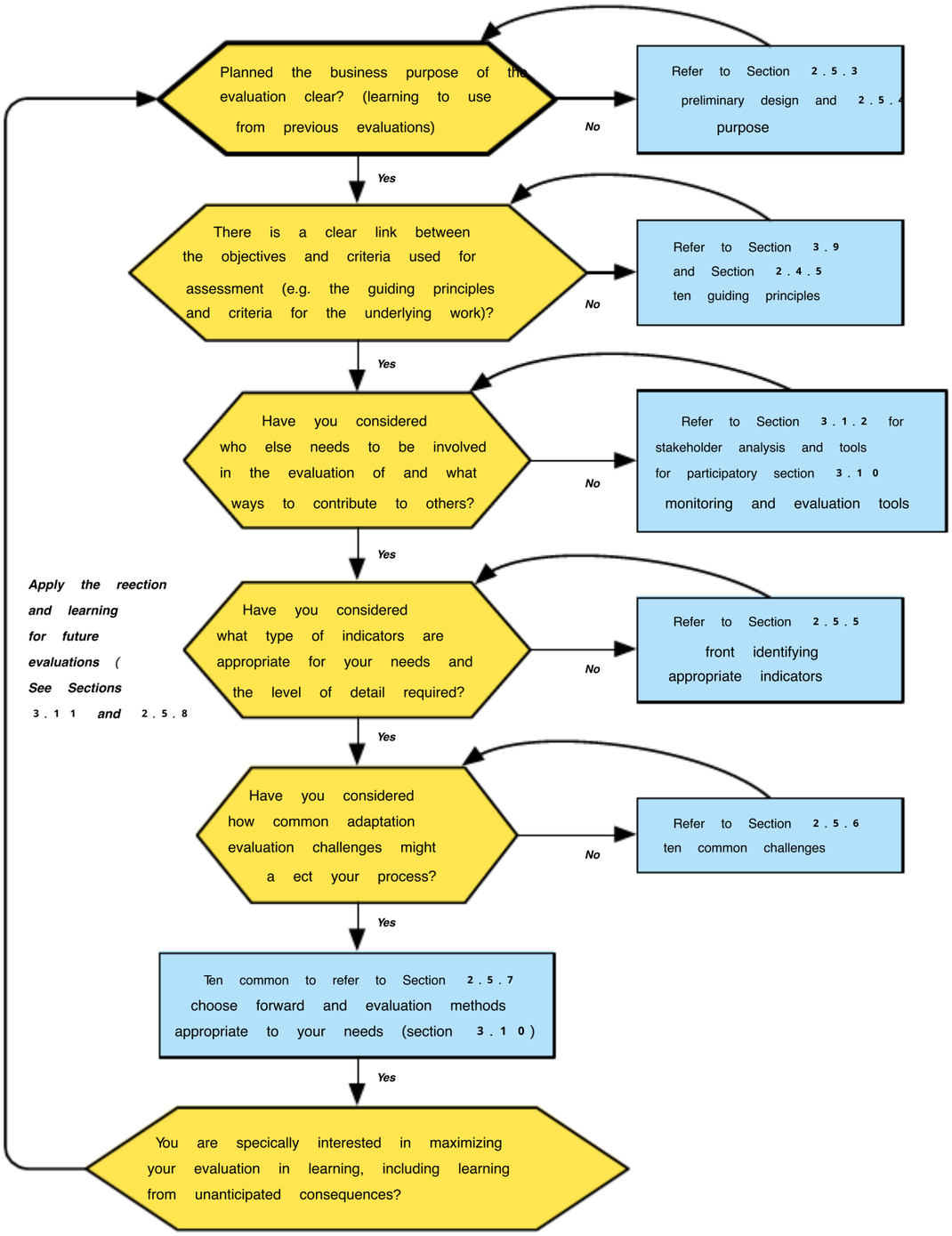


FIGURE 2.5.1 *Guidance for monitoring and evaluation of the process.*

Ideally, evaluations bring in a mixture of different types of information (scientific, political, legal, technical as well as local knowledge). It is useful to provide opportunities to compare these different perspectives - for example, through a science-policy dialogue. Essential Aspects for creating sustainable solutions may may not be adequately captured through indicators of local and scientific indicators could be used to provide a fuller picture. Having a wider understanding of the whole system can help in identifying leverage points for catalysing change; informing decision-making in the change process; facilitation strategies research informing teams, and supporting evidence-based policy-making.

2.5.3.1 *Reasons for evaluating adaptation projects*

Evaluation may now have more than one purpose, and it is important for everyone involved to understand the purposes of job evaluation, which now meant to be serve. ADAPTMe ukcip's Guidance (Pringle 2011) identifies the following possible purposes for M&E adaptation:

To evaluate the effectiveness: Evaluations are Often the moment used to determine whether the intervention has achieved its intended outputs and outcomes, which must be clearly stated at the start. Understanding the effectiveness particularly valuable in adaptation because we are still learning what are the most effective interventions, under what circumstances, and why. It is also important to consider whether the measures taken were truly needed and appropriate: for example, they could actually result in maladaptation?

To assess efficiency: Evaluators may want to determine the moment whether intervention was efficient in terms of costs, benefits and risks involved and timeliness of actions. This may require eco- need evaluation techniques where the costs and benefits are calculated in financial terms.

To understand equity: The impacts of climate change will be unevenly experienced, both spatially and temporally, and some affect individuals and communities more than others due to their differing vulnerability. Equity and justice are Thus important factors to consider when evaluating adaptation interventions. This may raise questions about the effects of the project on different social groups (distributional justice) and their ability to engage in (procedural justice) and benefit from the intervention; whether specific intervention targeted the "right" people; and whether certain groups are disproportionately exposed to risks bear additional costs or otherwise adversely affected by the intervention.

Accountability to provide: There may be a contractual or procedural requirement to undertake evaluation to ensure that commitments moment, expectations, and standards are met. This is especially true where the public money has been invested in adaptation, and evidence needed to work illustrate the achievements and challenges of the project. Accountability may overlap with efficacy and effi- immunodeficiency considerations - for example, to account for t investment at the moment in terms of its costs and benefits

To assess outcomes: Evaluation may now seek to provide the moment of understanding the outcomes and impacts of an intervention. This can be challenging, as it may not be always clear to what extent the outcomes are attributable to the intervention rather than to other factors. Adaptation projects, in particular, is a common challenge that has an outcomes may note be seen until long after the inter- 'vention is over. A project to introduce drought-resistant crop varieties, for example, might be able to show that you are now x number of hectares planted with such crops, but the benefits (or lack thereof) won't be seen until the next Dole. This is even more the case if the adaptive measures are meant to address longer-term climatic changes. The name wastion, it is difficult to take credit for avoided negative

outcomes - for example, no cholera outbreaks that occurred due to improvements in sanitation, pre - cisely because nothing happened. The assessment tends to be associated with the outcomes of summa- tief evaluation approaches and the use of impact indicators.

Learning to improve: Learning should permeate all evaluations, but the reality is that the invest- ment learning can vary considerably between evaluations. This can be the result of a tension between learning ("what happened and why?") and Accountability Act ("we have done what we said We would?") and the limitations placed upon mon- itoring and evaluation processes. Recognizing these tensions and identifying who should be learning what, when and how, can help achieve the learning objectives. Learning can occur in different spaces within and between organizations, com- munities and support it. Given the complex nature of adaptation, we should look to combine our own learning objectives with broader societal learn- ing about adaptation. While some information may be commercially sensitive, much of the time, sharing, adaptation of knowledge and experience makes sound business sense, helping to make future adaptation interventions more efficient and cost-effective.

Future interventions to improve: The purpose of the evaluation may be active at the moment to strengthen the future- ties and interventions, either at the end of a project (to inform future projects), or mid-way through at the moment ongoing project. This would suggest a strong focus on the pre-design evaluation of learning and, where appropriate, the use of formative methodol- ogy. Given that we are at an early stage in adapting to climate change, golden sun Lakeview strong consid- competes for all evaluation processes.

Compare to other evaluations: You may wish to compare the experiences, results and other different evaluations from learning to understand adaptation is how the impact of a specific type of intervention has varied in different locations, or communities, and what factors might underlie the differences compare to the implementation or adaptation of one of those and outputs with the option of another.

The choice of the purpose or purposes of an M&E framework will now have obvious influence on the type of indicators to be developed, the type of data to be collected, the level of detail required, etc. That, in turn, will dictate the level of complex- ity of the evaluation process, with implications for the availabl resources, manpower requirements and time needed to collect the data. For example, Defra (2010) suggests that obtaining a snapshot of the status of the UK consist of adaptation could be col- lecting and interpreting data for the four components:

1. *Level embedding*: The degree to which cli- mate risk management is embedded in the main- stream risk management and decision-making processes across society (including the policies, programmes and systems of government).

2. *Adaptive capacity*: The ability of a system to adjust to climate change (including climate variability and extremes) to moderate a poten- tial damages, take advantage of opportunities with the trash or the consequences. Note, within all the skills, knowledge and understanding (e.g. of interdependencies) is required for adaptive capacity are provide the capability to track and decreased levels of climate and weather events: the existence and quality of monitoring/warning systems that finished next climate event and/or their likely effects business to take place and the business taking place or has taken place, as well as providing timely warning of the finished signif- cant climate sensitive thresholds are being approached was.

3. *Effectiveness of actions*: The relative effectiveness of past/current adaptive actions and options in terms of sustainably reducing the rate and magnitude of impacts and enhancing adaptive capacity and resilience.

4. *Preserved the flexibility of the degree*: The degree of flexibility in preserved or promoted after the society's systems by maintaining or increasing flexibil- ity through evolution and future options for adaptive actions taken.

While it is important to the evaluation of the moment design pro- cess that is comprehensive and focused on the key areas of interest in, there will always be a balance between the types of data that would be ideal to col- lect for the given purpose and what is pragmatically possible given data availability and the availability of resources.

In addition to clarifying the purpose of the eval-the ation, it may also be useful to articulate the principles underlying the work. Spearman and McGray (2011) suggest three principles that underpin effective M&E Systems for adaptation interventions: design for learning; managing for results; maintain and flex- ibility in the face of uncertainty. They emphasize the need to carefully articulate adaptation of the objec- tives of the moment when undertaking the evaluation, to clarify the basis for the project design, and the universe transparent assumptions regarding, for example, climatic, social and economic factors that may influence the project to help vulnerable people's ability to thrive in a changing climate. Before this has been clarified and agreed, it is then possible to go on to select indicators and information systems that are build to be able to track adaptation success.

2.5.4 *Designing monitoring and evaluation processes*

Spearman and McGray (2011) distinguish between three types of adaptation efforts after: a community-based adaptation Programme - and project-based adap- in, and national policy initiatives. Each type has evolved to meet the specific needs of each moment requires M&E system that is tailored to meet those needs. Examples of evaluation design and planning processes are provided in Section 3.9.

It is important to remember that adaptation activities occur within a broader context, so in many cases, rather than create a separate M&E frameworks, the task will be to integrate climate change vulnerability and adaptation into the exist- ing frameworks. For example, rather than create a new system to monitor climate-related health issues, one might add adaptation indicators that are already in use in public health surveys. In addition, adaptation-specific M&E frameworks can be strengthened by capturing longitudinal data from monitoring various government structures across agencies and IT support.

There is a clear need to be getting a different perspectives on the "success" of the adaptation of evaluation. Funders may see the project as suiting their needs, but the intended "beneficiaries" might see no pos- itive change. This requires methods that can effec- tively bring in different perspectives. A number of resources are available that address this; they are discussed in sections and 3.9.5 3.9.3.

Below, we describe different approaches for design- ing M&E processes in developing and developed countries.

2.5.4.1 *developing countries*

Spearman and McGray (2011) propose a six-step process to develop adaptation-relevant M&E sys- TEMS, getting in developing countries. For each step, they identify design and implementation questions for practitioners to address, and they provide the example of the adopted indicators along three key dimensions- tion: adaptive capacity, adaptation actions, and

the sustained development in a changing climate. Below we describe those steps in the context of the previous sections' guidance.

Step 1 - Describe the adaptation context: It is essential for practitioners to understand the climate and non-climate factors, and populations affected by and that affect the interve- they plan po. This information can be drawn from vulnerability and/or climate risk assessments done at the outset (see Section 2.1) as well as from additional research and participatory processes during the appraisal of adaptation options (see Section 2.3) and the development of the able to adjustion plan (see Section 2.4). Additional data may be gathered to better understand the context.

Step 2 - identify the contribution to adjust to the able- tion: As discussed in Section 2.4, a key aspect of adaptation planning work to set specific goals linked to specific activities. Spearman and McGray (2011) propose the activities of the three categories based on their potential contributions to the adaptation process: adaptive capacity, adaptation actions, and the sustained development in a changing climate. Funders and their partners can use this framework to, among other things, the treasure of the high-level goals or outcomes. Practitioners can use it to characterize the types of lessons learned from M&E Systems for adaptation to various interventions.

Step 3 - form adaptation hypothesis: To test the validity of a location-specific approach to adaptation, practitioners can now able to adjust plot- tion hypothesis for each major outcome expected. For example, crop diversification might be a strat- egy for a farming village to manage increasing climate variability. The hypothesis might be that the use of a particular seed will blend to reduce crop sensitivity to extreme temperatures and drought, thereby improving the average yield and the overall average food security. Results of the intervention would the show tested whether the approach yielded the intended quality or degree of behavioural or envi- ronmental changes.

Step 4 - create the moment, adaptation theory of change: Many uncertainties surrounding light adaptation interventions, a theory of change in business is a helpful tool for practitioners to illustrate the relationship between the moment intervention's compo- nents, expected results, and the assumptions about the factors that can enable or inhibit of achieving success. Practitioners can use a theory of change to identify and correct false assumptions, and integrate new information into a strategy, or pinpoint the reasons for successes or failures.

Step 5 - Choose and set a baseline indicators: Choosing the appropriate indicators for adaptation requires rooting intervention moment's goals within its specific context of climate change and development. Adaptation practitioners can use the three dimen- sions. Spearman and McGray (2011) offer two sets of indicators within each dimension example: "assets" and "institutional functions" adaptive capacity; "climate hazards" or "vulnerability drivers" for adaptation actions, and "ecosystem services" and "livelihoods" for sustaining development in a changing climate.

Step 6 - use the adaptation M&E system: This step Spearman and McGray (2011)'s guidance explains how to use the M&E system for various purposes. Adaptation-relevant M&E systems can be used by practitioners to demonstrate the relative contribution of interventions to adapevaluation process and answer questions related to, for example, performance, efficiency , and effectiveness. The differences between activity and outcome monitoring are highlighted, as well as the importance of results-based management, flexibility, and learning, including through regular feedback loops and engagement with partners.

2.5.4.2 *developed countries*

At Project or programme level, ukcip's AdaptME toolkit (Pringle 2011) offers ways to think through some of the factors that can make the moment eval- uation of adaptation activities are inherently challeng- ing, and assist in designing a robust evaluation. Specifically, the toolkit offers help on:

- The purpose of the evaluation and Refining objectives;
- What is being evaluated and the front reflecting the logic behind this; specific
- traits of understanding how climate adaptation can make the evaluation is challenging, and how to overcome these
- challenges; drawing out, understanding and re-evaluat- ing assumptions; progress
- and performance considering how best might be measured and evaluated;
- Identifying examples of good practice and techniques which may help to ensure evaluation in the context of robust business now climate change; evaluating and
- prioritizing activities, recognizing that evaluations need to be proportionate to the investment and resource are limited.

Identifying appropriate indicators 2.5.5

The ability to track progress pre-adaptation and learn lessons that relies on the selection of indicators that are capable of representing and isolating the essen- tial changes sought. Going through the process of defining indicators may also help in clarifying the dif- ferent perspectives on the desired outcomes and setting realistic expectations, and they may also help to achieve consensus. On the other hand, there are many potential pitfalls in the use of the S-indicators. It's easy to pick misleading or inappropriate landed- cators, the data may be unreliable, and a great deal of the context may be lost, creating a false sense that climate risks have been fully quantified and understood.

The United Nations Development Programme's M&E guidance (UNDP 2002) notes that the cost of com- plexity and/or the timing of data collection may prevent the result from being directly measured in those situations, proxy indicators for the business using the recom- mended. For example, "fair and efficient adminis- tration of justice" may be measured by surveying public confidence in the justice system, and the level of toxins in duck eggs might serve as a proxy indicator of water quality in a lake. UNDP also recommends:

- Using disaggregated data - by location gender, income level and social group (as relevant); - involving stakeholders
- in the development of indicators (See also Section 2.4); Distinguishing
- between quantitative and qualitative indicators, and choosing one or the other based on the nature of the intended result to be measured; Limiting the number of
- indicators, choosing "a few credible and well-analysed indicators that substantively capture" changes; a balance should be struck between what should be measured and what can be measured; Ensuring
- timeliness, so the indicator target date corresponds to the expected progress of the activity being evaluated.

A report by the Organisation for Economic Co-operation and Development (OECD) provides the first empirical assessment of M&E frameworks used by agencies for development cooperation projects and programmes with their adopted- tion-specific or adaptation-related components, the drawing experience six bilateral devel- one of the specialized agencies (Lamhauge et al. 2012; See also Lamhauge et al. 2013). 106 of the rules review projects and programmes, the authors find that the selection of appropriate and measurable indica- tors is a critical aspect of M&E for adaptation. They suggest that M&E frameworks adopted- tion combine qualitative, quantitative and binary indicators, and note that on its own to any category for the synthesis of insufficient business. For instance, to establish the successful development of a policy framework, you also need to find indicators to assess imple- mentation and sustainability. Policy development indicators thus need to be augmented by quan- titative indicators that measure, for example, the number of projects that have been developed in response to the policy, or the number of house- holds that have benefitted from it.

Bellagio Framework (McGray et al. 2009) also identifies indicators for criteria to be used in M&E processes:

- Broad applicability;
- Flexibility to accommodate national circumstances;
- Logic and straightforwardness;
- User-friendliness and common sense;
- a top-down approach that empowers bottom-up action;
- Comprehensiveness with regard to key national adaptation functions;
- Compatibility with other tools, frameworks, and decision criteria.

The OECD review (Lamhauge et al. 2012) found a wide variation in the level of detail of the data that were being collected for adaptation evalua- po. Some projects had detailed indicators corre- sponding to every component of an intervention, while others used more aggregate indicators. The authors suggest that the preferred approach is likely to depend on the type and scale of activity. It is clearly important to be rigorous and careful in identifying indicators to develop a cred- ible and effective evaluations that can be used to capture learning and provide accountability. However, there is a danger that too much focu is placed preliminary results measurement and indicators, and managing the process from diverting those useful and potentially more effective, but less measur- able activities.

2.5.5.1 *process and outcome indicators*

UNDP (2007) notes that the adaptation "is not generally the outcome of moment, but rather holders of a diverse suite of ongoing processes (including social, institutional, technical and environmental processes) that enable the achievement of the development objectives". It is thus important to distinguish between the two basic types of indicators that may be used in M&E: *the process indicators*which measure progress in a process leading towards the desired outcome (e.g. number of farmers trained in water-saving techniques), and *outcome indicators*which define a specific outcome (e.g., change in irrigation water losses). Process indicators are relatively easy to use, and they are frequently used; using the outcome indicators for the evaluation of adaptation interventions can be more challenging, because often the outcomes take a long time to be realized given the long time horizons of climate change. Still, both types can be valuable, job evaluation and any likely to be a mix of both types. Defra (2010) explains that the roles of the two types of indicators, thus:

*Illustrative example of a '**process**' Indicator*: A process that could contribute to improving the UK's resilience to the changing climate might be to ensure that the government of the estate was embedding its adaptation into management. Progress by departments increasing their estates' resilience to the impacts of climate change might be monitored through an indicator that measures the moment:

"the number of government departments, improving the capacity of their estates to adapt to the impacts of climate change"

Performance Levels could be gauged through a grading system (0-4) with a higher number representing a further adapt to the progress made in planning to climate change. '1' might represent increasing evidence gathering or understanding of the issues; whereas '4' might represent the reviewing and taking actions based on the completed risk assessment and action plan. Such moment indicator could be monitored annually or less frequently, e.g. every few years before.

*Illustrative example of an '**outcome**' indicators*: Now outcome of adaptation to climate change in the UK be better reflected in our ability to adapt to the hotter summers. One aspect of our progress in adapting these might be monitored through:

"the number of excess deaths from heat-related illnesses during the 3 months, the hottest of the year"

Such moment indicator might be analysed in a number of ways: it could be better looked annually or over longer periods of time. Observing a limiting increases or sus- tained a number of such decrease, in the face of increased heat, might reflect the moment in the UK's ability to adjust to increase our changing climate. However, no such moment of outcome indicator could be influenced by factors drawn from a great variety of systems right Cross Society.

Clearly no one set will work for all of the indicators of adaptation interventions, and indicators must be chosen based on the relationship between planned adaptation activities and the context in which they are to be implemented. AdaptME The guidance (Pringle 2011) offers some useful ques- po to consider:

- Refer back to the objectives of the intervention - do the metrics and indicators to help you understand whether the objectives have been met?

- Test it thoroughly and Consider the logic behind your chosen indicators. Are they fit for the Purpose? Would be more robust if they worked into ***package*** indicators?
- How might changes in the availability of data over the study period affect what can be measured, and when? This may affect which metrics you choose.
- Resist the temptation to distil your findings into a ***single number*** - this may be appealing to policy-makers, but it does tell them the full story?
- Remember that while metrics may be objectief, the choice of indicators is not; these may reflect a particular framing of climate change. For example, a business may develop metrics to look at the economic viability of adaptation action at the moment rather than examine the social distribution of benefits. Consider framing your own challenge, so it provides a picture with you as full as possible, as well as meeting your organizational needs.
- Quantitative metrics are attractive, but should be balanced with qualitative data, which examines the facts behind the figures.
- Do you have the metrics chosen to reflect a particular idea of success? Do you need to consider, from the point of view of success to the other stakeholders or members of the community? For example, the success of a project to increase green space in urban areas could be measured in terms of ***reduced impact of the urban heat island effect***, ***increased biodiversity*** or ***increased recreational space***. All may be valid measures of success depending on the individual's perception of the moment.

2.5.6 *common challenges*

Adaptation activities take place within complex systems, and the quest to develop indicators that can be used right away, it's easy to oversimplify, Tianhe district pick from that the actual indicators and goals, or even skew the process (since people will naturally prioritize what is being measured). Evaluation processes may also be too short to cover a time-span to capture the slow process of creating a real, sustainable and effective change. Methods that capture something of the complexity of the system (beyond linear causality), such as outcome mapping and the "most significant change" evalua- po, projects to enable capture "surprise" and unanticipated consequences of an intervention, which is useful in challenging assumptions about how change happens and what type of intervention is a business most likely to be effective.

The growing of other challenges described in the litera- type pre-M&E Systems for adaptation include:

- Choosing the appropriate indicators to monitor performance;
- Lack of experience to draw on as the impleme- in projects and programmes that specifi- cally target is still a relatively recent adaptation; Difficulties in defining baselines in order to measure project or programme impact; the uncertainties around the timing and scope of change that can be anticipated; Difficulties figuring out how to measure the effectiveness of adaptive measures taken in anticipation of climate changes will note that , for decades, or still; uncertainty about how society, technology, as a whole the country and the climate will change over the same period; focus on things that are easy to measure, or where monitoring already exists, even when they May and may not be the most relevant; this can also be a disincentive for undertaking activities which outcomes are not easily measurable; Difficulty in measuring "soft" areas of capaci- ty-building, even though these may be very effective in supporting unsettling adaptation; Existence of many other factors influencing a particular outcome or output, which makes it difficult to attribute them to a particular intervention.

This clearly makes it difficult to know what to measure as indicator of success at the moment. Also, as adap- business mainstreamed into existing policies and risk-management processes of organizations, it will become harder to attribute the actions taken for the desired adaptation outcomes. For more useful guidance on managing "tricky" issues asso- ciated with designing evaluations adaptation, see Pringle (2011).

Common approaches 2.5.7

The OECD review (Lamhauge et al. 2012) of M&E frameworks in projects and programmes by development cooperation agencies finds that one of the most commonly used approaches to distinguish between outcomes, outputs and activities are results-based management and logical frame- works. These are briefly described here, but more information is available in Section 3.10.

Logical frameworks 2.5.7.1

A logical framework for management an analytical tool which can help planners and managers anal- identify if a situation and objectives, the means by which they will be reached, potential obstacles, and a way to monitor and evaluate outputs and outcomes summary. The findings are usually summarized in a four-by-four matrix, called a logframe. List the rows and columns of a vertical hierarchy of objectiv each objective will be assessed and how the present means of assessment. The columns also outline the assumptions that may affect the project achievements. Table 2.5.1 outlines a typical logframe.

2.5.7.2 *results-based management*

Results-based management is a business management approach that focuses on ensuring that all pre project's (or organization's) processes, products

TABLE 2.5.1 *The logical framework approach.*

Complex narrative summary	*Objectively verifiable indicators*	*Means of verification*	*Assumptions*
Objective - the overall objective to which the project is expected to contribute to work	Measures (direct or indirect) to show the project's contribution to the objective	Sources of information and methods used to show the fulfilment of the goal	Important events, conditions or decisions beyond the project's control necessary for maintaining progress toward the goal
Outcomes (or objectives) - the situation in which the new work project aiming to bring about	measures (direct or indirect) to show progress toward the objectives	Sources of information and methods used to show progress against objectives	, important events, conditions or decisions beyond the project's con- troll if necessary for achieving that objective is going to contribute towards the overall goal
Outputs - the results should be within the control of the project management	Measures (direct or indirect) to show if the project outputs are being delivered	Sources of information and methods used to show the delivery of outputs	, important events, conditions or deci- sions beyond the project's control, and if necessary, that are producing the outputs going to work to help achieve
Activities - the things that have to be done by the project to produce the outputs	Measures (direct or indirect) to show if the project outputs are being delivered	Sources of information and methods used to show activities that have been completed important events	the objectives of important events, conditions or decisions beyond the project's con- troll required if completing activities will produce the required outputs
Inputs: Resources - type and level of non-financial resources needed for the project finance - budget overall Time - planned start and end date			

Source: adapted from Mikkelsen (1995), as cited in Bakewell and Garbutt (2005)

and services contribute to achieving the desired results. It requires clearly defined accountability for results and systematic monitoring, self-assessment and reporting on progress. Results-based management at the moment provides a way to prioritize the organization's (or project's) work and systematically link activities carried out by it at all locations and preferences, regardless of the funding sources. M&E results-based man- agement approach focuses on:

- Active ***application*** monitoring and evaluation to the information ***continuous improvement*** strategies, programmes and other activities;
- monitoring of substantive ***development results*** instead of just inputs and implementation processes;
- monitoring and evaluation of results ***as they emerge*** instead of After Effects project completion;
- Conduct monitoring and evaluation as ***joint*** exercises with development partners.

2.5.7.3 *Outcome mapping*

Outcome mapping was developed by the International Development Research Centre (IDRC) in Canada as a methodology for planning, monitoring and evaluation. Grounded approach to the development of an understanding as a com- plex and non-linear process that involves multiple actors, some of whom work for, and some of whom work against change. Outcome mapping has a lot to offer the adaptation of the evaluation of inter- ventions, as it gets away from assumptions made in the impact-based methods, such as that it is possi- ble how to make a simple cause-and-effect links. It also that positive outcomes are usu- ally due to a number of factors coming together rather than single intervention or the actions of the actor. Outcome mapping provides a mechanism for drawing together different contributions to the moment of the outcome, which is essential in order to learn more about what supports successful adaptation.

2.5.7.4 *most unsettling change*

The most significant change of business form a participatory monitoring and evaluation of a list based on- ing to what people (beneficiaries/participants/ stakeholders) to consider have been the most significant change resulting from the project or initiative. The approach requires no special profes- sional skills, easy to work and communicate across cul- tures, as people generally find it not easy to tell stories about events they think were important. There is no need to explain what a moment indicator work. It is also a good way to pick up the changes and unanticipated changes that may challenge your assumptions of what is happening. This approach encourages people to engage in analysis as well as data collec- tion stages of a project as they have to explain why they believe one change is more important than another. It can be used to monitor and evaluate the bottom-up initiatives that do not have pre-defined outcomes against which to evaluate.

2.5.8 ***Assessment as learning opportunity for the moment***

Spearman and McGray (2011) suggest that M&E systems play two critical roles in ensuring effective adaptation: they support the long-term process of learning "what works" in the adaptation, and they provide a tool for practitioners to manage their work in the context of the uncertainty surrounding climate change impacts. Evaluation processes can be specifically designed to enhance learning by encouraging the use of insights from all of the evaluation landed- cators adapt the current plan in order to develop your next design project or compare with other evaluations of the cycle win either. Evaluations are often spoken of the moment as an opportunity to learn, but as noted earlier, this needs to be consciously built into the process if it is to be effective. This requires thinking through who needs to be learning, how people can provide feedback and insight, what kind of things can be learned (facts, skills, stories) and

what level of challenge available people to move beyond "business as usual" thinking. It also requires that the "spaces" that are made available for process. Later for you to feed it into learning programmes of work there has to be a process for how the feedback from the evaluation feeds into other processes to complete the finished job evaluation.

It is also important to provide for both the fast (short- term) and slow (long-term) learning. For example, it might take 10-15 years to learn that a measure meant to reduce vulnerability to increasing water scarcity (e.g. planting trees) does or does' not work well. Quick ways we need to check our assump- po about what needs to change and how it will change - e.g. farmers are actually adopting new practices after the moment, intervention, and if not, why not? - our knowledge while also building over time, both about about climate change adaptation and impacts (e.g. on the long-term effects of various stressors front mangroves).

Spearman and McGray (2011) conclude by high- lighting the ways to "learn by doing" the develop- ment of M&E for adaptation practice, and proposes areas for further development and research:

- *The project think outside the box*: The chal- lenges of M&E for adaptation are largely shaped by factors outside the individual project cycle. Therefore, developers of M&E systems need to move toward measuring changes in broader systems.
- *Explore options for overcoming barriers to participation*: Further work is needed to understand how technology, capacity-building, and wise use of financial resources can reduce the costs associated with stakeholder participation in M&E inclusion, improve processes, and scale up use of participatory approaches.
- *Link existing M&E Systems*: Stronger connections between bottom-up and top-down information and decision-making could help the focus scarce resources by eliminating duplicate reporting structures sharing common information that is relevant, and potentially improving the accessibility and transparency. Integrated adaptation M&E systems could also be used to link disparate sectoral or thematic events.
- *Promote experimentation*: Useful experimental approaches for adaptation from the industrialized world are beginning to gain traction in the development of the sphere. M&E will now play an important role in helping to learn when and how such approaches have value ' they can be adjusted to specific locations.
- *Face tensions and trade-offs openly*: M&E presents the adaptation of challenges in a world of limited resources, where it is rarely possible to manage multiple processes for a given place, issue, or activity. Open discussion of the tensions and trade-offs can ensure that a given system is used appropriately, and that its results are not misunderstood, misinterpreted, or used for cross-purposes.■

3 Methods and tools

3.1 participation and engagement

3.1.1 *introduction to participatory processes*

Adapting to a changing climate, a world that is changing simultaneously in many other ways, is a good example of a "wicked," or unbounded problem, as described by Chapman (2002): one where there is no clear agreement on pre-what's the problem job, which is created by and there is uncertainty about how to solve it, and there are no limits to the amount of time or resources could be the problem absorb. Such situations require considering the perspectives of all involved, even if it is not easy, as when there is a history of conflict. Dialogue processes are needed that engage all those with influence over the pro- cess or those affected by it, and enable them to freely contribute and be heard and understood by the others. This section describes tools to guide you in setting up and managing participatory pro- cesses. We begin with an outline of the benefits of stakeholder engagement, adapted from Twigg et al. (2001):

1. Participatory initiatives that can make processes more sustainable, by building on local capacity and knowledge, and by creating a sense of "ownership" among respondents, making them likelier to comply with any decisions made.

2. Working closely with local communities links help decision-makers gain greater insight into them, enabling them to work more efficiently and produce better results. Community mem- bers, in turn, learn how the decision-making process works and how to influence it.

3. Links are working and achieving things together build communities and strengthen adaptive capacity by creating awareness of different people's priorities and finding ways to address them. It can reinforce the role of local organs- zations, and build confidence, skills and capacity to cooperate. In this way it increases peo- Plen's potential for reducing their vulnerability may give them confidence to possession and other challenges, individually and collectively.

4. Stakeholder participation in the planning, implementing and evaluating business projects consistent with the people's right to participate in decisions that affect their lives. Participatory processes and also we can improve the equity in decision-making and help resolve conflicts.

5. Although engaging stakeholders in business time-con- suming it may make processes more cost-ef- fective than the long-term externally driven initiatives, because the process that allows ideas to be tried, tested and refined before adoption.

You need to be flexible and adaptation processes to sup- port improvisation, rather than focus on control and predictable outputs that may be impossi- ble to achieve such a dynamic and unpredict able system. When engaging others in the focus participatory processes for adaptation should be, thus creating the conditions to be front and capacity to pick up the signals of change have options that are robust to a range of situations, and be able to respond effectively. This requires developing the capacity to notice the change, preliminary assumptions reflect what is happening and what needs to change, and to learn the actions that follow so that you benefit from this experience.

A key benefit of participatory processes that help ensure that they make tools and methods

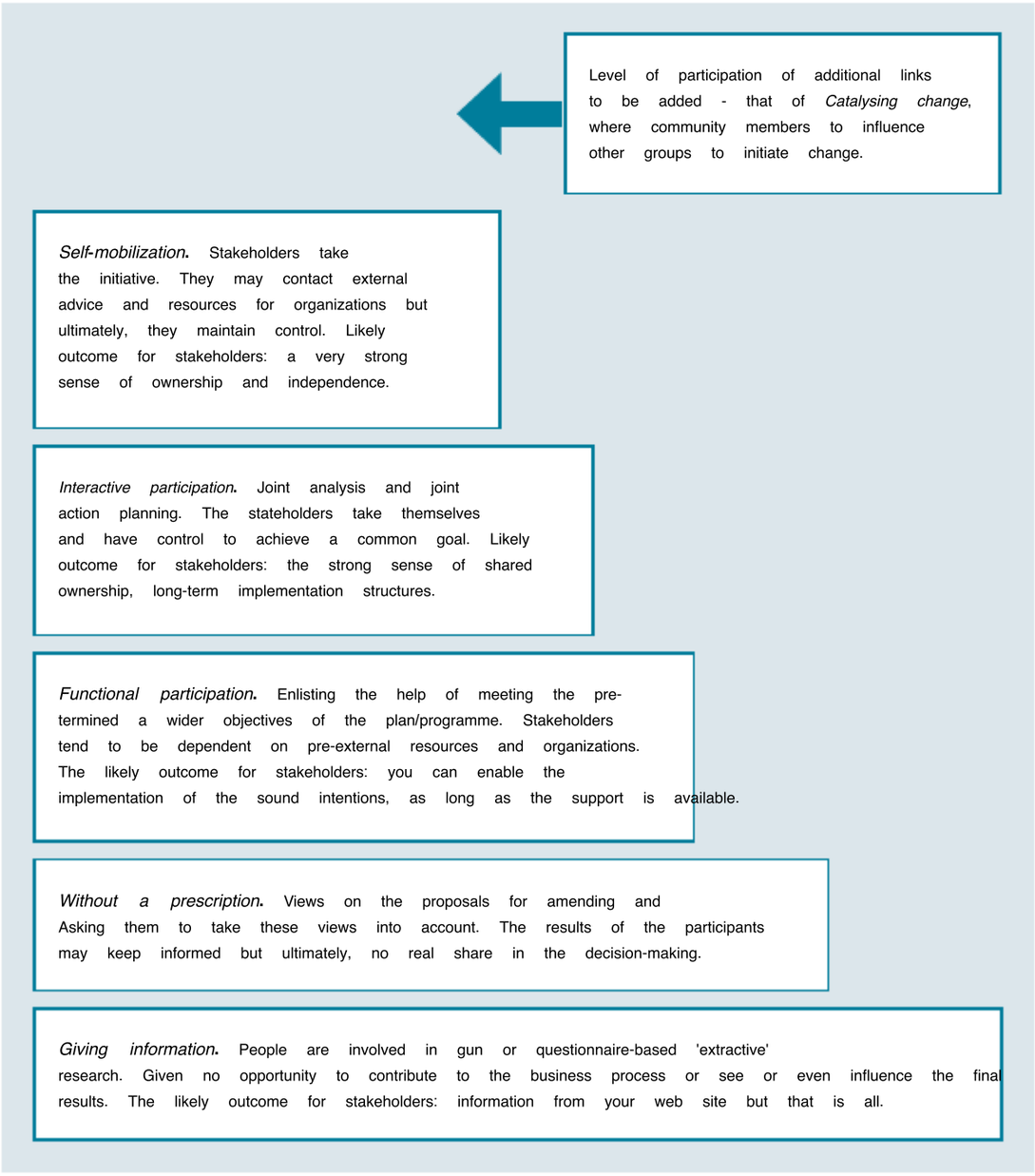


FIGURE 3.1.1 *Ladder of participation* (adapted from Pretty 1995).

sense "on the ground", which is essential if they are to be absorbed and implemented. Adaptation in practice, one effective way to accomplish this is through "co-production" with the knowledge of collaborative learning between experts and users. This can be challenging: issues around power and who controls the process can have a significant impact on the effectiveness of collaboration, and that there is a risk of reproducing (or even reinforcing) and unhelpful previously held perceptions and a sense that "things will never change." These are all processes that depend on the quality of relationships between individuals of the system. People need to be supported to be able to engage, especially if they are new to such exercises, or else the interaction of the level will be reduced. The facilitator can now play the important role in encouraging and supporting engagement and dialogue.

3.1.1.1 *the level of participation varies*

O'hara (2006) warns that "there is a thin line between facilitating a process driven by community members for long-term positive change and 'facipulation of the community to come up with a short-term, tangible success story for the donor consumption". Arnstein (1969), on the other hand, viewed as a form of citizen participation citizen power, defining it as "the redistribution of power that enables the have-not citizens' presently excluded from the political and economic processes, to be deliberately included in the future". Some have suggested viewing a participation spectrum, or a ladder. One such ladder, offered by Pretty (1995), business shown in Figure 3.1.1.

The key factor here is how much power and influence the process stakeholders. Engagement can range from quite passive approaches interac- Po, where the stakeholders are informed simply provide information or to the "self-mobilization", where the stakeholders themselves and initiate the entire process of design. Closer to Engagement self-mobilization is not necessarily "better" for being more participatory; different levels of participation are appropriate for different stages of a project, or under different circumstances (for a thoughtful discussion of the challenges of ensuring meaningful participation C, based on experiences with adaptation on the coast of the UK, few see et al. 2007). It is important to consider who is making the decisions at each stage of the process: defining the research agenda for climate risk assessment; identifying adaptation options; appraising the options; developing adaptation plans the moment; imple- menting the plan; monitoring and evaluating the actions and drawing lessons.

Kanji and Greenwood (2001) distinguish between five possible levels of participation:

- *Compliance*: Where tasks and incentives are aligned, but the agenda and process the outsiders directed by;
- *Consultation*: Where stakeholders' opinions are sought, and the outsiders analyse and decide the course of action;
- *Cooperation*: Where to work with stakeholders to determine priorities for the outsiders, but the outsiders are still responsible for directing the process;
- *Co-learning*: Where stakeholders and outsid- ers share knowledge, create new understand- ing and work together to form a summary of; and
- *Collective action*: Set Where stakeholders carry out their own agenda and to mobilize it , the absence of the outsiders.

That is now important factor to consider stakeholders need to understand why it is worth their while to participate, or else they may see the process as a waste of their time and effort. Rigid, externally imposed agendas may narrow the discussions so that they become much from the outset uninteresting or even irrelevant to those being asked to participate. Stakeholders may also get frustrated

if no adjustments are made in response to the new insights generated through the engagement process. The action resulting from the lack of concrete work can undermine stakeholder engagement over time, leading to "participation fatigue".

3.1.1.2 *ethical and social justice considerations*

Defining the role of participatory approaches a key part of the adaptation process of designing process. Given the nature of either win in the customs- tion, the role of business stakeholders are likely to change over time, but it is still important to be honest with ourselves and with the people we work with about the nature of their participation, how the information they provide will be used, what power they might have to influence decisions, and what decisions have already been made. Blackburn and Holland (1998) write that "participation is a way of viewing the world and acting in it. It's about a commitment to help create the conditions which can lead to significant empowerment of those who at present have little control over the forces that condition their lives."

Participatory approaches are often overtly about empowering and building the capacity of those involved to analyse and act and increase their control over resources necessary for their lives. People that engage Processes of the decisions that affect their lives and livelihoods of the key aspects inevitably to the need to give serious consideration to such engagement of the boundaries and what the impact might be of low involvement, false expecta- PO or a failure to include the voices of the key. Participatory processes can also be viewed as exercises for the use and control of the power to depict reality, its causes and what to do about it" (Mbilinyi and Rajani 2001) and thus need to be seen as far more than a set of tools and methods. There has been a backlash against the use of participatory approaches in both developed - and developing-world contexts (called and calling Cooke 2001) as they have been used without attention to the ethical aspects to extract information quickly with no follow-up or report- ing to the results of those who participated. Purely extractive research may be appropriate in certain situations, but it becomes unethical if it labelled as "participatory".

"Outsiders" coming into a situation may also be unaware of the power dynamics in the community, and not realize that some people are excluded from participatory processes, or don't feel comfortable speaking when certain other people in the room (Chambers 1995). Local people can help to overcome this, but the outsiders should also be constantly verify and cross-check information for trustworthiness throughout the process.

In his book ***The reflective Practitioner: How Professionals think in action*** (1983), Donald Schön explains that in order to achieve the participation of ten empowering end of the spectrum, outside experts have to know how to change they view their role, from the moment authority is a "facilitator". Rather than being in control, they have to "speak to be silent, to list, to sit on the ground and note attentively to the lecture, note 'to wag a finger or a stick'". 3.1.1 Table outlines the implications of such a shift.

3.1.1.3 *Being a good facilitator*

Facilitators play a crucial role in participatory processes, guiding in the discussion, ensuring that everyone's voice being heard, checking periodically activities are proceeding as planned, and making adjustments as needed. Well doing this that does not require advanced technical skills, but it does require a personal commitment to a partierpatory process (rather than a particular outcome), reliability, being a good listener, and being a good questioner (for clarification and deepening understanding). A good facilitator must also be able to summarize and reflect back and clearly, without bias, to be able to work as part of a team, understand

TABLE 3.1.1 *From reflective practitioner to expert - Thu Schön* (1983).

Expert	*Reflective practitioner*
So do not presumed and must know how to claim to know that I am regardless of my own uncertainty.	But I am not presumed to know that I am the only one in the situa- tion relevant and important knowledge to have. My uncertain- ties may be a source of learning for me
Hold onto to keep my distance from the client and the expert role. To give the client a sense of my expertise, but convey a feeling of warmth and sympathy as a "sweetener".	and for them. Seek out connections to the clients thoughts and feelings. Allow the feeling to emerge from feeling respect for my knowledge discov- ery of the situation.
Look for the client's response to my look of deference and status of the sense of freedom and connection for real professional persona	as a consequence of no longer needing the client to maintain a professional facade.

and be able to manage, group dynamics, and communicate well with all stakeholders. This business is a lot to expect from one person, but several people can work together and support one another.

Relationship-building is an important part of participatory approaches, and requires strong interpersonal skills, which are often undervalued in organizations - can there even an assump- tion that everyone can do this, or that good facilitation business just about "being nice". As Pelling and high (2005) emphasize, it is also important to make connections and how to build trust outside of the formal process; informal spaces that allow people to get to know one another are also important for relationship-building.

Facilitators need to be clear about the goal of the work, the involvement at different stages of the scope and what people can expect to get from being involved. Use the techniques that they need to get below the surface issues, but also need to be skilled in creating a feeling of safety in order to do this. It may feel very dangerous for people to say what they really think, especially about shared and scarce resources. There is a clear ethical aspect to this: what can people safely talk about here? In whose presence? Who dominates in this group? Where possible, it is helpful to engage local facilitators who understand the local situation and speak the local language. Training local people who are as recognized, trustworthy and unbiased by the local community is also a way to build local capac- ity and ensure that a unique legacy to the work beyond the end of the project.

It is also important to recognize the many subtle judgements made the recording of the discussion: what information is included or excluded, and how are summarized. As Cornwall and Gaventa (2000) note, "what emerges is neither a neutral set of 'facts', nor a neutral process." Participatory processes can produce large amounts of unstructured information that still needs to be analysed and incorporated into the overall study, analysis or plan. Ace work this material analysed and reflected upon, patterns are noticed, deeper suggestive are identified and shared, and true learning can occur. As in any editing or the prioritization process, the people who manage this stage, have great deal of influence over the results. Ideally, those who contributed to the generation of information should also be involved in this stage, as this will build their capacity for analysis, allow for clarification as needed, and potentially increase the quality of equity and social outputs. If, on the other hand, analysed the information remotely, away from those who it is generated, it is easy to Misu the- derstand suggestive. Undertaking the process of reflection and analysis within a community and the people that produced the original material Omani not only increases the quality of the data

suitability ideas and solutions that come out of the process of those involved but also on the LAN to gain confidence in their ability to represent their views to others. This moment also provides the opportunity to delve deeper into the causes of the problems and understand more about why these issues are relevant and important to identify realistic and a left- po (Guijt and Braden 1999).

A general note about participatory tools 3.1.1.4

Participatory processes often use multiple tools together: e.g. the time lines, Venn diagrams, seasonal calendars, ranking exercises. There is an ethos of "open source sharing and adaptation in the use of participatory tools. Tools can be adapted to the spe- cific context and do not have to be rigidly applied - that they are meant to help you, note prescribe what to do. The most important thing is to know why you are using a particular tool.

Many of the tools described below can be used at different stages in the process: e.g. the same tool (rich pictures, diagram or H) can be used to scope the problem, gain others' perspectives and identify priorities for learning, and evaluate the process. Several are also explicitly designed to engage stakeholders throughout the adaptation process, ensuring that they play a role at every stage: from identifying climate risks to implementing adopted- tion actions and evaluating their effectiveness. We have those tools are grouped together in Section 3.1.3; be aware that many have names that suggest a narrower focus on identifying adaptation needs of the front, but they actually go beyond that. A closely related discussion of participatory processes - community participatory vulnerability assessment and sce- nario development - business magazines in Section 3.2.3.

Along with tools and guidance developed specif- ically to support adaptation, we list the more general tools that are valuable for a wide range of partier- patory processes, adaptation and beyond. These include tools for Stakeholder Analysis (Section 3.1.2), tools for facilitation (see Section 3.1.4), the participatory analysis tools (see Section 3.1.5), large-group and whole-system techniques (Section 3.1.6), and conflict resolution tools (section 3.1.7). The name was- tion, see Ayers et al. (2012), and the discussion in Section 3.10.3 for a participatory approach to evaluating community-based adaptation, and Section 3.11 for participatory tools for learning and reflection.

Listed here are the majority of the materials avail- able as free downloads over the internet; however, where relevant, we have also included some useful books and peer-reviewed journal materials.

3.1.2 *Stakeholder and social network participation analysis tools*

A key step in engaging stakeholders to under- stand all the actors who are in adaptation to a given situation: who is affected by climate risk or pro- posed adaptation measure, who has the power to make various decisions, and how different actors influence one another. The tools described in this section are designed to help you identify who needs to be consulted on, assess their interests and rela- tionships with one another, and understand what support they might need in order to be able to par- ticipate effectively. Not an in-depth introduction to stakeholder engagement, see the Condé and Lonsdale (2005) for a useful overview or a quick BIBL the- ography, see Bharwani et al. (2011).

Stakeholder analysis 3.1.2.1

These tools -including tables and matrices - help you to think through who is involved and what their particular interests, or the work of that decision might be. This clearly affects how they should be involved and at what stages in the work. The tools can be used for diagnostics, sharing of understanding for a team and cross-checking with stakeholders, for

for planning or monitoring and evaluation (e.g. , whether reflecting the front right people involved at the right times and in the right ways). For quick overviews, see Hovland (2005, pp. 8-9) or Lonsdale (2011), both available free online. A subset of this type of stakeholder influence mapping, business analysis, which examines and visually displays the relative influence that different individuals and groups have over decision-making. Examples of appli- cation of these approaches include:

- Stakeholder influence mapping to examine the changes in the UK's international develop-
- ment policy; changes in influence over the Costa Rican forestry policy, and preliminary policy influences a wildlife-based enterprise in Kenya - plus the moment in-depth explanation of this approach (Mayers and Vermeulen
- 2005); scenario-based stakeholder engagement, including stakeholder analysis, applied to two case studies of coastal planning for climate change in the UK (Tompkins et al. 2008);
- stakeholder analysis combined with social network analysis (see below) to support water infrastructure planning amide climate change in Switzerland (Lienert et al. 2013).

3.1.2.2 *social network analysis*

Business social network analysis was used to create visual map of relationships and flows between people, groups, organizations, support, government entities, etc. It is used to understand who is involved in the business of a system of interest, how they relate to one another, who has power of the situation, and points at what interventions might be most effective. Social network analysis work with a very wide range of fields and settings see Journal ***Social Networks*** (*www.journals.elsevier.com/social-networks*), published since 1979, or the comprehensive guide by Knoke and Yang (2008). For a quick overview and links to many tools, see: *www.kstoolkit.org/Social+Network+Analysis*. Examples of applications of risk assessment and climate change adap- can include:

- "Influence Strategic network planning for new water board governance in
- Ghana (2008); social network analysis as part of the study of adaptation by smallholder farmers livelihoods of South Africa and Mozambique (Osbahr
- et al. 2010); analysis of the decision-making context and information networks in five climate-sensitive support in the Carolinas, U. S. (Lackstrom et al. 2012).

3.1.2.3 *Ladders, scales and spectrums of participation*

Different types and levels of participation appropriate for adaptation to different situations. As discussed earlier in this chapter, thinking of par- ticipation in terms of a "ladder" or a spectrum can help clarify what role stakeholders are expected to play and at what stages in the process and how much power they will have in the shaping process. Spectrums ladders and it can be used as diagnostic tools scoping stage, as a planning tool finished designing stakeholder engagement approaches, and monitoring and evaluation as a tool to chal- lenge assumptions. For a discussion of the "ladder" approach, see Pretty (1995); for a discussion of the participation of scales, see Bradley and Schneider (2004). The International Association for Public participation a in a unique one-page overview of the spec- trim approach (IAP 2 2007); also useful for the Joseph Rowntree Foundation's guide to assessing levels of community involvement (Burns and Taylor 2000).

3.1.3 ***Participatory tools and methodologies used designed to support adaptation***

The tools described in this section have been devel- oped to engage stakeholders in both impact and capacity analysis, as discussed in Section 2.1 in - but they do not stop there: they also provide for the stake- holder engagement in identifying and appraising adaptation options, and for building adaptive

capacity within local institutions and communities. Two of these approaches, community vulnerability assessment and participatory scenario development, are discussed in depth in Section 3.2.4. Here we briefly describing those and other participatory tools specifically designed to support adaptation.

3.1.3.1 *the resort Community Vulnerability and capacity analysis methodology*

The Remedy created this methodology (Daze et al. 2009) to help development practitioners understand the implications of climate change for the lives and livelihoods of the people they serve. It is meant to provide a framework for dialogue within communities, as well as between communities and other stakeholders, enhancing scientific data, local knowledge and adaptive capacity building. The process engages all stakeholders understanding climate-related challenges, identifying adaptation solutions, and taking steps towards those solutions. The handbook is available as a free PDF download in English, Spanish, French and Portuguese (*www.careclimatechange.org/cvcal*). It provides an overview of the methodology, as well as using it for practical guidance on the design and implementation of adaptation actions. A separate document (Fontenla et al. 2011) offers a case study of the application of the methodology in Ecuador, Peru and Bolivia. The case study which was done as part of the regional project for Adaptation to the impact of rapid glacier retreat in the tropical Andes (PRAA), implementing pilot projects for the resort which business to support adaptation. Glacial retreat is not only the limits of water availability, but also increases exposure to geomorphological hazards, such as landslides, mudslides and lake outbursts. Use of the resort's methodology highlighted the differential nature of vulnerabilities, and thereby enabled appropri- ate adaptation responses to be identified.

A complementary document, Ayers et al. (2012), local guides practitioners through participatory approaches to monitoring, evaluation, reflection and learning. The guide notes that adapting to climate change amid uncertainty requires a "learn- ing by doing" approach, and it envisions ongo- ing stakeholder engagement to support social learning.

3.1.3.*CRiSTAL Screening Tool* 2

CRiSTAL (Community-Based Risk Screening Tool - adaptation and livelihoods) as a screening tool developed as part of a collaboration led by the International Institute for Sustainable Development (IISD). Work it designed to help project planners and managers to integrate risk reduction and climate change adaptation into community-level projects. It helps them:

- The links between livelihoods and still climate in their project areas;
- Assess a project's impact on community-level adaptive capacity; and make
- adjustments to the project to improve its adaptive capacity and reduce the impact of ten communities of the vulnerability to climate change.

The toolkit is available at CRiSTAL *www.cristaltool.org*in multiple languages and formats. It includes two modules, the front-front synthesizing information cli- mate and livelihoods, and improving planning and manag- ing projects for adaptation. The site also includes written guidance, a video and other resources.

CRiSTAL has been applied in central and South America (Bolivia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Haiti, Honduras, Nicaragua and Peru); Africa (Ethiopia, Kenya, Mali, Niger, Tanzania and Zambia) and Asia (Sri Lanka).

3.1.3.3 *Participatory learning and Action: community-based adaptation*

For 25 years, the International Institute for Environment and development (IIED) published in PLA notes, Journal front of an informal participatory methods and approaches, providing a wealth of examples of the use of participatory tools in vari- ous settings.

PLA 60 (Reid et al. 2009) focuses on the communi- ty-based adaptation to climate change. The book- length volume provides a useful overview of the role of participatory processes in adaptation and describes the moment of array approaches tested in case studies around the world, such as:

- Combining different types of knowledge Small Island Developing States;
- Engaging children in disaster risk reduc- tion and adaptation (El Salvador and the Philippines);
- In Sri Lanka rice Participatory
- variety selection; adaptation to
- support filmmakers as farmers in
- Malawi; development of calendars rain with farmers in Ethiopia.

It is important to note that these approaches are grounded in the principles of "action research", which works to bring about positive change by building "communities of inquiry and action" to collaboratively explore an issue and address it (Reason and Bradbury 2008). Access to the entire archive of PLA notes, go to *pubs.iied.org/search.php?s=PLA*.

A separate discussion of action research to sup- port adaptation in Africa, see French et al. (2012); for an in-depth review of action research, see Burns et al. (2012) and it introduces the issue of the journal.

3.1.3.4 *Participatory scenario development*

Participatory scenario development (discussed more at length in Section 3.2.4) is a process that involves the participation of stakeholders to explore creative in the future and policy-relevant way. It can be used to identify the effects of alternative responses to emerging challenges, to determine how different groups of stakeholders view the range of possible policy and management options available to them, and identify front the public poli- CIES, or investment needed to support and facilitate effective future actions. It is particularly useful in complex situations where multiple climatic and non-climatic factors are at play, increasing uncer- tainty. Below are three useful guides:

- ***Participatory Scenario Development Approaches for identifying pro-poor Adaptation options: capacity development Manual*** (The World Bank, 2010a);
- ***Formulating climate change scenarios to inform climate-resilient development strategies: a guidebook for practitioners*** (UNDP 2011);
- ***Decision-making for Climate Resilient Livelihoods and Risk Reduction: A Participatory Scenario Planning Approach*** (CARE International, 2012).

3.1.3.5 *other participatory tools for adaptation*

Christian Aid's (2013) "Good Practice Guide" participatory vulnerability and capacity assess- ment of this type of analysis explains what it entails, then provides a step-by-step guide to conducting one, including the main challenges that are likely to occur at each step and how to overcome them. This approach was developed in the realm of disas- ter risk reduction, but increasingly being applied to the livelihood of a wider set of risks.

Ten case studies from around the world, Drawing on its own experience and rural commu- nities, *Oxfam International* produced a report

(Pettengell 2010) that shows how "bottom-up" participatory approaches can be combined with top-down approaches to enable people living in poverty to adapt to climate change. The underlying what is philosophy? "learning to adapt as important as any specific intervention adaptation"; participatory processes thus not only identify adaptation needs, but help prepare communities to make informed decisions about adaptation to the ongoing change process at the moment.

ActionAid International has developed a tool for "participatory vulnerability analysis" for its work on pre-emergencies and conflicts that involves com- munities, local authorities and other stakeholders in-depth examination of what makes them vulnerable. A step-by-step guide for field staff (Chiwaka and Yates 2005) explains how to analyse people's vulnerability, draw, action plans, mobilize resources and work to enact appropriate policies, laws and strategies to reduce vulnerability.

International Centre for Integrated The *Mountain Development* (ICIMOD) has published a framework (Macchi 2011) for assessing the environ- mental and socio-economic changes affecting rural livelihoods, natural resource-dependent communities living in mountainous environments. It also gives guidance on how to gain a better understanding of the various forces which shape of mountain communities' vulnerabilities, and places a special focus on the inherent capacities of these communities for coping with and adapting to environmental and socioeconomic changes.

The UK-funded *Livelihoods and Development Programme* prepared in Nepal a community-based toolkit for practitioners (Regmi et al. 2010) that explains how participatory tools can be used to assess adaptation needs and to explore adaptation options. It covers climate hazard trend analysis, impact assessment and hazard ranking, livelihood resources assessment, vulnerability assessment, use of matrices vulnerability, coping and able to adjust- tion strategies, assessments, and community-based adaptation planning, among other tasks. Though written in Nepal, the material work is broadly applicable.

Further resources include:

- The *Red Cross and Red Crescent* vulnera- bility and Capacity Assessment guide (IFRC 2007), and an application of the methodology in Rwanda (IFRC 2003);
- *Practical Action* (n.d.) unique incorporated into climate risk commonly used vulnera- bility assessment methodology and capacity to make Adaptive Livelihoods framework is operational;
- *Bread for all* and *HEX* have developed a tool (Keller 2009), the resort is largely based on methodology and CRiSTAL (see above) to help analyse the existing or planned development projects with respect to climate change and disaster risks; A
- *UN-HABITAT* (2010) guides toolkit for local governments and others through participa- tory climate change assessments based on the experience of Sorsogon City, Philippines.

3.1.3.6 *Tools to ensure the participation of people who are often excluded*

There is extensive evidence that climate change impacts will disproportionately affect people who are poor, illiterate or marginalized (due to their sex, age, disability, caste, ethnicity, etc.). Without close attention to these issues, the links after adaptation efforts fail to address the needs of the most vulnerable target, and even reinforce existing disparities. Business the same is true of participatory processes: it takes a concerted effort to ensure that ***all voices*** are heard.

Many of the tools and guides described above directly address this concern. We describe below some resources to support inclusive and participatory processes.

Engaging Indigenous Peoples:

- The indigenous peoples ' Biocultural Climate Change Assessment Initiative has developed a methodological toolkit for local assessments (IPCCA n.d.), including methods and application total C C- tical examples. It provides a general frame- work that can be adapted to different local contexts.
- The synthesis of a conference held in 2008 by the international work group for Indigenous Affairs (Nilsson 2008) provides a good over- view of key issues, with recommendations (See also valuable for 2008 Polack context of pre - procedural justice).

Addressing gender issues in adaptation:

- The ***Gender, climate change and community based adaptation Guidebook*** (UNDP, 2010b) provides examples of mainstreaming gender issues in adaptation projects around the world. The resort has produced
- a guide (Internal RESORT- tional 2010a) to integrating gender and wom- adaptation in Eni's empowerment projects, starting with the differentiated assessment of vulnerabilities. The
- Global Gender and Climate Alliance website *www.gender-climate.org*) offers a wealth of resources, including a distillation of alliance members' experiences (Love et al. 2012)

One promising set of approaches business *participatory audio, video and photo stories* - multimedia tools that allow people to share their perspectives. A work of this kind can be time-consuming and resource-intensive, but it has the great benefit of bringing the voices and faces of people "on the ground" - and the scenes from their communities - directly to decision-makers and others with whom they might never encounter in person. These tools can also be fun to use and links to involve the youth, the elderly, people who can't read or write, and others whose voices might otherwise be excluded. Photo stories accomplish many of the same goals, but are less resource-intensive, require less bandwidth than Video When shared online, and can also be shared in print. Here are some helpful resources:

- InsightShare, a specialist in participatory video offers extensive guidance on its web- site, including a detailed manual (lunch and lunch 2006); see *insightshare.org/pv/pv-nutshell*; The
- Red Cross/Red Crescent Climate Centre has videos of participatory video training farmers in Africa: *www.climatecentre.org/site/films-by-farmers*; The
- Zeitz Foundation has published a blog- post Front photo stories with practical tips and guiding principles: *www.zeitzfoundation.org/index.php?page=newsblog&id=116*;
- ResourceAfrica UK has multiple examples of both videos and photo stories, many directly related to adaptation projects; see *www.resourceafricauk.org*; Institute
- for Development Studies (IDS) used unique photo-audio stories to bring knowl- edge about climate change and adaptation to communities in East Africa; for a discussion of sampling and the resulting work, see *community.eldis.org/.5b7d3fc4*.

3.1.4 *trademark facilitation*

As discussed earlier in this chapter, good facilita- tion of participatory processes are crucial in business. In this section, we present some of the trademark and guidance to help you be more effective facilitators. We should note that several resources cited earlier in this section are very valuable in this regard:

- The methodology of the resort described in Sec- 3.1.3.1 tion (Daze et al. 2009) offers practical tips (see pp. 30-33) and stresses the impor- tance of effective, sensitive facilitation;
- Bradley and Schneider (2004), a guide to participatory approaches published by

Voluntary service Overseas business geared spe- cifically to facilitators with extensive advice, tools and tips;

- Hovland (2005), which looks more broadly good at communication, it also offers useful advice facilitation of the front, as well as a list of name was- tional resources.

Some additional helpful resources include:

- Australia's Department of Environmental Protection has published a clear and comprehensive guide to facilitation (Keating 2003), with the advice of ten facilitation processes and techniques, tips for adding value and working with difficult situations and people, checklists and practical.
- Smith (2009), a free online guide more introduction to the theory and practice of facilitator's role in supporting processes of change in groups.

Participatory analysis tools 3.1.5

The tools presented here illustrate some of the ways that data can be gathered and prioritized to establish clearer examined in more depth and discuss alternative perspectives suggestive with those who encourage reflection to generate the information. They can also help participants to map out and understand the complex relation- ships and interactions and influences. Several of the tools presented in this section are are visual, which makes them particularly useful with people who are not literate - and require little input in terms of materials.

Note that these tools are most appropriate for infor- mal discussion and analysis. For a more structured approach, See section 3.2.3 and Section 3.1.3.4 to learn about participatory scenario analysis.

Problem and solution trees: This analytical tool helps to find solutions by exploring cause and effect around an issue in greater depth. It allows the problem to be broken down into manageable and definable chunks, enabling a clearer prioritiza- tion factors for focus and objectives. When done with a group, the tool allows you greater understand- ing of the interconnectedness and contradictory , which should lead to more causes to develop a workable solutions for everyone. See Hovland (2005), pp. 12-13).

H Diagram: This simple tool - literally, a diagram shaped like a wide H - can be used in numerous settings to rate something along a scale (e.g. con- cern about Dole - note from worried at all, to be extremely concerned, or quality of workshop - note from useful to very useful), moment providing easy-to-understand visual representation of the par- ticipants' responses.

Rivers of life: This tool can be used in many different ways: to help people get to know one another, reflect on their relationships, explore their hopes and fears about a new venture, discuss what was surprising or difficult project, etc. Participants are invited to use the symbol of the river to reflect on the key stages of their lives, or they are focusing on experience, identify and pos- itive impacts (tributaries) and challenges (rough waters). See Moussa (2009).

Force field analysis: This framework, developed by Kurt Lewin, helps to understand the factors that influence a given situation, either by driving the move- ment toward a particular goal (motivating forces) or blocking movement (constraining forces or barriers). Such forces can be very dynamic, vary- ing both over time and with experience and awareness of those tasked with identifying them. They can include aspects such as motivations, values, needs, personalities, goals, and ideals as well as the more structural aspects of orga- nizational decision-making. See Hovland (2005, pp. 14-15).

For descriptions of several other participatory ana- lytical tools, see Bradley and Schneider (2004) and *www.reflect-action.org/how*.

3.1.6 *large-group and whole-system techniques*

The tools described below to take diverse approaches , but are all based on trust and cooperation between a wide variety of participants. with the goal of encouraging creativity and new ways of thinking. Participants create strategies and action plans together and take joint responsibility for imple- mentation. There is also a tendency to focus on a positive vision of a desirable future rather than what has gone wrong in the past the front; this creates some incredible and the Energy (See also Section 3.1.3.3 for a discussion of "action research" approach).

Open Space Technology: This approach, used in a wide range of settings since the late 1980s, it brings together people to discuss a topic of mutual inter- est, then lets them set the agenda and manage the process. In the open space works best when the issues are complex and urgent, there are diverse ideas and agendas, and the desire for high resolution work, as this helps to focus in the front of people's minds, having conversations that matter. It is structured in a way that allows a great deal of flexibility for new ideas that may emerge through the process, and can be used with groups of a handful of people, or 2,000+ at a weekly staff meeting, or a multi-day conference. See *www.openspaceworld.com*.

World Café: This approach creates the moment, informal discussions and a relaxed setting, like a real cafe, with people seated around small tables - perhaps with tablecloths and drinks. World Cafe the good of the business and generating input for engaging large groups, sharing knowledge, and stimulating innovative thinking. It's also good for exploring a different per- spectives (e.g. key challenges or opportunities. The process by giving links a group to build the capacity of their own sense of knowledge and insight. The method has been used to a few groups with over 1,000 participants. See *www.worldcafe.com*.

Action Learning Sets: These are small groups (five to eight people who meet regularly to support one another in order to take their learning in pur- poseful action on an issue. A facilitator helps par- ticipants searching questions and to reflect the love to the actions to be taken. The Asian Development Bank has published a short guide for English and French; see Serrat (2008).

Pregnancy action research: This is a strategy for whole system change that works with live social and organisational issues to uncover their complex dynamics in order to identify interventions and support action to change the whole system. It consists of a set of concepts and approaches to extend the action research beyond the individual and group level organizations, governance systems and networks. See Burns (2012) for an overview and Harvey et al. (2012) for a discussion of the context of participatory action research in southern Ghana.

Citizens' juries: This approach works on the notion that given adequate information and opport-the nity to discuss an issue, a group of stakeholders can be trusted to make a decision in ten on behalf of their community, even though others might be considered to be more technically competent. Citizens' juries are most suited to problems where the selection needs to be made from a limited number of choices, and it works better value ten questions (whether or pathways are certain choices shall be deemed acceptable or desirable) with technical issues than ten. The jury assembled of work that is meant to represent a microcosm of the community, including its diverse interests and sub-groups. They hear testimony from a panel chosen by disinterested experts, and they also may call additional experts to clar- specify points or to provide extra information. For example, Financial, see Bryant (2008).

Barefoot Guides: The Barefoot Collective has developed several free guides to support leaders and facilitators working towards organizational change, seeking to improve their learning processes, etc. Website and supporting the guides explain the key concepts of Organizational Change, provide examples, and offer hints, and suggested exercises. The guides are aimed at leaders and facilitators of civil society organizations, but it can be helpful to anyone managing processes of engag- ing people around an issue or collaborating on a project. See *www.barefootguide.org*.

3.1.7 *conflict resolution techniques*

Conflict resolution tools can be used to reframe an issue being presented how to create opportuni- ties for dialogue and engagement, and even encourage , where the actors are in dispute. Useful tools include:

Nonviolent Communication: This is a communication process is often used in the conflict resolution. The front of it focuses on three aspects of communication: self-empathy (defined as a deep and compassion- ate awareness of one's own inner experience), empathy (defined as listening to another with deep compassion), and honest self-expression (defined as expressing oneself authentically in a way that is not and inspire others in compassion for others). See *www.nonviolentcommunication.com*.

The conflict spectrum: This is a practical exercise to foster understanding about an issue in which there is work conflict. People are asked to stand along now invis- ible spectrum line in relation to how strongly they feel about the issue. Individuals can then be quizzed about why they chose that spot and what might encourage them to move in a different direction along the spectrum. See Kraybill (2000, p. 8), which also provides useful advice on the front facilitation. ■

3.2 impact analysis

Approaches for analysing the impacts of climate change were introduced in Chapter 2 as the impact-Analytical Methods (section 2.1.2). In this section, we further separate those approaches into the detection and attribution of observed impacts (Section 3.2.1) and the modelling and indication of future impacts (section 3.2.2). Each of the methods described in this section relies front climate variables in one form or another, so it is useful to start by differentiating between three key terms: weather, climate and climate change.

Weather set of meteorological phenomena what we experience on a daily basis: temperature, rain- fall, cloud cover, windiness, etc. (AMS 2012). We expect changes in weather occur from day to day; and researchers often pay particular attention to extreme weather events that can have damag- ing the impacts of human activities and the natural environment, such as heat waves, strong winds or intense precipitation.

Climate in its wider sense is the state, including a statistical description, of the climate system (IPCC, 2012, p. 557). In a more narrow applications, the climate is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to millions of years or miles. The standard period for averaging these variables is 30 years in business, as defined by the World Meteorological Organization; the most recent updated issued by the WMO climate for 1961-1990. Many national meteorological agencies, however, every issue of rolling averages 10 years (most recently for 1981-2010), to provide more timely and recent preliminary data from ongoing changes in climate. The relevant data types covered are most often surface variables, such as temperature, precipitation, humidity and wind. *Climate variability* fluctuations of climatic variables to type

their average around the state, which are due to both the climate system to natural internal processes as well as external influences (such as modulations in the solar cycles and volcanic eruptions).

Climate change a job state change in cli- mate that can be identified (e.g. through statistical tests) means as altered and/or the variability of its cli- matic variables for that persist for an extended period, typically decades or longer. Climate change may be caused naturally or by internal processes by external influences affecting the climate system, or due to human-induced causes such as persistent changes in the composition of the atmosphere or in land use (IPCC 2012, p. 557). In contrast to the general definition, used by the IPCC, the United Nations Framework Convention on climate change (UNFCCC) defines climate change as only a change attributable to human activity that alters atmo- spheric composition and occurs in addition to the Nat- ural climate variability (United Nations 1992, p. 3).

3.2.1 *describing the impacts of current climate change*

In many places around the world, people report changes in weather and seasonal patterns, as well as natural systems. Which scientifically verifying these observations involves two kinds of exploratory data analysis: impact of trend detection and attribu- tion. The first focuses on establishing a pattern on front to distinguish from climate change to climate vari- ability - e.g. business really rainfall decreasing, or did we just have a couple of dry years, with no observable long-term trend? The second involves linking spe- cific impacts of climatic changes - e.g. attributing climate change to an increase in pest infestation. Thus these approaches start by demonstrating the impacts of recent trends (i.e., systematic changes in the natural environment, or aspects of human activities), for whatever cause (detection), and then relate them to trends in climate statistically (attribution). In Determining whether a trend due to natural or anthropogenic causes the business climate is also the type of attribution (see box 3.2.2). Such relationships, if they can be established, it may be very instructive in understanding and anticipat- ing future impacts the business, which of course vital to choosing the appropriate adaptation actions. They rely on empirical observations derived from the sys- tematic measurements, which are analysed in rela- tion to time (Section 3.2.1.1) or other variables (see Section 3.2.1.2).

3.2.1.1 *Detection of trends*

Carlo statistical methods

more

Time-series datasets that document the long-term behaviour of observed variables through repeated measurements collected over a period of time. Detection studies (box 3.2.1) use statistical tech- niques to determine whether or not a variable has changed over time, with no judgement made about the likely causes of that change (for laboratory U. et al. 2007).

At its simplest statist trend detection applies if-to - play model to time-series data in order to establish the form and strength of the changes over a given

BOX 3.2.1 ***Overview of trend detection***

Question addressed

There is a trend in observations?

Data requirements

Time-series data for the study unit (e.g., rain- fall measurements at a particular weather station)

Typical result

Statistically significant trend in the data- or no statistically significant trend

Generic steps

In the interest of variables to Select and apply statistical methods

period. For example, figure 3.2.1 below shows a graph depicting aspen trees in the flowering dates from 1901 to Canada in 1997, the mean bloom date for that period. The data appear to show aspens have been blooming earlier in recent decades. To demonstrate this, and the authors have fitted the data to a linear trend for the entire period, which shows a coefficient of determination (r^2) of 0.35. However, the dataset is incomplete, with notable gaps in the time series. Here it is advisable to plot trends for Feb-periods as well, and the authors note that the same trend (0.26 days per year) business seen in the well-reported years 1973-1997. First, such a trend is detected, its likely causes can be investigated through the attribution of impacts.

It can be applied to trend detection data associated with either natural or human systems. For example, Emanuel (2005) studied the destructiveness of tropical storms between 1949 and 2003 by using measures derived from systematic observa- cyclone activity over five ocean's po. He the upward trend of the moment found the strength of tropical cyclones after the mid-1970s, especially over the western North Pacific and North Atlantic Oceans. Pielke et al. (2008), on the other hand, analysed the economic damages associated with mainland U.S. hurricane landfalls from 1900 to 2005, normalizing the data to account for changing societal condi- po over the time series. Their results showed no long-term trend in economic damages over the study period.

3.2.1.2 *Attribution of impacts*

The impacts of the context, attribution to type a confirmation of the trend observed at that moment, the impacts can be directly related to a trend in climate. We use the definition below, but readers should be aware that this is only one of several alternative definitions used by researchers investigating the attribution of observed impacts to different causes (Box 3.2.2). Box 3.2.2 the attribution of the work in this form , referred to as method IV.

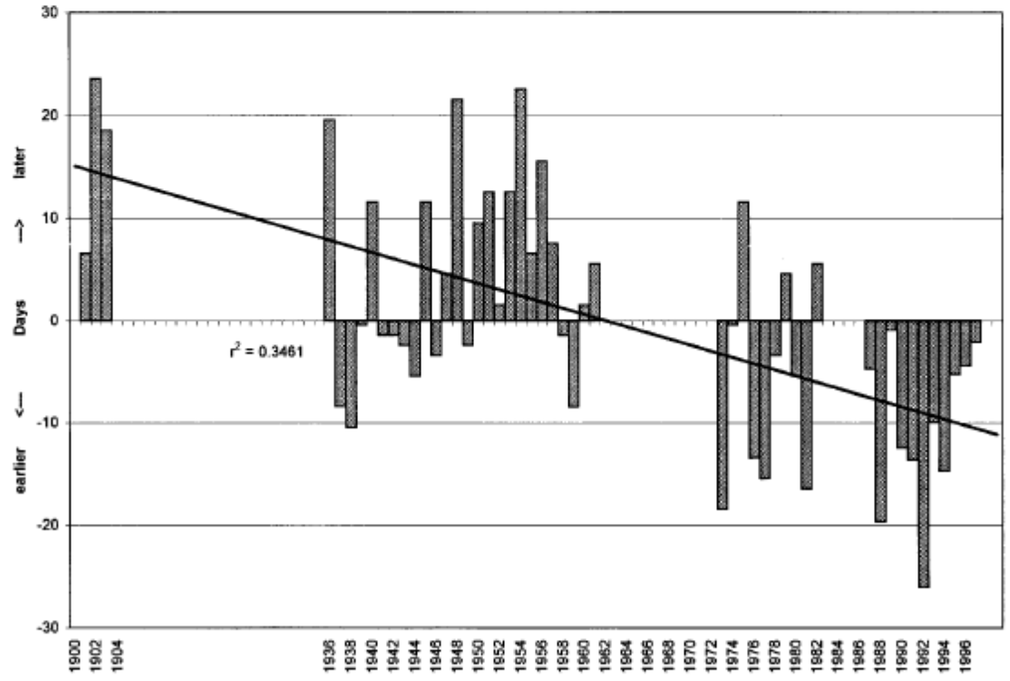


FIGURE 3.2.1 *First-flowering dates of Aspen (**Populus tremuloides**) at Edmonton, Alberta as deviations plotted in from the days of the long-term mean, the mean relative to the bloom date date bars (bars). A linear trend has been fitted to the data for 1901-1997.* Source: Beaubien and Freeland (2000).

The impact of attribution studies (Box 3.2.3), relationships between pairs of variables (i.e. univariate analysis) or sets of variables (i.e. multivariate analysis) are commonly explored through research designs, statistical methods such as regression analysis, correlation and analysis of variance. Both external factors such as climate, land-use change and air pollution, as well as a unit to study the internal factors (e.g. adaptive capacity; cf. Yohe and Tol 2007) can account for the observed impacts, so explanatory vari- Ables the user should be carefully selected based on theory and literature. A general issue for attribution stud- ies may be possible to the sheer number of expla- tory variables, which is not conducive to building statistical models. Other challenges confronting analysts may include:

- *Discontinuous time series*: Abrupt changes or breaks in the time series must be identified and treated prior to analysis.
- *Scale issues*: The data for the explanatory variables must be matched to preliminary data observed impacts.
- *Sample biases*: The bell systematic errors prej- udice evaluations and findings, especially the observed impacts of sampling biases (e.g. over-reporting of climate-sensitive

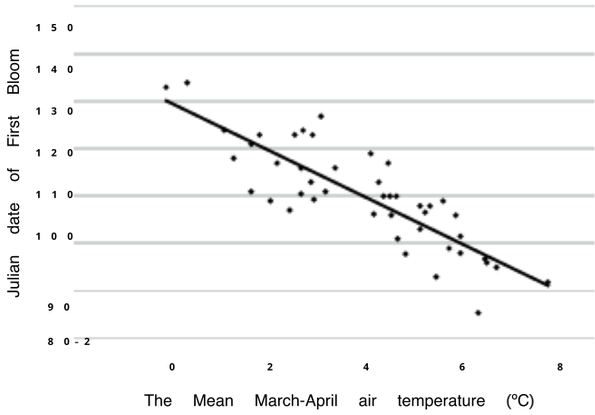


FIGURE 3.2.2 *Relationship between the Mean March-April air temperature (**Populus tremuloides**during 1936-1998 in the area of Edmonton, Alberta. Each point represents a single year.* Source: Beaubien and Freeland (2000).

BOX 3.2.2 ***Approaches to attribution of the change (based on laboratory U. et al. 2010)***

The meeting was convened in 2009, the IPCC experts moment to clear up the confusion about attribution among different research communities. The result was a guidance document (for laboratory U. et al. 2010) that distinguishes between four methods of attribu- tion commonly found in the literature. The first three focus on the attribution of impacts and/or cli- mate change are external forcings, a rise in green- house gas levels in the atmosphere. The fourth addresses the link between impacts and climate as the main driver without addressing the pos- sible causes of any changes in climate.

- *Method: a single-step attribution to external forcings* involves detecting a significant change in a variable of interest (e.g. mean daily temperature, or aspen bloom date) and then comparing with the observed changes in those expected, usually based on modelling of the response variable to external forcings and drivers. Attribution work demon- strated a statistically significant if a match is found and other confounding factors can be ruled out. An example of the direct statistical association established root et al. (2005) a northward shift in between the range of the species in the northern Hemisphere and the responses predicted by the models of anthropogenic climate change.

continued

BOX 3.2.2 *continued*

- *Method II: multi-step attribution to external forcings* involves attributing moment the observed change of a variable of interest in climate change and/or environmental conditions, and then attributing that change in climate and/or environmental conditions and external forcings to external drivers. Now the first example would be to attribute changes in spring phenology in the region, such as earlier Bloom Times observed with increases in mean temperatures (see example in Figure 3.2.2), and then in a subsequent step, cooler temperatures relate to those anthropogenic climate change by comparing them with the modelled temperature changes. This example differs from the method is that it takes two steps to make the connection. Each step in multi-step attribution has its own level of confidence with confidence combined result in Comment than buy each individual step.

- *Method III: Associative pattern attribution to external forcing* similar to method II, but rather than analysing a single variable , in the interest of this method involves the synthe- sis of large numbers of results (often across multiple systems) and the demonstration of the association between these and the moment impacts of climate change, followed by the attribution of this external forcing of climate change and drivers (often using spatial and tempo- ral measures of association). For instance, Rosenzweig et al. (2008) demonstrated that the pattern of changes in the natural physical and biological systems datasets in at least 20 years' duration since 1970, be better better explained by the pattern of observed temperature over the same period than by temperature patterns simulated by climate models assuming no external forcing.

- *Method IV: Attribution to a change in climatic conditions (climate change)* demonstrate that involves assessments of the moment (the Association process based on knowledge) between observed at the moment of the change of a variable of interest and an observed change in climate conditions - for example, between warmer springs and aspen earlier bloom dates. This method can be one of the steps in multi-step attribution, but it can also be used on its own to address climate impacts on a variable of interest.

Scientifically and politically one of the most important conclusions of the IPCC in its ***Second Assessment Report*** the attribution was state- ment (using the Method I) that "the balance of evidence suggests a discernible human influence ten global climate" (IPCC 1996, p. 4). This conclusion has been strengthened if it is in the sub- quent reports, and presented new evidence to the front to impacts observed using Methods II and III show that "it is likely that anthropogenic warm- ing has had a discernible influence on many of the ten physical and biological systems" (IPCC 2007a, p. 9). Moreover, any historical climate change, regardless of cause, which resulted in observed impacts (e.g., determined using Method IV) could also have led to adaptation responses. Hence, the study of such situations might be instructive in preparing for adaptation under future climate change.

3.2.3 BOX ***Overview of the impact of attribution***

The theoretical assumption

Climate and/or non-climate drivers are responsible for the observed impacts

Question addressed

Which combination of variables can explain the observed impacts on the study unit?

Data requirements

- Data pre-observed impacts
- Data pre-potential explanatory variables

Typical result

Statistical model explaining the observed impacts

Generic steps

1. Select potential explanatory variables based on theory and literature
2. to Apply statistical methods

biological species, etc less sensitive species) or publication bias results towards showing positive associations with climate and away results from exhibiting no long-term change.

- *Non-climate drivers*: Climate is not the only variable that gives rise to the impacts;
- *Correlation vs. causation*: Care must be taken not to conflate the two.

In the example demonstrated in Figure 3.2.1 a trend in flowering dates of Aspen during the 20th century. The authors then explored the possible causes or attribution of this trend, and that concluded in March-April mean temperatures in the Edmonton region exhibited a strong correlation with flowering dates (Figure 3.2.2). They also have established relationships with ocean temperatures in the Pacific, including

TABLE 3.2.1 *Attribution studies Impact by sector.*

Sector	*Examples*
Agriculture	Crop responses (Lobell 2010) Livestock productivity and welfare (Gould et al. 2006; Mellor and
Water Resources	Wittmann 2002) groundwater resources (Stefanopoulos and gemitz 2011) Drinking Water resources (Kistemann et al. 2002)
Health	Mortality associated with extreme weather (Conti et al. 2005; Hajat et al. 2002; Keating et al. 2000; Barnett et al. 2005; Schwartz and zanobet 2008) weather events and disease outbreaks (Wu et al. 2007; Reyburn et al. 2011; Checkley et al. 2000; Singh et al. 2001; Hurtado-Diaz et al. 2007; Simmonds and Keay 2006)
Coastall Marine	temporal patterns of start dates of the pollen seasons (emberli et al. 2002; Van Vliet et al. 2002) Fisheries catch rates (Menard et al. 2007; Corbineau et al. 2008) open-sea species range (Edwards and Richardson 2004) responses of Species (Beaugrand et al. 2002; Beaugrand and Reid 2003; Brander 2005; Dutil and
Biodiversity	Brander 2003) Vegetation dynamics (Herrmann et al. 2005) Phenological events (Schleip et al. 2006) Animal responses (Erikstad and Sandvik 2008; Chan et al. 2005)
Other	insurance and reinsurance markets (Romilly 2007; Klawa and Ulbrich 2003)

the influence of the El Niño-Southern Oscillation phenomenon (Beaubien and Freeland 2000).

3.2.1 examples table identifies the impact of attribu- tion across different studies support. Shumway and Stoffer (2011) provide additional guidance for the Ten Techniques of detection and attribution of observed impacts. They have written a textbook on time series analysis accessible to non-statist the- cians, which includes software examples for the R computing environment.

3.2.2 *Modeling future impacts*

Climate science is a key insight from the sharp rise in anthropogenic greenhouse gas emissions has begun, and will continue to alter climatic pat- terns around the world. We can use Whilst walking neighbourhood- cal recent observed trends to detect and attribute changes, to determine the likely future impacts - and the need for adaptation planning - it is neces- sary to make use of models.

Selection of the methods for projecting future impacts of climate change starts with a determin-the nation of whether the causal relationships between the study variables describing the behaviour of a unit and the external drivers of change can be formally represented as a computational model (See section 3.2.2.1). Adaptation in situations where models are not available, the indication of vulnerability approaches (Section 3.2.2.2) can be used to say something about possible future impacts based on preliminary data collected on the study of the current state of the unit, combined with decreased levels of changes in cli- mate variables of study to which the business unit known to be sensitive. Alternatively, knowledge elicitation (section 3.2.4) provides a means of surveying and classifying expert and lay opinions about climate change and its potential impacts. We conclude this section with a detailed overview of the studies employing these methods in a variety of different contexts (see Section 3.2.5).

Modelling future impacts involves the deploy- ment of methods and tools drawn from a formida- ble and ever-expanding range of options. A large proportion of climate change impact assessments to make use of predictive models that describe the causal relationships between climate and a study unit. However, modeling tools tend to be avail- able only for certain support, such as agriculture, water resources, coastal zones, and terrestrial ecosystems.

Technical requirements for projecting climate change impacts are generally high and often dif- ficult to meet in so many cases it will be prefera- ble to adopt an existing model and tailor it to meet specific assessment context or adaptation

BOX 3.2.4 ***The impact of projection Overview***

Theoretical assumptions

- The study unit and the interaction between drivers of change can be formally repre- sented as a computational model
- Adaptation can be formally represented as a computational model

Question addressed

What are the impacts of climate change?

Data requirements

- Climate and socio-economic scenarios
- Information about adaptation options

Typical result

Each scenario is a list of propositions that map to the moment of impact and adaptation option.

Generic steps

1. Select climate and socio-economic scenarios
2. Select adaptation options for the use of model
3. Compute the impacts of the scenarios and adaptations

needs. Models vary enormously in their complexity, the spatial and temporal scale of their application, and their assumptions about adaptation, but the process is generally the impact of the business projection is the same: to select the climate and socio-economic scenarios, choose a different adaptation options and strategies to examine where these can be simulated, and then compute impacts. Each of these steps is described in detail in the following work on Feb-sections. Scenario analysis For a discussion of the adaptation of this Section, see Section 3.4.

3.2.2.1 *representing adaptation*

Note that Projecting climate change impacts depends on not only the climate and socio-economic scenarios that are selected, but also the assumptions that are made about adaptation. It is therefore important to carefully consider whether to choose models that project ***potential impacts*** which are those that may occur without considering adaptation (Fussel and Klein 2006), in contrast to the tools that project ***residual impacts*** which include adaptation.

The most natural and human systems will undergo some form of autonomous adjustment in response to either a sudden or gradual changes in climate shocks, so it is not generally understood is that potential impacts will almost certainly occur in the note. However, it is important to note that the purpose of repre- senting the impact of adaptation, projection Business note the moment to compute optimal adaptation to the policy, but to model how different assumptions about possible adaptation measures translate into differences in impacts. In other words, the selection of able to adjust- tion strategies to represent the impact of projection serves the same purpose as the selection of cli- mate and socio-economic scenarios: to explore a range of possible futures. This is a good example of a win and either the non-linear nature of the adopted- tion: when this approach is taken, impact analysis, which is part of the first stage of the adaptation process (Section 2.1), incorporates results the second stage, identifying adaptation options (see Section 2.2) and by modeling the residual impacts, informs the third stage, appraising adaptation options (see Section 2.3). We should note that adaptation options (e.g. new infrastructure, or drought-resistant crops) may be easier to model than others (e.g. strengthening local institutions).

3.2.2.2 *model-based guide for practitioners*

Selected scenarios and adaptation strategies identified projecting climate change impacts of the deployment comes down to models that can calculate the interaction between drivers of change and the study unit. It is common to discriminate between models that represent the physical or biological systems of direct responses to climate, sometimes referred to as first-Order or ***biophysical models*** models estimate that the socio-economic implications of such biophysical impacts, known as higher-order or ***socio-economic models***. Also ***model-based integrated anal- analysis*** which attempts to capture the complex interactions of the first and second-order effects in order to provide insights about their implications in a changing climate and changing world.

Biophysical models

Biophysical impact models for a range of complexity, from simple monotonic relationships established between a single variable and a single climate response type (e.g. high temperature up to ten effects of excess mortality among elderly people), through to complex simulation models where develop- ers have attempted to incorporate all the pro- cesses to be thought of importance in determining the responses of the system. Examples of the latter include dynamic vegetation models and basin-scale hydrological models.

All biophysical models rely on empirical relationships between driving variables and system

analysis of the responses at some scale, but the level of empiricism varies enormously. In process-based models, many of the equations describing physical or biological processes are well established, theo- retically and empirically have been verified (e.g. water flow processes in photosynthetic plants or soils). Other processes may be less well estab- lished and are subject to greater uncertainty (e.g. long-term response of different tree species to increases in atmospheric CO_2 concentration). Taken together, the description of the interacting pro- cesses allows for a deeper understanding of the behaviour of the different components of a complex system and hence a better appreciation of the rea- sons given for the response of a system. However, such models tend to be very demanding of data, expertise and time for model testing and applica- tion, which may limit their use in different regions.

The Model estimates of future impacts is increasingly rely decreased levels of not only climate, but also ten other conditions that affect either of the scenarios direct impacts (e.g. changes in the atmospheric com- position or sea level) or precondition sensitivity to the impacts (e.g. population, income, Land Use and land cover change or technology). To assist users, process-based models with potentially wide application s are being packaged in a user-friendly decision support systems, where users are able to model the impact of the need to tailor their own assessment being provided with detailed guidance and procedures for data collection, model calibration and testing, as well as advice and built-in tools for statistical and graphical analysis and interpretation of the model outputs.

Table 3.2.2 identifies examples of decision support tools that are used in conjunction with impacts projection.

In contrast, at the other end of the spectrum are simple empirical-statistical models that are based on the overall statistical association between an exposure unit and a set of response climate

TABLE 3.2.2 *A selection of Decision Support Tools by sector.*

Sector	*Examples*
Agriculture	APSIM, the agricultural production systems simulator (*www.apsim.info*) DSSAT decision support system for Agrotechnology Transfer (*dssat.net*) GRAZPLAN four models to support decisions for grazing systems (*www.csiro.au/en/Organisation-Structure/Edit/Plant-Industry/GRAZPLAN-integrated-decision-support-for-farming.aspx*)
Water Resources	WEAP water evaluation and planning system (*www.weap21.org*) RiverWare, a general River and reservoir modeling tool (*www.riverware.org*) WaterGap, Water Global Analysis and Prognosis (*www.usf.uni-kassel.de/cesr/index.php?option=com_project&task=view_detail&agid=47&lang=en*)
Biodiversity	GLOBIO3 a global biodiversity assessment model (*www.globio.info*) LPJmL, Lund-Potsdam-Jena managed Land dynamic global vegetation and water balance model (*www.pik-potsdam.de/research/projects/lpjweb*) DIVA,
Coastal/ Marine	the dynamic Interactive vulnerability assessment, an integrated model for assessing the consequences of sea-level rise (*www.globalclimateforum.org/index.php?id=divamodel*) Roadmap for adapting to Coastal Risk*www.csc.noaa.gov/digitalcoast/training/roadmap*)
Multi-sector	SimClim, the simulator of climate change risks and adaptation Initiatives (*www.climsystems.com/simcliml*) CLIMSAVE IA platform for Integrated Assessment of impacts, adaptation and vulnerability in Europe (*86.120.199.106/IAPI*) CIAS, Community Integrated Assessment System, a system of linked energy, climate, and economic impacts models (*www.tyndall.ac.uk/research/cias*)

predictors, without consideration of by- diate process that might have produced a given response. Here, the statistical associations are sought between the observed responses to climatic variations over long periods of time or across geographic or an altitudinal climatic gradients (CF. impact attribu- tion in Section 3.2.1.2). Impacts of future climate change are estimated by applying the same statis- tical relationships observed in the past and assum- ing that they can be extrapolated to future conditions that can be represented using climate scenarios.

Such models include the advantages of minimal data requirements (usually only observations and climate scenarios readily accessible variables) and speed of the application. However, there can be major extrapolation of the pitfalls of relying ten statis- tical relationships to represent the responses under future conditions. Consider, for example, the effects of climate warming in wheat yield ten cen- tral Europe. Simple regression of wheat yield and temperature might reveal a negative association between wheat yield and temperature (decreased yields in warmer and cooler years in higher yields in years). When applying a statistical correlation with future warming scenarios would therefore predict reduced crop yields. However, use a process-based model that incorporated not only the negative effects of increased temperature on the front of yield, but also the positive effects of future co ization, as well as the effects of changes in soil mois- fertile-

species might produce yield responses that are quite different for the same scenario, but warming also increased CO_2 concentration and precipitation changes.

To conclude, analysts wishing to apply the biophysi- cal models projecting future impacts, whether process-based or statistical, need to carefully con- sider the outcomes required from the modelling exercise. This involves weighing their confidence in the capability of a model to provide a reliable representation of the responses to future change conditions alongside the simplicity of its appli- cation and possible limitations imposed by the data computing expertise and capacity.

Modelling of the socio-economic impacts

Higher-order effects of climate change on human society are most commonly expressed in terms of the economic cost, though other metrics may also be employed in the Regional Quality Manager (e.g. number of persons affected or at risk of potential negative impacts, Parry et al. 2001). This guidance provides only partial con- sideration of the higher-order effects, although their assessment work necessary for a full understanding of future impacts.

A recent review of economic assessments of adaptation costs in Europe for the ClimateCost project, Watkiss and hunt (2010) observe that the boundary between the assessment of impacts (damage and adaptation costs of Business drawn differently depending on the study authors. They also identify a number of variations in approaches to assess- ment, including whether:

- Future socio-economic change in the job adequately accounted for in the cost estimates for future impacts; climate changes are
- sufficiently distinguished from the present-day climate variability and the so-called "current adaptation deficit", which relates to the (in)effectiveness of the current account for adaptation to ongoing climate variability; climate change
- should be cost should be weighed against possible benefits and reported as "net costs" (e.g., where energy costs increased summer cooling are assessed alongside reduced costs of heating).

Some of the main methods of assessment of the eco- costs of other examples of their application, along with their advantages and other issues are summa- rized in Table 3.2.3.

Table 3.2.3 *Economic assessment of climate change and frameworks and Methodological models adaptation (altered from Watkiss and hunt 2010).*

Approach	*Description*	*Examples*	*Advantages*	*Issues*
Economic integrated assessment models (IAM)	Aggregated economic models; values in future periods are expressed in absolute terms (EG £) as % GDP and Ace values over time (present values)	Global Studies (e.g., de Bruin et al. 2009) that provide outputs for Europe	Headline Provide values for raising awareness Very flexible - wide range of potential outputs	The represe aggregated and low- impact in; generally exclude extreme events and adaptation note capture any realistic form; not suitable for detailed national planning
Investment and financial flows (I&FF)	Financial analysis; calcu- Lates the costs of adaptation (increase against future baseline)	Global Studies (e.g. UNFCCC, 2007; Parry et al. 2009) national studies (e.g. the Swedish Commission on climate and preliminary Vulnerability 2007) National	The adaptation costs in the short-term policy time-scale even easier to apply without detailed analy- sis of climate change	No specific linkage with climate change or adaptation (though can be included) no analysis adaptation of the Bene- fits or residual impacts
Computable general equilibrium models (GCE)	Multi-sectoral economic analysis	level - Germany (Kemfert 2007); EU review (Osberghaus and Rafe 2010)	Capture cross-sectoral linkages of the economy wide models (note that in other approaches) can represent the global and trade effects	Representation of the Aggregated impacts of issues with decreased levels of sectoral linkages Omits non-market effects are not suitable for detailed National Planning
Impact assessment (scenar- IO-based assessment)	Physical effects and eco- costs of the other climate change sectoral models in future periods, and the costs and benefits of adaptation or cost-EF- fectiveness analysis	Multi-sectoral study PESETAS (Ciscar et al. 2009); national scale: flooding UK (Thorne et al. 2007) and Finland (Perrels et al. 2010), Sector	More sector-specific analysis Provides physical impacts as well as economic values - therefore can capture gaps and non-market support it	Note to be able to represent a cross-SEC- toral, economy-wide effects tends to treat adaptation as a menu of hard (technical) adaptation options less relevant for short-term policy
Impact assessment - shocks	Use of historical damage, loss of relationships (statis- tics and econometrics) applied to future project- po shocks combined with adaptation costs (and sometimes benefits)	level, e.g. National Audit Office study in the UK (NAO 2009) and FINADAPT the study in Finland (Perrels et al. 2005),	Allow consideration of future climate variability (in addition to future trends)	Issues of applying historical relationships to the future with issues of high uncertainty in predicting future extremes
Impact assessment - econometric - based	Relationships between economic production and climate parameters derived with the economet- ric analysis and applied to future scenarios and to consider adaptation; Ricardian analysis relates to land prices in regional climate and other factors	National-, sector - or household-level Ricardian analysis has been applied in agriculture (e.g. Lippert et al. 2009)	Links provide infor- mation ten overall economic growth and allow analysis of the longer-term effects Provide greater sophis- tication with level-of - detail	Mostly focused on pre-autonomous or non-specified adaptation relationships very simplistic to represent complex parameters no information pre-specific attributes pre relationships whether Issues are applicable to future time periods

Table 3.2.3 *continued*

Approach	*Description*	*Examples*	*Advantages*	*Issues*
Risk management	Current and future risks to climate variability; probabilistic approach.	Flood risk studies (coastal and river)	Well suited for current and future risks and uncertainty, often used with cost-effectiveness analysis Has been applied in adaptive management and analysis	The extra dimension of complexity associated with the probabilistic approach has Limited applicability: focused front thresholds (e.g. risk of flooding)
Adaptation assessments	Risks over a range of policy / planning horizons; often linked , risk management and adaptive capacity	No real eco- other examples; number of emerging adaptation of assessments	either win Stronger focus on pre - immediate adaptation needs and policy decision-making under uncertainty and greater consideration of diversity of adap- can soft-including options) and adaptive capacity	Less explored in relation to economic assessment

Model-based integrated analysis

Now the important technique for assessing broader scale effects of climate change, to integrate bio-physical and socio-economic models. Rather than attempting to represent all the processes within a single integrated assessment model (IAM) as some researchers do at the global scale (see, for example, the models used to develop scenarios for the IPCC in Nakicenovic et al. 2000), a model-based integrated analysis based on the separate links are also models that are run independently and in parallel. The models are soft-linked "with one serving of the outputs as inputs for another, in order to explore the relationships between components of an integrated system. Many multi-sector impact assessments have been conducted using this type of framework, often using a common set of exogenous climate and socio-economic scenarios to ensure consistency and promote synthesis across the modelling exercises.

Examples at different scales include a global study pre impacts of climate change-food security, water stress, flood risk and coastal wetland loss, exposure malaria risk and terrestrial ecosystems (e.g., Arnell et al. 2004), an evaluation of climate change and ecosystem services in Europe, including models of species biodiversity, water resources, forest growth, and terrestrial carbon cycling, land use change (Schröter et al. 2005), and modelling Regional Climate Change Impacts front of the agriculture, biodiversity, coastal zones and water resources in northwest England, East Anglia and the REGIS project (Holman et al. 2005; Holman et al. 2005).

A development of this approach, positioned at the boundary of the class of IAMs with proper business models are represented by the community Integrated Assessment System (CIAS - Warren et al. 2008). The CIAS seeks to address some of the challenges posed by Integrated Assessment modellers Risbey et al. (1996), by:

- Alternative sets of Connecting together component modules (Figure 3.2.3). Each set of modules connected component business is broadly equivalent to the IAM. It is a flexible and multi-modular to allow a range of policy questions to be addressed, thus facilitating interaction with stakeholders either win.

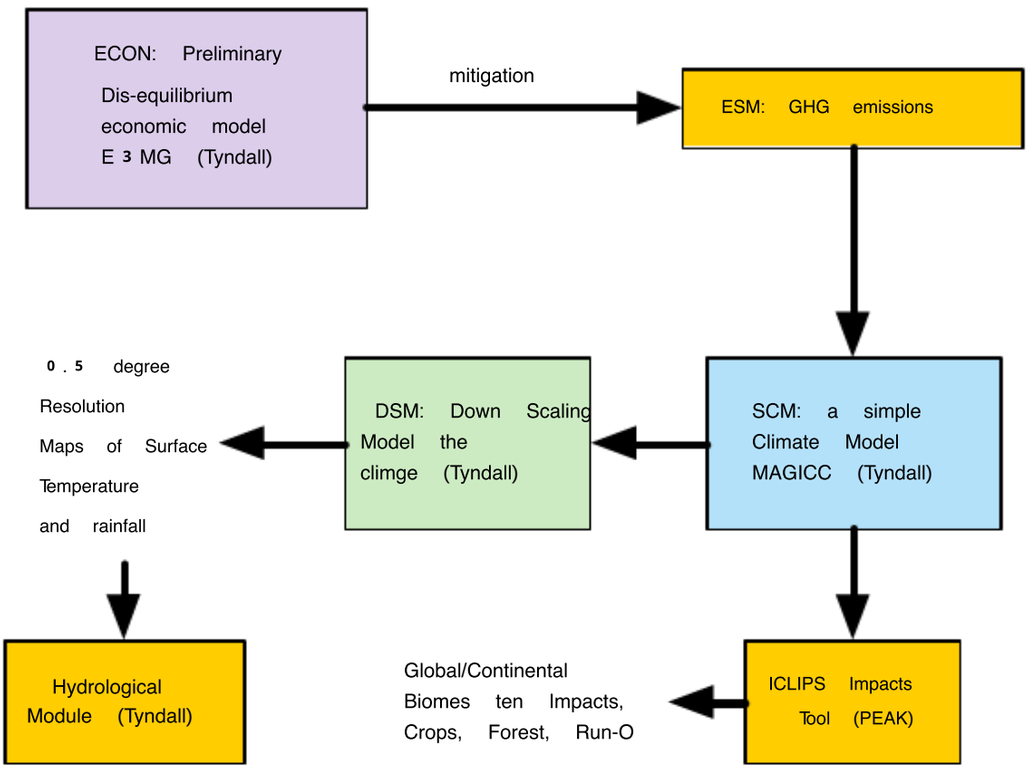


FIGURE 3.2.3 *Operational components of the community Integrated Assessment System (CIAS) at the time of distributed with contributors reporting in parentheses (Warren et al. 2008). Note that the Tyndall Centre is a business in itself distributed among eight research institutions throughout the United Kingdom.*

- A distributed Operating system model deployed across a wide range of institutions in different countries, which promotes greater diversity and comprehensiveness of the model- ling components, pre drawing a wide range of international expertise , Enabling
- models to communicate with each other regardless of the operating system or Preferences com- the computer language.

In various combinations of the modules depicted in Figure 3.2.3 can be used to address different policy questions (Warren et al. 2008).

3.2.3 *indication Vulnerability*

Indication of Vulnerability has been used in many contexts around the world to evaluate and compare the vulnerability of different populations to climate change impacts. Indicators and indices also a popular option for prioritizing adaptation interventions (Klein, 2009; See also Klein, 2010). Section 2.1 discusses some of the major criticisms and concerns relating to vulnerability indication. However, when used to gauge social vulnerability - in lieu of, or preferably, in conjunction with analysis of impacts - these approaches can provide crucial information for Climate Risk Assessment. Social vulnerability analysis assumes that political, institutional, economic and social structures interact dynamically to influence exposure. From this perspective, adaptation involves "altering the con- text in which climate change occurs, so that you landed- viduals and groups can better respond to changing conditions" (O'brien et al. 2007, p. 76). That type of business analysis the primary focus of this section.

Before delving into social vulnerability indication, we should note that many indices and indicators that go well beyond these aspects, and aim to cover

BOX 3.2.5 ***Vulnerability Overview indication***

The theoretical assumption

Individual or social capacities and external drivers are responsible for climate impacts, their interactions, but cannot be reliably simulated using computational models

Question addressed

Combinations of variables Which give indication of how climate change may impact the study of the unit?

Data requirements

Data pre -, indicating potential variables

Typical result

A function that maps the current state of the unit is a measure to study the possible future impacts

Generic steps

1. Select variables indicating potential based on the literature based on
2. Aggregate variables indicating the theoretical and normative arguments

full range of climate risk, including exposure and sensitivity to hazards. Accordingly, some indicators (primarily of exposure and sensitivity) are drawn from the biophysical realm, while others (mainly describing adaptive capacity) are drawn from socio-economic statistical sources. Indicators can then be combined to form indices: either as a COM- posite, where the Make-Up landed on the component- cators apparent business or an aggregate, it is where note (Eriksen and Kelly 2007). Many indices have focused on pre-adaptive capacity, for use in conjunction with exposure and sensitivity (biophysical vulnerability) data. Increasingly, these kinds of analyses are also pro- duce spatially explicit information - literally, the map- ping of vulnerability and adaptive capacity to show how adaptation needs vary across locations (see, e.g., Preston et al. 2011; Acosta et al. 2013).

There have been several attempts at developing national-level indicators and indices aspects of social vulnerability, varying the nature of each security vulnerability addressed the hazards involved, and the geographic region. There is a strong trend attempting to refine the index for each building on its predecessors by adding to complexity. This can occur through a variety of means, e.g. by increas- ing the number of variables considered, and/or using more sophisticated techniques of econo- metric and statistical modeling to transform and aggregate the indicators. The first vulnerability indices ten focused on small island developing states (e.g. Briguglio 1995; Crowards 1999; Easter 199 Kaly et al. 1999a). The moment index of social vulnerability to climate change-induced changes in water avail- ability has been created for Africa (Vincent 2004). Assessments of vulnerability to climate change has also taken place at Mar-a national level. For instance, Figure 3.2.4 depicts district-level vulner- ability to climate change, the agricultural sector in India, based on a set of composite indicators (O'brien, Leichenko et al. 2004).

Whilst many indices have focused on pre-spe- cific regions, others have taken a more global approaches to assessing vulnerability and resil- ience, explicitly in regard to climate change (UNEP, 2001; Moss et al. 2001). In recent years, var explicit indices have been released, including the Global Adaptation Index (*index.gain.org*), World Risk Index (*worldriskreport.org*), and Climate Vulnerability Monitor (*daraint.org/climate-vul- nerability-monitor/climate-vulnerability-mon- itor-2012/*). Clearly there is a policy for appeal of such global indices, particularly given the speed for the transparent allocation of a growing pool of adap- funding. However, a recent study showed that the sector-specific or hazard-specific criteria give a more robust assessment of vulnerability, since the

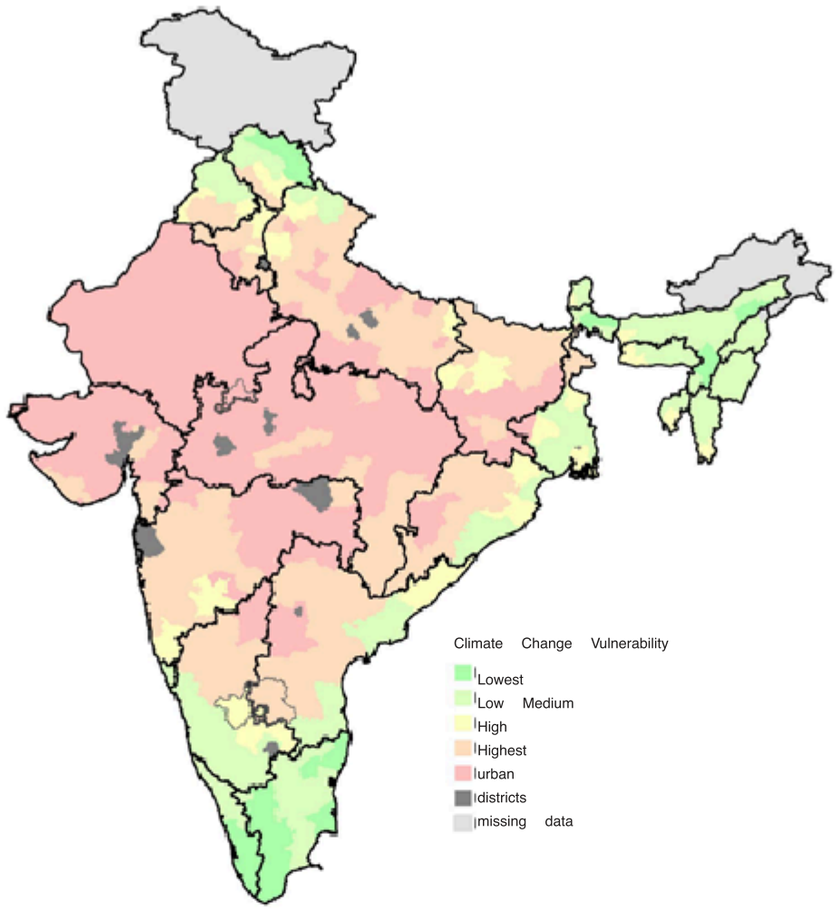


FIGURE 3.2.4 *The agricultural sector Vulnerability to climate change of India, by district. Business Vulnerability sensitivity and adaptive capacity to climate indices computed as a composite of exposure under climate change.* Source: o'brien, Leichenko et al. (2004).

patterns of vulnerability factors for different sectors vary geographically (Fussel 2010).

The methodological debates on the use and construction of indicators have grown, commensurate with the range of indicators and indices (for a review, see Fussel 2009). One of the most fundamental distinctions between business and the moment inductive (data- driven) and deductive (theory-driven) approach (Niemeijer 2002). The former is a large number of potential vulnerability indicators might be chosen in what has been labelled a "vacuum cleaner" approach (UNEP 2001). Final selection might occur by means of expert judgement (Kaly and Pratt 2000; Kaly et al. 1999a; 1999b), or principal components analysis to determine those that account for the largest proportion of the vulnerability (e.g. Easter 1999). However, the weakness of this proxy variable for vulnerability must be chosen as the benchmark against which indicators are tested - somewhat paradoxically, as the very reason why vulnerability indicators that are needed there is no such tangible elements of the vulnerability. The alternative theory-driven approach, in which existing theoretical insights into the nature and causes of vulnerability are used to select variables for inclusion (Edgar 2006), although in practice this necessarily occurs within the limits placed by data availability (Briguglio 1995). This inevitably leads to the subjectivity of the choice of indicators, but this can be addressed by ensuring all decisions are grounded in the existing literature and made fully transparent.

Although a number of indicators and indices have been devised for assessing social vulnerability to climate change, there is no "one fits all" blue-print preferences that can be used regardless of context. Indicators are context-specific and typically cannot be transferred to different scales of analysis (e.g. GDP per capita might work as thu a national-level landed- cator, but does not easily translate to the village level). Whilst the driving forces of social vulnera- bility might be similar, the appropriate indicator to capture that at a national level, will likely differ- ent from that at Feb-national level (Vincent, 2007; Eriksen and Kelly 2007). A recent paper reviewed the use of indexes in a variety of circumstances, concluding that they are most appropriate for identifying vulnerable populations at the Feb-national level (Hinkel 2011). Various indices have been created for assessing social vulnerability at the community level (Vincent, 2007; Hahn et al. 2009; Bell, 2011), based on household-level data.

The value of the disputed vulnerability indices in the business literature (Hinkel 2011). Some of these criticisms relate to indices in general, and relate to others the nature of the vulnerability. A critical evaluation needs to take account of the limitations of indices in gen- eral when assessing vulnerability. Business vulnerability is multi-dimensional in nature and to the state board that time - and scale - specific. It's impossible to verify the vulnerability at this point in time, and thus links generally portray not only a measure indicators of the relative vulnerability (such as between places or between time periods). Similarly, it is impossible to represent the inter-relationships between the differ- ent driving processes or determinants that interact according to different ways of temporal and spatial scales of analysis (Wilbanks and Kates 1999; Dow, 1992). Given these uncertainties, many of them use indices to show the current data presented above current social vulnerability, on the grounds that if the vulnerability that exists now, it will likely be a / commit themselve to- fied when exposure changes in the future.

However, the current conditions are unlikely to remain constant into the future, when climate changes are projected to occur. Although some indices have embraced the use of socio-economic scenarios (e.g. Moss et al. 2001), others suggest that current best possible proxy vulnerability (e.g. Edgar and Kelly 1999), identifying appropriate for the job and the means of increasing resilience, coping ranges and adaptive capacity (Edgar et al. 2003). Ideally the index should be updated annually with new data in order to capture temporal shifts. Now argu- ment for future modelling socio-economic condi- Po, on the other hand, it allows analysts to explore the sensitivity of the resulting composite indices plausible future trends,for example, make a bigger difference than does a change in GDP, changes in women's educational levels? With all ace

BOX 3.2.6 ***The UNFCCC Compendium of methods and tools to evaluate impacts to the front, and vulnerability and adaptation to, climate change***

As part of the Nairobi work Programme, front-impacts, vulnerability and adaptation to climate change, the secretariat of the United Nations Framework Convention on climate change (UNFCCC) main- tains its website a compendium of knowledge sources: *unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/5457.php*. The Compendium was developed in 1999 and has been updated several times, most recently in 2009. Entries are searchable through three filters: sector (e.g. agriculture, forestry), theme (e.g. climate scenarios for Impact Assessment), and type (e.g. guidance document, the meta-modelling tool).

indices, the subsequent assumptions and methods should be used in the transformation was evident, and the index should be subject to a process of continual testing and refinement. If decision-makers require more specific information, then the estimates of the impacts might be more appropriate.

3.2.5 Figure below shows how the biophysical and social determinants combine to shape vulnerability based on Preston and Stafford-Smith (2009). However, while they distinguish between the "present vulnerability" and "future vulnerability", we have modified the schema to refer to their vulnerability to climate variability and vulnerability to climate change (figure 3.2.5). This avoids using the term vulnerability is present, type of vulnerability, given that the potential harm in the future, but still includes both that there are two different time horizons of interest in framing vulnerability, especially with respect to the implementation of adaptation responses.

It has been argued that adaptations that are robust filed ***projected*** biophysical changes will also robust for existing vulnerabilities (sometimes known as no-or low-regret-regret measures - Willows and Connell 2003). It also argued, however, that ***present-day*** social determinants of should guide vulnerability, adaptation, and that such interventions will then drive the future development pathways that are less vulnerable to climate change. This tendency to superimpose the projected exposure of the pre-adaptive capacity also reflects current international funding goals, which have tended to target capacities with the trash climatic condi- po experienced today, rather than projected longer-term climate change. Interestingly, future socio-economic changes are rarely explored as a guide for targeting adaptation in anticipation of future vulnerabilities, one argument being that such anticipatory adaptation may not necessarily adequately address current vulnerabilities (Preston and Stafford-Smith, 2009).

3.2.4 *Knowledge elicitation*

An alternative or complementary approach to quantitative studies to work for the synthesis involve stake- holders in agreeing the main issues to be addressed in a vulnerability assessment (Malone and Engle 2011). Stakeholder involvement in business Such critical knowledge production of a new model for vulnerability assessments that goes beyond the traditional one-way flow of information science into policy (Vogel et al. 2007). We recommend

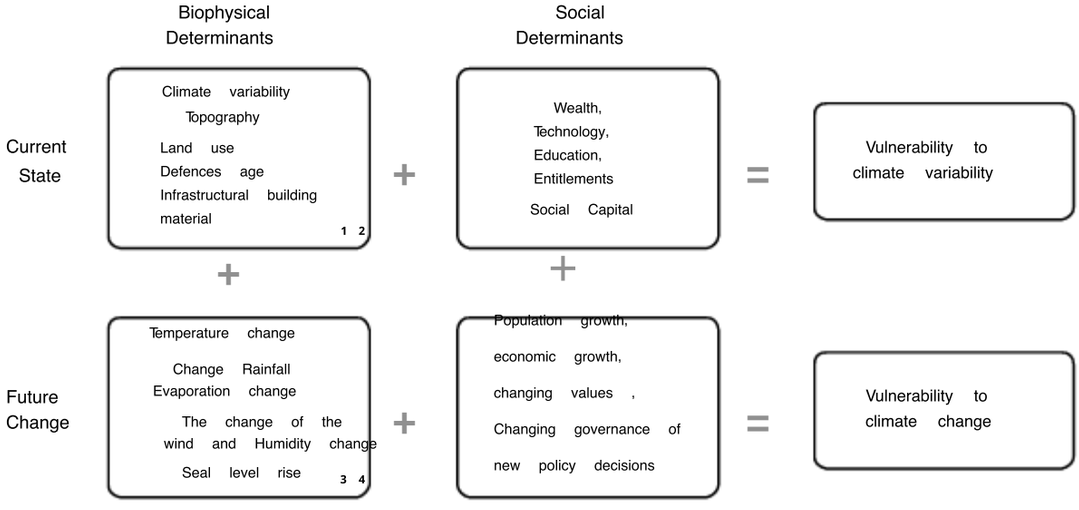


FIGURE 3.2.5 *Determinants of current and future vulnerability to climate variability and climate change (modified from Preston and Stafford-Smith, 2009). A notable gap in knowledge that relates to adaptation to changes in the future targets social determinants of vulnerability.*

BOX 3.2.7 ***Overview of knowledge elicitation***

The theoretical assumption

The stakeholders who will experience climate change (depending on the scale of analysis) have valid knowledge and expe- rience, which can be used to add value to vulnerability assessments

Question addressed

How the context-appropriate knowl- edge communities and technical exper- tise of experts contribute to the robustness of the vulnerability assessment?

Data requirements

Data pre-drivers as potential vulnerability appropriate to the context

Typical result

A more robust and comprehensive vulnera- bility assessment.

Generic steps

1. Salient domains of identification
2. drivers and selection of strategies by stakeholders
3. knowledge representation

this section along with Section 3.1 reading to learn more about stakeholder engagement and tools to support it.

Stakeholder involvement can take many forms, depending on the purpose of analysis and scale of the impact assessment. At the community level, if a high-resolution vulnerability and impact assess- ments are required, stakeholder participation, not only to have insights on the local LAN be taken into account, but also encourages ownership of the process. Stakeholders can also provide invaluable information about non-climate factors that may affect the potential impacts of climate change. It it may also be appropriate to assess the opinions of a panel of experts in the field to find out what com- munities who are vulnerable, vulnerable, how vulnerability may be characterized future, and at what scales. Expert judgement methods can also be appropriate quantitative data in regions where poor business availability (Downing and the patwardha 2005). Sectoral expertise and also experts can offer: pre - health, biodiversity or food production, for exam- ple. Often these are As cost-effective ways to gather information with places of available limited data, also suggested such participatory methods to fill data gaps in developing-world contexts (Kates et al. 2000).

It is important to note that stakeholder engage- ment, well done, is not a quick or easy task. Engaging stakeholders means recognizing that every actor is unique and relevant information valid a view to con- tribute to the task. Multi-stakeholder processes can help ensure that the views of all the main actors and reached a consensus that are incorporated business (Hemmatí 2002), but this requires ensuring that ***all views are actually heard***. Facilitating multi-stake- holder requires a willingness to particular processes- ipate on the stakeholders which are part of, and skilled and sensitive facilitation (see Section 3.1.1.3). The facilitator must be able to adapt to varying circum- stances and be willing to deviate from a plan, if needs arise, whilst still ensuring that the end goal in business is achieved. Facilitation to support several tools are suggested in Section 3.1.4; in addition, the two books listed note there may be useful: ***Facilitator's guide to Participatory decision-making*** (Kaner 2011) and ***Participatory workshops: a sourcebook of 21 Sets of ideas and activities*** (Chambers 2002).

Community vulnerability assessment 3.2.4.1

NGOs and civil-society organisations working to assess vulnerability at the local scale, commonly using a stakeholder participatory methodologies (See also Section 3.1.3). Early examples include

Capacities and vulnerability analysis (Anderson and Woodrow 1998) and the vulnerability and Capacity Assessment Tool (IFRC 1999). Although many organizations use their own approaches, and guides have been some generic trademark pro- also smuggled to outline good practice (e.g. Twigg 2007; Abarquez and Murshed 2004). Common under- standing of good business practice that assessments should be based on a participatory methodology (e.g. participatory rural appraisal), require local ownership, and integrate other non-stakeholder processes (Davis et al. 2004).

Although participatory vulnerability assessments yield valid data may have such concerns may have arisen over the years about the uncritical use of tools with- out appropriately adapting to local circumstances - and that is related to, viewing communities as homogeneous and harmonious social units (Davis et al. 2004). Assessments of a study con- ducted by the Red Cross/Red Crescent Societies is high- lighted the important of keeping the community risk assessments are simple enough for wide application, which requires a better tool for guiding the design and interpretation of the outcomes (van Aalst et al. 2008).

At their most basic, many community vulnerability assessments are designed to use low technology and thus be appropriate even impoverished and remote environments. But the same principles are likewise popular elicitation of knowledge in higher-technology, developed-country contexts. Here there is often scope (existing data and greater availability) for a more comprehensive approach. Community vulnerability assessments vary in their scope. Some focus specifically on the front of adaptive capacity, while others also include exposure and sensitivity to climate hazards. The U.S. National Oceanic and Atmospheric Administration (NOAA) developed a community vulnerability assessment Tool that supports the linking of environmental, social and economic data of the coastal zone. It is GIS map overlay analysis of the procedure for a static analysis of the relative risk or vulnerability of coastal communities to a series of existing threats. Seven steps in the procedure are followed:

1. Hazard identification and
2. prioritization; Hazard
3. Analysis; Critical Facilities
4. analysis; Social analysis;
5. economic analysis;
6. Environmental analysis; Mitigation
7. opportunities analysis.

3.2.4.2 *Expert judgement*

Community vulnerability assessments elicit knowl- edge from community members, who have an inti- mate knowledge of their local situation. Expert judgement, meanwhile, informed solicits opinions from individuals with particular expertise. This approach is often used to obtain a rapid assess- ment of the state of knowledge concerning particular- ular aspects of climate change. Expert judgement is most effective when used in a panel format, bringing together experts with a range of experi- ence and/or opinions.

Expert judgement has been used in a variety of ways. Climate impact Some of the earliest stud- ies in the late 1970s and early 1980s used this method, which drew criticism at the time (Stewart and Glantz 1985). More recently, in devel- oped-country studies, it has been used to validate the findings of the vulnerability and impact assess- ments, indicators, studies that attempt to place the front boundaries of what constitutes adaptation, or the thresholds of dangerous climate change (Brooks and Edgar 2005; Fontana et al. 2009; Arnell et al. 2005; Smith et al. 2009).

There are also some examples of the expert judge- ment forming key, method, or being integral to the creation of an assessment. Alberi et al. (2006)

used conjoint choice questions of Public Health and climate change experts to determine which of two hypothetical countries (described by a vector of seven socio-economic and health attributes) they shall be deemed to have a higher adaptive capacity. Probit models indicated that respondents viewed Thu capita income, low levels of income inequality, universal health care coverage, and high access to information as important determinants of adaptive capacity. They then used the estimated coefficients and country socio-demographics moment to construct the index of adaptive capacity for several countries. In panel data regressions, this index proved to be a good predictor of mortality in climate disasters, expert judgement affirming the value of vulner- ability and impact assessments.

Despite its widespread use, and evidence for the utility, caution has been expressed drugs the use of expert judgement as a method for climate Impact and vulnerability assessments. Those who prioritize empirical and quantitative data, the interests of comparability, warn against potentially Feb- jective nature of expert judgement (Fussel 2007). Even the way experts understand climate change and its risks subjective work, and thus the way they work to bring their knowledge to bear shaped by their values and understanding of climate and social systems (Lorenzoni and Lowe 2007).

3.2.4.3 *Participatory scenario development*

Stakeholder the predominant method for assess- ing how work will change in the future vulnerability of participatory scenario development. Scenarios can be defined as plausible was held on how the future may unfold. Script writing Community participatory approach is based on a dialogue between researchers and climate futures-vulnera- ble communities that enables context-awareness (Gidley et al. 2009). Participatory scenario building visioning a popular approach in environmental futures, and guidance has been produced ten good practice (Pahl-Wostl 2008; Bizikova et al. 2009). A number of authors have contended that future changes in socio-economic systems have been insufficiently integrated with an analysis of climate change impacts, and that participatory methods of scenario development are the ideal approach for analysing potential change of socio-economic systems (Berkhout et al. 2002). In particular, par- ticipatory planning business scenario is intrinsically linked with the understanding that anticipatory learning required to work to bring about adaptation to climate change (Tschakert and Dietrich 2010).

Ace community vulnerability assessments and expert judgement, there are many examples of participatory scenario development within various regions and support. The moment one study took an integrated approach to the construction of the socio-economic scenarios required for the analysis of climate change impacts in the front of European agricultural land use (Abildtrup et al. 2006). It started the global scenarios developed for the IPCC ***Special Report on emissions scenarios*** (An SREs - Nakicenovic et al. 2000), but used a stepwise procedure based downscaling to which expert judgement and ten pairwise comparison obtain quantitative socio-economic parameters, such as prices and productivity estimates, which were then included in the model.

In another project used participatory modelling for the assessment of climate change impacts on Water Resources in the Thukela river basin from 2007 to 2009 (Andersson et al. 2011). Used in the stu of several regionally downscaled climate change scenarios linked to hydrological and agro-hydro- logical models, stake and combined them with the holder of the identification of prominent climate and water-related issues, including information to be produced and institutional-related obstacles to be overcome to reduce vulnerability. Likewise, participatory scenario processes were applied to the water issues of flood-prone municipality of Delta, British Columbia, Canada, producing 3-D

computer-generated images of climate change futures (Burch et al. 2010).

For a more in-depth discussion of the scenario analy- sis, see Section 3.4.

3.2.3.4 *user-controlled learning tools*

New types of mapping tools have appeared in recent years that offer users the flexibility to explore vulnerability indicators themselves (albeit from a pre-selected list, though stakeholders can also help define that list), and combine and to weight them according to their interest (e.g. Carter et al. 2013; Harrison et al. 2013). Such tools place of the vulnerability definition in more firmly and transparently in the hands of the user rather than the researcher, whose role in the business simply to compile the requisite data for analysis. This form of direct stakeholder participation may address at least one Hinkel's critiques of vulnerability indicators (Hinkel 2011 - see above), express that vague con- cepts and may note that convey any information relevant to stakeholders. Clearly, if the stakehold- ers themselves select and combine indicators and map them according to their knowledge of a given situation, this would appear to present a real learning opportunity.

Whether the development of the interactive features of the vulnerabil- ity of the tools and user-controlled learning, they can be regarded as must promote scientific research (vulnerability assessment the purpose of the sixth and dismissed by Hinkel listed above) may also merit further attention. Causality does not neces- sarily need to be explicitly represented by research- ers to describe vulnerability; it can also be inferred subjectively, but still usefully so by an expert user (for example, by comparing the number of visitors a given impact of candidate patterns with indicators that might contribute to those impacts). Moreover, the study of user decisions in such an environment might yield moment is actually very useful insights into how stakeholders to perceive climate change vulnerability spe- cific context in which they work.

3.2.5 *application methods for projecting future impacts*

Numerous studies have been conducted at various scales of analysis to determine the future impacts of climate change, using different methodolo- my apologies discussed throughout this section. Below we present an overview of studies to point the reader towards further sources of information.

Table 3.2.4 impact studies of a matrix, orga- nized by analysis of the sector, and geographic area. The next Symbols after each study methods employed by the quality manager regional study: various types of model- ling, integrated assessment, and participatory scenario development, expert judgement and indicators. Some studies, particularly those with a global focus, use historical data as they analogues, or base their methods on the pre-existing literature reviews. On the whole, the studies presented in this table are looking to the future impact asse that use of climate decreased levels and provide analysis on how those will affect the various support levels decreased in the various locations.

In contrast, Table 3.2.5 gives an overview of studies that have used the context (the starting point) vulner- ability to look at the current approach to vulnerability to climate change in the potential future. These studies are typically smaller-scale approach and place-based. Again, variety is an illustrative exam- ples from around the world are presented. ■

TABLE 3.2.4 *The impact of Selection studies, divided by sector and geographical focus, methods and highlighting regional quality manager employed. Symbols are explained at the foot of the table.*

Location / Sector	*Europe*	*Americas*	*Africa and Middle East*	*Asia*	*Australasia*	*Global*
Agriculture	Abildtrup et al. (2006) A C Falloon and Betts (2010) h	Zhang, Liu, Li, et al. (2011) h Jones and Thornton (2003) d Meza et al. (2008) D K Ruane et al. (2013) d	Abraha and Savage (2006) d Al-Bakri et al. (2011) d Jones and Thornton (2003) d Roudier et al. (2011) h Thornton et al. (2010) d	Chavas et al. (2009) d Lioubimtseva and Henebry (2009) k Masutomi et al. (2009) d Srivastava et al. (2010) d Xiong et al. (2008) d Wei et al. (2009) d Thomson et al. (2006) d Simelton et al. (2009) K M	Luo et al. (2003) d, Pearson et al. (2011) B H	Berg et al. (2013), tropics f Fraser (2006), famines j Jacxsens et al. (2010), Food Safety, supply chain h Kang et al. (2009) d Mera et al. (2006), soybean and maize d Nardone et al. (2010), livestock k Ramirez-Vallegas et al. (2013), sorghum b d Sutherst et al. (2000), pests h Thornton et al. (2009), in livestock develop-ing countries k
Pollution	Alcamo et al. (2002) c	Macdonald et al. (2005) k				
Coasts and fisheries	Philippart et al. (2011) k					Badjeck et al. (2010) e Brander (2010) h
(marine) Ecosystems and/or biodiversity	de Chazal et al. (2008) H Lindner et al. (2010) c h the Minne van et al. (2002) H M Schröter et al. (2005) h Metzger et al. (2008) H M	Andalo et al. (2005) h Coops and Waring (2011) h Coops et al. (2012) h Dale et al. (2001) g Dalla Valle et al. (2007) h Ehman et al. (2002) g Ivits et al. (2012) h McRae et al. (2008) g h Nitschke and Innes (2008) g Taner et al. (2011) g	Pettorelli et al. (2012) f	Tanaka et al. (2012) h		Chakraborty et al. (2000), plant diseases h Şekercioğlu et al. (2012), tropical birds H K Sietz et al. (2011), drylands c Stock et al. (2011),the living marine resources h

TABLE 3.2.4 *continued*

Location / Sector	Europe	Americas	Africa and Middle East	Asia	Australasia	Global
Urban	Bonazza et al. (2009) [h]	Hayhoe et al. (2010) [c] Wuebbles et al. (2010) [c] Romero Lankao et al. (2012), more able to adjustion, less quantitative [c k]				Gasper et al. (2011) [k] Li et al. (2012), energy use in buildings [h] Romero Lankao and Qin (2011) [k] Willems et al. (2012), urban drainage [h]
Water	Eckhardt and Ulbrich (2003) [i] Falloon and Betts (2010) [h]	Boyer et al. (2010) [i] Chang and Jung (2010) [i] With kienz et al. (2012) [i] Zhang, Huang, Wang, et al. (2011) [i]		De Silva et al. (2007) [i] Kelkar et al. (2008) [I l] Lioubimtseva and Henebry (2009) [k] Park et al. (2010) [k] Park et al. (2011) [k] Arrival, et al. (2012) [H M]		Green et al. (2011), groundwater [k]
Transport						If koet and Rietveld, (2009) [k]
Health		Patz et al. (2008) [h] Romero Lankao et al. (2012), more able to adjustion, less quantitative [c k]		Lioubimtseva and Henebry (2009) [k] Nelson (2003) [k] Vineis et al. (2011) [k]		
Energy		Burkett (2011) [H K]				And Mideksa While kallbek (2010) [k]
Coasts						Nicholls, (2002), sea- level rise and flooding [h]

Key methods:

[A] = participatory scenario development [b]
[c] = expert judgement
[d] = integrated model/integrated assessment
[e] = crop simulation model
[f] = livelihoods framework
[g] = vegetation models
[h] = forest modelling
[i] = water models
[j] = landscape ecology
[k] = literature review / analysis / historical data / participatory knowledge elicitation
[m] = indicators

TABLE 3.2.5 *Vulnerability studies using the starting point of selection, organized by geographical location.*

Continent	*Country*	*Authors*	*Methods*
Asia	Philippines	Acosta-Michlik and the espaldo (2008) and Tran (2010)	Behavioural model (agent-based model)
	Vietnam		Qualitative household level
Americas	Mexico	Eakin (2005), Manuel-Navarrete et al. (2007)	Ethnographic data pre-stresses multiple post-disaster assessments
	Latin America and the Caribbean	McDowell and Hess (2012), Ford et al. (2010) and Polsky Hill (2007) Eriksen and Silva (2009) Osbahr et al. (2008) hisal et al. (2011) to paavol (2008) Reid and Vogel (2006)	Qualitative study of household Identifying the driving forces of vulnerability Historical data (including models) and qualitiative gun Household vulnerability to multiple stresses Qualitative household (coping/adaptation) National Household Survey household Qualitative data sustainable livelihoods framework for Integrated Assessment community mapping and multivariate Probit approach to Multi-scale indicators and downscaled scenarios at the local level
	Bolivia Canada (Health), USA, Mozambique, Mozambique, Uganda, Tanzania, South Africa,		
Africa			
Australasia	Solomon Islands	Schwarz et al. (2011)	
Europe	Norway	O'brien et al. (2004)	

3.3 capacity analysis

The methods and tools described in Section 3.2 current and future focused front assessing the impacts of climate change. This section focuses on ten methods and tools for another crucial task: assessing the capacity of individuals, communities, systems, getting and institutions to adapt to climate change, and thus reduce harm and/or seize opportunities. Capacity analysis is typically the job done the first stage of the adaptation process, identifying adopted- tion needs (Section 2.1), but it is also relevant in appraising adaptation options (section 2.3), and planning and implementing adaptation measures (see Section 2.4). Along with the resources presented in this chapter readers may also find it useful to consult Section 3.1, adopted participatory tools for front- tion, which describes several approaches designed to both assess and build adaptive capacity.

Its ***Fourth Assessment Report*** the IPCC notes that the work is shaped by the characteristics of adaptive capacity of the society exposed to climate risks, and Iden- tifies six factors that seem to determine the adaptive capacity: economic resources, technology, infor- mation and skills, infrastructure, institutions and equity (IPCC 2007a). Some of those factors are easier to quantify than others, and several assess- ments have used the adaptive capacity of the proxy landed- cators that focused largely preliminary economic resources, poverty and inequality (Brooks et al. 2005; Dulal et al. 2010). Such analyses are useful in helping to understand and compare the resources available to a nation or a community or a household) in adapting to climate change, but they miss other key aspects of adaptive capacity that are just as important - was the effectiveness of the local ins- tutions networks and social norms and values May that same adaptation.

3.3.1 *'Adaptation functions' and institutions adaptation support*

Thus, Assessing and building adaptive capacity requires an understanding of the complexity of the moment and how it changes the system, including decision-making processes, policy development, organizational culture and innovation, and risk percep- tion. This means not just looking at what a system horse ***has*** that is, adapt it to security, but more important, what at it ***does*** that is, adapt it to security. That's the approach taken by the Framework Bellagio (McGray et al. 2009)also discussed in Section 2.5, which identifies fundamental "adaptation func- Po" in countries that must perform if they are to effectively respond to climate change. The framework identifies three categories of functions: planning (assessment, prioritization, high-level coordination), management (information management, incentives and addressing barriers, and coordinating across government) and service delivery (with a focus on pre-infrastructure, natural resources management and social protection).

The World Resources Institute has built on this concept of adaptive capacity, together with its National frame- work (Dixit et al. 2012), which helps governments to systematically assess institutional strengths and their weaknesses that may help or hinder adaptation. The framework measures a country's overall adap- Tief on the basis of its capacity of national institutions' performance in five key functions: assessment, prioritization, coordination, information management, and Climate Risk Management. The tool can be applied at national or sectoral levels; it was tested in pilot projects in Bolivia, Ireland and Nepal.

A different approach to the same kind of analysis proposed by Gupta et al. (2010), Look who's at the ***characteristics*** for whatever reason of that enable them to effectively support adaptation (see Section 3.6 for a closely related discussion). For whatever reason, they argue, "actors should allow new insights to learn from

one of my experiences and flexibly and creatively in order to 'manage' the expected and the unexpected, while maintaining a degree of identity". This leads them to identify institutions that support the six key traits of adaptation: variety, learning capacity, room for autonomous change, leadership, resources and fair governance. To visually represent their frame- work, they propose, the moment the adaptive capacity wheel that shows those characteristics and their compo- nents (e.g., fair governance includes equity, still the legitimate- macy, responsiveness and Accountability Act). They suggest a colour-coding each wedge of the wheel, from Green to red to show how their social actors, institutions compare.

Of all the three approaches described above and assume that there are functions or institutional characteris- tics that are crucial in adaptation to any setting (see Section 3.6.3 for a related discussion). However,the analyses "from the ground up" and can also identify institutional needs for adaptation, which can then be compared with what currently exists. One such approach, the business climate Learning Ladder, devel- oped as part of Alxa league in studies of Inner Mongolia, China, and the Guadiana River Basin in Spain and Portugal (Tabara et al. 2010). The ladder structure, policy analysis offers a way to support decisions and identify critical reflection to support Climate Adaptation at the local, regional or national scale. It works in four steps: (1) manage to speak dif- ferent framings of the issues at stake, while raising awareness of climate risks and opportunities; (2) understand different motives to speak, and gen- erate incentives or sanctions to ensure action, and (3) develop feasible options and resources for individ- ual and collective transformation and collaboration; and (4) institutionalize new rights interests and feedback for the learning processes of climate adap- in the long term. Notably, this framework also assumes that it is possible to "unlearn" or "move down the ladder climate" whenever possible, agents and institu- po lose the knowledge and capacities acquired over time with the trash to climate risks.

3.3.2 *Organizational adaptive capacity*

The adaptive capacity wheel and the climate Learning Ladder Bell to not only be applied in both countries, regions or local communities, but also to organizations - which, like social institutions, life traits and capacities have to support adaptation, or may lack them. The term "organization" used in business here broadly to describe anything from a business, the moment to NGO to a group or network (e.g. a forestry association) - any of which might need to engage in private to collective adaptation (see Section 2.1). In assessing such organizations' needs, it is useful to consider what attributes might enable them to identify opportunities, gather resources, capture expertise, create partnerships and opportunities for dialogue, and monitor and manage the under- lying processes, for example.

There are a number of frameworks available, most developed through practice, that explore what it means for an organization to have high adaptive capacity and how to assess those attributes. UKCIP framings of the 17 reviewed studies and recent adap- tief capacity, focusing specifically the ten aspects that enable the organization (or occasionally another exploration unit, e.g. a National Adaptation Plan or network) to be "adapting well" (Lonsdale et al. 2010). It found a number of commonly cited attributes across frameworks, which can be summarized as eight questions to address when assessing organisational capacity:

1. Does the organization have leadership that understands and promotes adaptation?

2. Does the organization have access to or know where to access accurate, usable information and expertise?

3. There's space to translate the information throughout the organization?

4. Are novel projects, experiments, opportunities for innovation (and the individuals promoting them) supported?

5. Customarily Does the organization engage in collaboration with others, or through part- nerships, and attention paid to how this col- laboration can be done well and improved as required?

6. Adaptation integrated into the organization's business processes and practices?

7. There are regular opportunities for question- ing the core assumptions of how the organization works and its core purpose?

8. Does the organization have a culture of continu- ous learning? There are systems in place for the retention of knowledge and experience within the organization when key individuals leave?

One tool that has been widely implemented across the UK (and included in the UKCIP (review) labour PACT: performance acceleration capacity through Transformations, a framework developed by Alexander Ballard Ltd. (see *alexanderballard. Co., Ltd.uklpactl*). The framework of the pacts can help orga- nizations assess their current capacity to respond to climate change, identify who needs to get involved and what milestones need to be achieved, and monitor and evaluate actions. It provides customized reports that supports the progress and assessing the status of the current work programmes improvements to planning.

3.3.3 *social vulnerability and adaptive capacity*

As noted in the introduction, adaptive capacity has many dimensions - only some of which can be captured by the ten institutions focused frameworks. Another important type of analysis involves social vulnerability, which can be seen as the "flipside" of adaptive capacity in some respects: for example, people who can read and write may have a greater capacity to adapt than those who are illiterate - and thus the latter may be more vulnerable. Social vulnerability, adaptive capacity business dynamic, varying across time and space, and the array is now shaped by economic, social, cultural, institutional environ- mental and other factors (IPCC 2012). Therefore, like vulnerability assessments, capacity analyses can only reliably tell us about capacity ***here and now*** but not necessarily in the future, or under different circumstances. Section 3.2.3 discusses the use of indicators and indices to measure social vulnera- bility and adaptive capacity, as well as the common concerns raised about such approaches. In short, as Fussel (2009) puts it, all existing vulnerability/ adaptive capacity indices "show substantial con- ceptual, and their empirical methodological weaknesses , including lack of focus lack of a sound conceptual framework, methodological flaws, large sensitivity to alternative methods for aggregation of data, limited data availability, and hiding legitimate normative controversies" (pp. 8-9).

Problems with the indices do note, however, negate the importance of the socio-economic context in assessing adaptive capacity - they highlight the need for better analysis and a recognition that cannot be easily quantified and adaptive capacity have been compared across countries or populations. There is no agreed-upon formula by which to calculate adaptive capacity, and in fact, different factors will determine adaptive capacity under different circumstances. In that context, the factors sug- gested by the IPCC (2007a; see the discussion at the beginning of Section 3.3) can be seen more as a rough categories that warrant attention. Which aspects of adaptive capacity are given priority and will depend, at least in part, pre-normative choices: for example, with an emphasis on pre-poverty, inequality and lack of self-determination might be associated with a social-justice perspective (see, e.g., Dow et al. 2006).

Approaches that focus on the adaptive capacity of socio-economic factors may also point to devel- specialized interventions as useful ways to reduce social vulnerability and increase adaptive capac- ity - going back to our earlier example, if illiteracy the ideal candidate for the people's capacity to adapt the job, teaching them to read and write might be a sensible solu- tion. However, adaptation and development (or, more narrowly, measures to address climate risks and measures to reduce social vulnerability) hit just as easily work at cross-purposes. For exam- ple, intensive shrimp farming in coastal Asia has brought new trade income, but has also led to mangrove deforestation, reducing the livelihood of local communities and removing options at the moment are important protective barrier during storms (Edgar et al. 2005). Technological adaptation measures , such as irrigation systems, meanwhile, can lead to salinization of groundwater and wetlands in the Degra- tion, leaving people more vulnerable to the target water scar- city (Klein et al. 2007). Policy can play a major role in avoiding maladaptive outcomes; for a related dis- cussion portfolio screening the front, See section 3.6.2.

3.3.4 *participatory and community-based approaches*

Oxfam's approach to building the adaptive capac- ity of people living in poverty (Pettengell 2010) application of multiple elements of adaptive capacity, including institutional aspects, socio-economic factors, and practical issues such as access to knowl- edge and resources. The approach starts from the premise that "poverty, more than any other factor, determines vulnerability to climate change and adaptive capacity limits" (p. 4), but it does not solve the problem of poverty to target narrowly. Instead, it suggests a two-pronged approach to build adaptive capacity through knowledge generation, awareness-raising, upgraded so supportive policies, innovation, etc. - and to address factors that limit adaptive capacity - political and economic condi- po, marginalization, gender inequality, lack of to access services, etc. The Oxfam framework also makes it clear that different aspects of adaptive capacity are determined at different levels, from households to communities up to the National gov- ernments, all and addressing them requires a COM- bination of top-down and bottom-up approaches. is

The resort Community Vulnerability and capacity Analysis methodology (Daze et al. 2009; See also Section 3.1.3.1) takes a similar approach. Starting from the IPCC (2007a) definition of adaptive capac- ity, it notes that "one of the most important fac- tors shaping the adaptive capacity of individuals, households and communities to access their business and control over natural, human, social, physical, and financial resources" (p. 5). This access varies within countries, communities and even households, and work influenced by external factors such as policies, institutions and power structures; it can vary over time based on changing conditions, and it may differ in relation to particular hazards. In addition, the guidance notes business that adaptive capacity is closely linked to resilience - the ability to recover quickly and effectively from the negative impacts, preserving or restoring essential basic structures, functions and identity.

This translates into a view of the remedy adaptation framework that identifies the "enabling factors" which must be in place at household/individual, com- munity/local and national levels to support effec- tief adaptation. They fall into four categories: cli- mate-resilient livelihoods, Disaster Risk Reduction, capacity development, and addressing underlying causes of vulnerability. For example, at the local level, the committee must have the capacity and resources to plan and implement adaptation activities; one factor at the household/individual level whether women and other marginalized groups have equal access to information, skills and services. The meth- odology also notes that such minute analysis requires "significant engagement with communities and stakeholders and the substantial investment of time

and resources. Moreover, it requires a wide range of skills and experience:

- Research skills - research background; Knowledge of climate change - analyse climate and summarize available information; policy and institutional analysis - to analyse the enabling environment; scientific expertise in agriculture, water, and other relevant support; Facilitation of participatory processes to animate the balance of participation and keep everyone in the group, the group of the front track of the environment to construct and now that trust and openness; gender and diversity - to ensure gender and diversity-sensitive facilitation and to analyse differential vulnerability; Conflict management - help the group to understand diverse perspectives and ions, and to come to conclusions and/or consensus; qualitative interviewing to actively list and push for deeper reflection/additional information; writing skills to present a convincing, clear and robust to various audiences argument for incorporating adaptation strategies within new projects or activities.

3.4 scenario analysis

There is a formidable literature, the use of pre-data and climate impact scenarios and vulnerability assessments, and this guidance does not seek to repeat earlier extensive reviews (e.g. Carter et al. 2001; Howe et al over. 2001; Carter et al. 2007; Rounsevell and Metzger 2010). Instead, our goal here is to provide an overview of the business of some of the most useful resources, and to highlight important issues to consider when using scenario analysis in the context of adaptation.

In 1996, the IPCC task group formed the preliminary data and scenario Support for impact and Climate Analysis (TGICA), special cross-Working Group committee charged with making the relevant data and scenarios assessed by the IPCC accessible to the research community climate change world-wide (see the group's mandate: IPCC 2003). TGICA has prepared a number of guidance documents preliminary data and scenarios (e.g. IPCC-TGICA 2007; Nicholls et al. 2011), regional workshops arranged (e.g. , Leary et al., 2009), and established the IPCC Data distribution centre (*www.ipcc-data.org*to Facil the-Tate distribution of timely and consistent data scenarios for use in climate risk and mitigation assessments that can ultimately feed into the IPCC assessment process.

The horse world climate conference-3 in 2009, the global framework for Climate Services was launched (*www.gfcs-climate.org*), coordinated by the World Meteorological Organization to bring together researchers and the producers and users of information to improve the quality and quantity of climate services worldwide, particularly in developing countries. Many governments and organiza-Po are also heavily investing in their own data portals to provide data and scenario support for climate change research. Examples include:

- *Global*: The World Bank Climate Change Knowledge Portal 2.0 (*sdwebx.worldbank.*

*org*provides preliminary information and climate impacts, adaptation screening tool and some limited mitigation of coverage. [Only registered and activated users links query, map, compare, chart and summa- rize the key climate and climate-related informa- tion from various data sources and reports.

- *Global* (*developing countries*): UNDP climate change Country Profiles*www.geog.ox.ac.UK/research/climate/projects/undp-cp/*), posted at the University of Oxford, UK, to offer information from pre-observed and projected climate 5 2 in developing countries.
- *Africa*: The climate information portal of the Climate Systems Analysis Group, University of Cape Town, provides Climate information and scenarios for Africa and, to a more limited extent, Asia and other parts of the world (*chip.csag.uct.ac.za/webclient 2 /app/*); the tool also linked to weADAPT (*weadapt.org*), which allows cross-referencing with studies in the areas of interest.
- *Asia and the Pacific*: The Asia Pacific Adap- network (APAN) maintains a portal with an array of resources to support climate change adaptation in Asia and the Pacific region (*www.asiapacificadapt.net*).
- *Europe*: The European Climate Adaptation Platform CLIMATE-ADAPT (*climate-adapt.eea.europa.eu/*), a portal operating under the auspices of the European Environment Agency; it offers links to European and National Climate, Impacts and adaptation information.
- *Australia*: OzClim (*www.csiro.au/ozclim/*), developed by CSIRO, is a tool for generating climate change scenarios for Australia.
- *Canada*: The national Canadian Climate change scenarios Network (*www.cccsn.ec.gc.we*) distributes climate scenarios and adaptation information, including a mapping tool for providing a guide for practitioners climate; the Pacific Climate Impacts Consortium (*www.pacificclimate.org*) a regional climate Services Center at the University of Victoria that provides information for the Pacific and Yukon regions; the private, nonprofit Ouranus climate consortium maintains databases and other tools to support adap- research in*www.ouranos.ca*) maintains databases and climate adaptation resources for Quebec and other regions in Canada, English and French).
- *Caribbean*: The Caribbean Commu- nity climate change Centre (*www.caribbeanclimate.bz*provides regional climate data and information for practitioners and a guide and advice to the pre-adaptation responses. *Central America*: Serve the project (CI Regional de Monitoreo de Visualizacion Meso- America) and decreased levels of climate provides other data for Mexico and Central America (*www.servir.net*).
- *Denmark*: Was the Danish Meteorological ins- tute provides climate data and scenarios for Climate Change Adaptation through the portal (*www.klimatilpasning.dk*in Danish and English).
- *Finland*: The national portal *Climateguide.fi*, co-ordinated by the Finnish Meteorological Institute, Finnish Environment Institute and Aalto University, provides data and infor- mation front climate impacts, adaptation and mitigation (in Finnish, Swedish and English).
- *Germany*: The federal Environment Agency (Umweltbundesamt) maintains the web portal has served (*www.umwelt-bundesamt.de/themen/klima-energie/anpassung-now-than-klimawandel/kom-pass*); also a government-funded Climate Service Center Germany (*www.climate-service-center.de*in German with limited coverage in English).
- *Netherlands*: Climate services, including climate scenarios are provided by Royal Netherlands Meteorological was ins- tute (*www.knmi.nl*) and accessible from

the Dutch climate change portal platform communication on climate change (*www.klimaatportaal.nl*in Dutch and English).

- *Norway*: Climate scenarios from the Norwegian Meteorological Institute (*met.no*) are accessible from the Norwegian Climate change Adaptation Programme web portal hosted by the Norwegian Ministry of Environment (*www.regjeringen.no/en/dep/md/kampanjer/klimatilpasning-norge-1.html*in Norwegian and in English).
- *Spain*: Climate scenarios prepared by the State Meteorological Agency of Spain (AEMET, *www.aemet.es*in support of the Spanish National Climate Change Adaptation Plan is available a special portal AEMET (*escenarios.inm.es*in Spanish).
- *United Kingdom*: The UK Government has produced five sets of official climate projections since 1991, the most recent being UKCP09 (Murphy et al. 2009), and one set of socio-economic scenarios in 2001 (UKCIP 2001). These are distributed by UKCIP (*www.ukcip.org.uk*). Also there have been critical reviews of the effectiveness of both climate scenarios (Hulme and Dessai 2008) and socio-economic scenarios (Hughes et al. 2009).
- *USA*: The National Oceanic and Atmospheric Administration (NOAA) has a prototype Climate Services portal (*www.climate.gov*) offering observed climate data; the Nature Conservancy climate offers information for the USA and the world, available through a Climate of The Wizard (*www.climatewizard.org*); there are also regional providers of climate data and a guide for practitioners, such as the Climate Impacts Group at the University of Washington (*cses.washington.edu/cig/*for the Pacific Northwest.
- *Global*: WorldClim (*www.worldclim.org*) is a set of global climate layers (grids) with a spatial resolution of approximately 1 square miles for mapping, spatial modelling and use in GIS (Hijmans et al. 2005).

As a note of caution, while data portals are often pres- ENT at the moment readily accessible and appealing interface for data download, data quality and SCE- narios they provide can vary. If well-documented guidance is provided on site, usually that is a good sign that the authors recognize the com- plexities of the scenario selection and application, and the limitations of the data. Thus, before embarking on the sometimes resource-intensive activity data and the extraction scenario, it is strongly recom- mended to consult first general guidance docu- ments, such as those provided at the IPCC Data distribution centre.

Feb the following sections describe a number of data issues to consider in identifying, developing and presenting scenarios such information for use in assessments. They also provide support- ing literature, offering additional explanation and examples.

3.4.1 *qualitative information*

Qualitative descriptions of past, present or future conditions can be very effective ways of conveying information to non-making skills and quanti- tative data easier to understand. Moreover, the narra- tief descriptions of possible future developments (storylines), by virtue of note specifying precise framing devices useful for numbers that can be summarized by some analysts in the future that allow for Inter- preting future regional trends (Rounsevell and Metzger 2010). Through dialogue and negotiation, they can also allow for direct stakeholder partier- pation and eventual buy-in of the moment and agreed to set up sto- rylines (Alcamo 2001; See also Section 3.2.4.3 for a discussion of participatory scenario development).

3.4.2 *may be quantified variables and their sources*

The business of climate change as the central focus of study, most assessments of climate change impacts and adaptation, especially those employing models use climate data for a wide range of variables (near-surface air temperature, precipitation, solar radiation, wind speed and humidity are the most common). Data may also be required to describe a system of attributes relevant activity, or those that are exposed to climate change, or that the precon- dition of human responses to climate change. Data may be physical (e.g. productivity, forest, river flow, water quality or soil nutrient status), economic (e.g. income, or prices), social (e.g. population employ- ment, education) or technical (e.g. irrigation, forest Products, Building Materials). Potential sources of data are highly case-specific.

Some data are collected, observed or operationally, such as weather, streamflow, sea level and wave heights, population, economic activity. These are commonly available from national or international agencies and government statistical offices. They might also be especially collected for a study in targeted experiments or surveys. Climate informa- tion from the past may have been inferred from historical accounts such as proxy information, tree rings or cores. Ten regional climate Information can also be simulated using climate models. Some information can also be derived from other climate climate variables (e.g. accumulated temperatures, evaporation, and the number of air frosts). Often the data are reformatted to suit the needs of users, for example, by aggregating the data by regional population units, or by interpolating observed climate data from weather stations to a regular spatial grid.

3.4.3 *Characterizing future climate*

In addition to assessing the characteristics of the cur- rent climate is also likely to be in the interest of assessing how the climate might change in the future. Additional uncertainties and embodies This moment requires understanding of how the business climate is projected to change in the future. Practitioners as a guide for future climate that are applied in such assessments are conventionally referred to as ***climate scenarios***

CASE STUDY ***Using qualitative data to determine climate impacts in London***

The London climate change Partnership (LCCP) was established in 2001. Chaired by a high-profile businessman, the partnership comprises representatives from Central and local governments, utilities, transport- tion and public health agencies, emergency management, environmental consulting firms and UKCIP, among others. Its role to the business of then used an interactive process to explore how climate impacts of climate change in the pre-London, provide inputs into the changes in those measures might affect London. development of the city's adaptation strat - unsettling information in this way qualitative egy, and generally ensure preparedness for climate was gathered on the potential impacts of climate change. change ten different services in London.

As part of the development of an adaptation strategy, 15 workshops were conducted between 2005 and 2006, to raise awareness of how climate change might affect their services. The work- shops started by asking participants to identify the measures they use to judge the success of their work (numbers of people served, effective service delivery, costs, etc.) and to collect information on the pre-London, provide inputs into the changes in those measures might affect London. development of the city's adaptation strat - unsettling egy, and generally ensure preparedness for climate was gathered on the potential impacts of climate change. change ten different services in London.

Source: was Liget et al. (2007)

TABLE 3.4.1 *Selected methods of climate scenario development classified according to their resource needs applications and potential for adaptation planning* (based on tables in Wilby et al. 2009 and amended, with major additions in italics).

Level resource needs	*Methods*	*Input Spatial application and requirements*	*Applications for adaptation planning*
Limited	Sensitivity analysis	Local (site/area) (Observed climate data)	Resource management, sectoral
	Climate analogues		Communication, institutional, sectoral
	Trend extrapolation		, New infrastructure (coastal)
Modest	"Delta change"	Regional (And simpler global model AOGCM outputs)	Most adaptation activities
	Pattern-scaling		Institutional, sectoral
	Stochastic weather generation		resource management, retrofitting, behavioural
	Empirical/statistical downscaling		New infrastructure, resource management, behavioural
High	Dynamical down-scaling (RCM)	Regional-global (AOGCM outputs)	new infrastructure, resource management, behavioural, Communication,
	Coupled AOGCMs	Regional-global	Communication, financial
	Probabilistic	***Global-regional-local (Multiple sources)***	***New infrastructure, resource management, communication***

(Over Howe et al. 2001), which distinguishes them from climate predictions or forecasts, to which probabilities can be attached. However, this distinction is becoming blurred as climate scientists have moved towards climate expressing the future in terms of probabilities using. A useful recent comparison of different methods of climate sce- nario development for use in climate risk assessments provided by Wilby et al. (2009). Table 3.4.1 summary of that review application elements into a different scenario construction methods, their resource needs and potential applications.

The most credible and sophisticated tools for simulating the Earth's climate response to increasing emissions of greenhouse gases and aerosols are applicable to other coupled atmosphere-ocean general circulation models (AOGCMs). There is agreement among all models, the planet will warm, globally, though the magnitude varies from model to model. There is less unanimity of the projected changes in the regional pattern of climate variAbles the user, such as precipitation, radiation or wind speed, and quite coarse spatial resolution (grid box dimensions are seldom finer than 150 km). Since most impacts of climate change will be manifest locally, to have been there after the great efforts to downsc decreased levels of AOGCM a finer spatial resolution (Fowler et al. 2007), using either numerical models (over Howe et al. 2003; the rummukaine 2010) or statistical techniques (Wilby et al. 2004), and sometimes involving the use of stochastic weather generators (Wilks 2010). There have been several major research projects conducted to this end, such as in Europe. PRUDENCE (Christensen et al. 2007), and ensembles (van der Linden and

Mitchell 2009); North America (e.g. NARCARP - over Howe et al. 2009), and globally, with a current focus on the pre-Africa (CORDEX - Giorgi et al. 2009).

An alternative method used to generate climate scenarios involves identifying spatial analogues (climates in other regions) or temporal analogues (climates from the past) that may resemble anticipated a region of future conditions (Ford et al. 2010). Other simple techniques involve adjusting the present-day climate by fixed increments (e.g. warming in increments of 1 °C; can no precipitation changes in increments of ± 5 %) to explore the sensitivity of the exposure to a changing climate units (Carter et al. 1994), or applying simple extrapola- tion of past trends (Wilby et al. 2009).

Perhaps the most common technique for apply- ing climate scenarios climate risk assessments in the work of the so-called "delta change" method, whereby it would

Futures in New York and Metropolitan of use GCMs to determine climate CASE STUDY ***East Coast region***

As part of the U.S. national assessment of the potential consequences of climate variability and change, the moment climate change assessment of the Metropolitan East Coast (MEC) region of the 31 countries covering the New York City metropolitan area and the total population of 19.6 million of the states of New York, New Jersey, and Connecticut - was should be undertaken. The goal was to understand the impacts of climate variability and change on physical and human systems.

The assessment used the five GCM scenarios: one based on current trends; two from two from the UK Hadley Centre and the Canadian Centre for Climate Modelling and analysis, both of which consider greenhouse gases individ- ually, and then a combination of greenhouse gases and sulphate aerosols that are applicable emitted through industrial activities. Typically sulphate aerosols to create a cooling effect by reflecting other applicable and scattering solar radiation, and thus they to a certain extent offset the greenhouse gases. As a result, these scenarios forecasts using lower temperatures than only scenarios that include greenhouse gases. This gives a good estimate of the potential change of the envelope.

Linear interpolation between the GCM grid boxes meant for several scenarios that were obtained within the cities of the region. However, because cities are relatively close, there is little vari- ation between them, and so the study used the mid-point of the study region.

While each of the five future scenarios provide a distinct projection of precipitation change, it is important to note that the precipitation of project- po GCM scenarios do not agree either in magnitude or direction (as opposed to the projected changes in temperature, which agree in direction, but not magnitude). The Hadley Centre's scenarios show increasing levels of pre- cipitation, the Canadian Centre projects while decreasing precipitation over time.

Through the use of a range of plausible scenar- ios, the MEC assessment researchers are able to project possible impacts generated by climate variability and change, and evaluate the MEC region's responses. Now such assessment exercise , enabling useful business as the MEC study prepared- Ness for extreme climate events in the present as well as readiness for a changing future climate.

Sources: Liget was (2007) and the Metropolitan East Coast Assessment (*metroeast_climate.ciesin.columbia.edu*)

TABLE 3.4.2 *Scenarios of future environmental and societal developments adopted for the Types VIA assessments and examples of their application.*

Type of scenario	*Examples of scenario development methods*	*Examples of applications of the scenario*
Atmospheric composition	CO_2 concentration (IMAGE team, 2001)	Impacts of pre-ecosystems and agriculture (Schröter et al. 2005)
of sea-level	Guidance on sea-level scenario development (Nicholls et al.	economic impacts of pre-coastal systems in Europe (Richards and
Socio-economic	2011) Population (O'neill, 2005)	Nicholls 2009) Human health impacts in Europe (Watkiss et al. 2009) Vulnerability
Land-use	Land use scenarios for Europe (Audsley et al. 2006)	of agricultural land use and natural species (Berry et al. 2006) Crop
Technology	Crop yield potential (Ewert et al. 2006)	productivity and agricultural land use in Europe (Rounsevell et al. 2005) crop
Adaptation	Optimal crop management (Iglesias et al. 2009)	productivity in Europe (Iglesias et al. 2009)

modelled changes between the reference and future periods are appended factors (or "deltas") to the climate observed during the reference period. This includes both the common technique found biases of the model was held in the present-day climate (e.g. Fronzek and Carter 2007). Pattern-scaling business a method often applied in integrated assessment models (IAMs) for comments on the regional patterns of climate changes in individual derived from AOGCM simulations of global mean annual temperature (which can be computed in a simple climate models). The same pattern can then be scaled up or down according to the simple model's temperature pro- jections for a wide range of emissions scenarios and future time periods (Mitchell 2003). Finally, ace has improved computer power, multiple transverse I- ble simulations with climate models have become feasible, allowing different model uncertainties to be explored and encouraging climate scientists of climate likelihoods to attach to decreased levels. The UKCP 09 probabilistic levels are decreased (Murphy et al. 2009), recent levels are decreased in Finland (Raisanen and Ruokolainen 2006), Australia and Southern Africa (Moisè and Hudson, 2008) and Europe (e.g. Harris et al. 2010).

3.4.4 *other characterizing and environmental socio-economic futures*

In parallel with future climate is also possible to import- ant to characterize future environmental and societal conditions that may influence vulnera- bility, impacts and Risk Management in general. Other factors, these scenarios have been cate- gorized by Carter et al. (2007) and are summarized in Table 3.4.2 along with some examples of their application VIA assessments. Many of the same issues as for climate, regarding data availability and spatial and temporal dimensions (e.g. van Vuuren et al. 2010), also apply to these scenarios.

3.4.5 *Scenarios as integrating devices*

The selection of common scenarios can be a useful device for imposing consistency and comparabi'l- ity across Climate Impact and adaptation assess- ments. During the past decade, most model pro- jections in the climate of the 21st century have been based on the IPCC marker scenarios of the set of six ***Special Report on emissions scenarios*** (Nakicenovic et al. 2000). Narrative storylines describing the complex giving rise to an SREs emissions future worlds, and the demographic and economic assumptions

that accompanied them, and therefore offer a consistent framework for characterizing other environmental and socio-economic scenarios to be used alongside an SREs-based climate decreased levels. Several assessments have developed European scenar- ios using the framework for integrating the moment as an SREs (e.g., Arnell et al. 2004; Carter et al. 2004; Holman et al. 2005; Rounsevell et al. 2006; Spangenberg et al. 2012). Other global scenario exercises matched to an SREs emissions include those developed by the Millennium Ecosystem Assessment (Carpenter et al. 2005) and the United Nations Environment 's programme ***Global Environment Outlook*** 4 (UNEP 2007).

A new generation of global scenarios (socio-economic need, technological, land use and climate) was prepared by international research teams ahead of the IPCC's ***Fifth Assessment Report*** (Moss et al. 2010; van Vuuren et al. 2012). Decreased levels of climate are now available from the CMIP 5 exercise (Taylor et al. 2012) based on the four representative concentration pathways (RCPs). These correspond to the four different levels of the atmosphere radiative forcing by 2100 relative to pre-industrial levels, expressed in units of Wm :-² RCP 8.5, 6.0, 4.5 and 2.6, representing unmitigated emissions (8.5) and progressively more aggressive mitigation targets (6.0, 4.5 and 2.6 - van Vuuren et al. 2012). These decreased levels of climate can be accessed on the IPCC data distribution Centre website *www.ipcc-data.org*).

3.5 behavioural analysis

Behavioural research uses a variety of methods - e.g. laboratory and field experiments, econometric analysis to try to understand how people make decisions and how those decisions vary according to contextual factors. The resulting insights can then help explain to other decisions in a situation: for example, why people buy lottery tickets when their chances of winning are virtually nil.

In climate change adaptation, impact and vulnerability analysis, behaviour analysis can be used to explain how actors (organizations or individuals) make adaptation decisions - on the assumption that such knowledge is necessary to advance adaptation. For example, understanding the factors that shape household decisions pre-flood pro- purple design can help to improve flood risk communication strategies. It also shed light on the limits to adaptation, leading to more realistic assumptions about autonomous adaptation to climate economics models and adaptation plans (Dow et al. 2013; Warren et al. 2012).

The top-level criteria for classifying the behaviour of ana- lytical approaches the theoretical assumptions they make about what drives individual behaviour. Cooke et al. (2009) distinguish between methods based on social psychology, and methods that assume rational actors and utility optimization. The former ten prominent approaches to build such as the protection motivation theory, which explains the actions in terms of individuals' perceptions of risks and capabilities. The latter draw on wide-ranging literature in the sky, and Game Theory. 3.5.1 Table summarizes these approaches, and they are discussed further below.

3.5.1 *social psychological*

As briefly noted above, models based on social psychological theories to explain behaviour through

cognitive factors such as motivations for and barriers to action. Protection motivation theory, which has been applied adaptation to many situations, it posits that actors take action based on four factors: the perceived severity of a threatening event, the perceived probability of the occurrence of the efficacy of the recommended preventive behaviour, and perceived self-efficacy (Rogers 1983). The domain of climate change adaptation, Grothmann and Patti (2005) examine the farmers' adaptive behaviour in case studies in Germany and Zimbabwe, and find that better explains the protection motivation theory on adaptive than traditional actions taken microeco- other models of decision-making.

3.5.2 *utility maximization and bounded rationality*

Maximization models are based on the assumption of rational individuals maximizing utility. This

TABLE 3.5.1 *Overview of behavioural analysis methods.*

	Social Psychology	*Rational choice*	
Method	*Protection motivation theory*	*Utility maximization*	*Bounded rationality*
Theoretical assumptions	Individuals take action based on their perception of risks and the effectiveness of acting to reduce perceived risks.	Individuals take action to maximize utility, and have complete information and the required analytical abilities.	Individuals take action to maximize utility, but have limited information and limited cognitive abilities.
Steps taken	1. The explanatory factors based on the literature with select 2. Identify actors and decisions	1. Select and actors constraints 2. Specify the decision rule in a Motion Picture for	
Results achieved	The model explaining adaptive actions. Prediction of the actions in different situations.	Prediction of actions. Consequences of predicted actions. Rounsevell et al. (2003) apply a linear program- ming model to examine how crop rotations, flips vary between locations. The model inputs costs and benefits of crop types, and time constraints. The results predict how to farm- ers again rotate crops in different locations if seeking to maximize profit.	
Example cases	Grothmann and Patti (2005) examine the role of climate information in adaptation decision-making through two local-level case studies in Germany and Zimbabwe. They conduct focus groups with gun and farmers who have to access to understand the role of climate forecasts in seasonal forecasts of crop-planting decisions. They find that actors' perception of their ability to act effectively to address an important determinant of the risk or threat of action taken. Berkhout et al. (2006) examine how organizations adapt to current and projected future climate change. Drawing on models of organizational learning, they conduct focus groups with nine companies of the gun and how to determine IT support in the UK, housing and water, or whether they have reacted to return to climate impacts or climate information. They find similarities to adaptations to regulatory or technological changes, but also differences due to the longer timescales to the feedback of climate adaptation decisions. Businesses are reluctant to act due to the uncer- tainties of the Climate Information and doubts about the benefits of taking action. Difficult		Botzen and Van der Bergh (2009) use bounded rationality assumptions to estimate risk Prem- IAS under different climate change scenarios for the Netherlands. They find that the estimation results suggest that a profitable flood insurance market could be feasible.
Issues involved	to observe cognitive barriers; studies often rely on the stated intentions rather than observed behaviour to ten.	May the assumptions may not be realistic.	May the assumptions may not be realistic.

a vast literature, going back to the foundations of modern economic thought and utilitarianism (e.g. Mill 1863). It is beyond the scope of this guidance to comprehensively discuss developments in this field, but we can briefly discuss key issues relevant to the application of this approach to adaptation. Business typically predicted Behaviour under condi- po independent decisions, in which individu- als are assumed to be rational maximizers perfect: complete the information that they have and are able to calculate the outcomes for all contingencies, and optimize utility. This is referred to as maximization (Cooke et al. 2009).

While utility optimization approaches are used widely, they has been criticized for making unre- alistic assumptions. Note that Knowledge work is often freely available and the limitations of human cognitive capacities are well documented (van den Bergh and Gowdy 2000). Further, the well-known cogni- tief biases exist. Bounded rationality and relaxes the assumptions of utility optimization, and aims to predict behaviour based on, for example, heu- ristics or rules of thumb, which are simple rules that achieve the optimal moment approximately outcome (Kahneman et al. 1982). Bounded rationality sug- gests that people engage in a mental search of options available and choose the first one that satisfactory job (Simon 1956). This so-called "sales- ficing" optimizing business in a way different from that instead of comparing all possible choices to achieve the optimal outcome, made a choice among a narrower set of options that meet the minimum cri- teria. Satisficing reduces the costs of collecting and processing information. Closely linked to the concept of bounded rationality the adaptive heuristics: people develop and use mental short- cuts to quickly identify acceptable options, with a minimal amount of necessary information (Payne et al. 1993).

3.6 institutional analysis

Assessments of vulnerability, impacts and adap- will often seek to understand the institu- tional context, including political, social and eco- structure the choices of individual factors that need it. Such methods are broadly categorized as institu- tional analysis (Hinkel and Bisaro 2013a). Several approaches are described below; criteria for select- ing a given method are given in Section 2.1.3.4.

Governance description 3.6.1

Description describe Governance approaches adopted for the relevant actors and institutions- tion. These types of analyses have been done all around the world in the context of climate change. For example, Tol et al. (2008) review the institutional context for adaptation in Coastal Zone management in Europe, and identify the three levels of decision-making: national governments, local governments and private individuals. They find that national level decisions are determined partly by EU policies, e.g. the coastal Bathing Water Directive, the Water Framework Directive and the Habitat Directive. This type of approach requires no strong theoretical assumptions on the part of the analyst, and contributes to adaptation by pro- viding a more comprehensive description of the policy context in which adaptation takes place.

3.6.2 *design Governance*

Governance addresses the question of how design design to an effective, for whatever reason, the front is the theoretical assumption that the link between institutions and outcomes can be understood and predicted with some confidence. One particular kind of gover-

the design approach that has been applied nance ■

business literature extensively the adaptation policy analysis. Policy analysis seeks to determine "which of various alternative policies will achieve a given set of goals in light of the relations between

the policies and goals" (Nagel 1999). It applied ex ante to improve the design of policies, pro- grammes or projects.

Regional quality manager has the body of literature by expanding the moment employed to analyse the mainstreaming of policy analysis adap- in into policies. adaptation occurs in all levels of IT support and the social organization at all, the goal of adaptation policy to ensure business generally relevant existing policies that address climate risks and to increase the capacity of individuals and societies to respond to these risks. In this sense, adaptation is not a stand-alone policy on a domain, but rather to integrate the task, or ***mainstream*** the consideration of climate change risks into existing sectoral policies. The recommendations of the high-level adaptation policy documents, such as the EU white paper pre-Adaptation (European Commission 2009), are illustrative, as they focus on the need to increase the consideration of climate risks across all support it.

Studies of mainstreaming has been one focus of development policy (e.g. Gupta 2009; McGray et al. 2007). Mainstreaming has been carried out through portfolio screening in order to identify climate risks which might conflict with develop- ment policy goals. For example, Sietz et al. (2011) report on the proportion of donor investments made in support climate in Mozambique while baschier and Dasgupta (2010) identify which goals in the national poverty-reduction strategy are threatened by climate impacts in Ghana. Klein et al. (2007) screen project portfolios of six donors, the development agency to identify the extent to which climate hazards are considered. These studies address the question of whether existing policies are at risk due to climate hazards.

On the other hand, if the climate is already being considered mission-critical business "climate-proof - ing" the policy in question. "Proofing" policies addressing related risks involves the early for policy formulation process, to identify any obvious effects or other support up to ten objectives. The practice of proofing policies are well-established in other sec- tors, such as health, and Rural Development (Urwin and Jordan 2008). The case is able to adjust the climate- tion, in this activity the business in its infancy, although several tools have been developed to support this pro- cess. For example, GIZ, the German Development agency, has developed a tool for climate-proofing development plans (Frode et al. 2013; Hahn and Frode, 2011); Norad has published a short practical guide (Ibrekk 2010), and the Asian Development Bank published case studies of its members for the Pacific (ADB 2005). Remedy's ***Toolkit for Integrating climate change adaptation into Projects*** also pro- vides relevant advice (CARE International, 2010 b).

3.6.3 *emergence Governance*

Within those methods which aim at understand- ing and explaining the governance emergence, a dis- tinction made between those approaches that assume that it is possible to generalize beyond a single case, and those that do not. Several anthro- pological and ethnographic approaches assume that this note is theoretically feasible.

For example, Mosse (2006), a case study in water management institutions in southern India, finds that business collective action is correlated with the Pres- ence of ceremony and rituals surrounding village water tanks. He argues that the causal mechanism behind this relationship can only be explained by understanding the meaning and symbolism of local institutions, which requires an in-depth anthro- pological methods. Such a moment of understanding causal relationships is not generalizable beyond the case study, because it depends front location and historically specific processes. Based on these find- ings, Mosse criticizes the social capital approach (e.g. Putnam, 1994), which relates the quantitative measures of institutions, e.g. the number of associ- ations in the study unit, to levels of collective action.

Although such a relationship may hold in a particular- ular case - in fact, in the villages it would Mosse has studied - generalizing to other situations without understanding the causal processes can lead to flawed interventions and maladaptation. Results from these approaches can thus only inform adap- for policy development in the particular case analysed.

On the other hand, approaches the new institutional economics, which have made significant and extensive contributions to natural resource and water management literature (e.g., Hagedorn et al. 2002; bougherar et al. 2009), and frameworks for institutional analysis (if any, 2005) and analysis of the governance of socio-ecological systems (Folke et al. 2005; If 2007; 2009) assume that be beyond single case studies on nonlinear higher level of abstraction. These approaches face the challenge that the general ratio between the number of relevant variables and the number of business cases is often too high to derive statistically significant results. Nonetheless, with these limitations in mind, carefully constructed studies comparing the moment a large number of similar cases has been produced evidence of accumulation, leading to conclusions about the general characteristics of social-ecological systems that can be related to desirable outcomes.

Examples of such nonlinear insights" "8 design principles for sustainable resource man- agement" (If et al. 1999), "principles of adap- Tief governance" (Dietz et al. 2003), or "institutional posted by adaptive water governance" (Huitema et al. 2009). These principles are, how- ever, very abstract and thus are intentionally left to make it difficult to empirically verify the operational and across differing contexts. In relation to able to adjust- tion, payday loans provide input regarding these institutional attributes that enhance the adaptive capacity of actors faced with climate insights can risks. These general comment need to be supplemented by contextual knowledge when implementing adaptation interventions. The fact that the pre- scriptions remain and require general contextu- alization of that differentiates the approach from policy design, which assumes that outcomes can be predicted ex ante. ■

TABLE 3.6.1 *Institutional analysis methods.*

Method type	*Governance description*	*Emergence Governance*		*Governance design*	
		Understanding case	*Generalizing design principles*	*Screening Policy*	*Proofing Policy*
Task	Identifying the relevant actors and institutions adaptation,	Even the emergence of governance systems, which enables adaptation		Identifying policies that ensure that goals are not negatively affected by climate change impacts	
Adaptation situation	Vulnerability, impacts and adap- are a result of many actors interacting and making interre- lated decisions None			Climate change risks climate change risks to policy to policy goals that are known are known note goals	
Theoretical assumptions		Attributing moment out- attribute the institution to come out- A comes to the front only possible in particular- case by case basis. ular institution.	It is difficult to work	There is a direct pre- dictable relationship between policies and outcomes.	

TABLE 3.6.1 *continued*

Method type	*Governance description*	*Emergence Governance*		*Governance design*	
		Understanding case	*Generalizing design principles*	*Screening Policy*	*Proofing Policy*
Steps taken	1. To identify actors and institutions	1. Select potential explanatory variables based on the literature 2. Collect data 3. Apply cause-effect reasoning		1. Identify relevant institutions and actors 2. Analyse documents and interview actors in the pre-policy development 3. Front analyse the impacts of climate change policy goals	
Results	Description of the institutions and actors that are relevant for	Recommendations on a case by case basis	Design principles to be contextualized in a given case , If et	identified in the handbook risks and opportunities for policy goals	Identified opportunities for improved policy
Example cases	adaptation Tol et al. (2008) was to review the ins- tutional context for adaptation in Coastal Zone management in Europe. They iden- tify three levels of decision-making: national governments, local governments and private individuals. The EU regulates certain areas through the Coastal Bathing Water Directive and nature through the Habitat Directive. National governments are at different states of awareness regarding coastal management, different states of urgency.	Pelling et al. (2008) address the question of which social and institutional factors have led to an absorbent mat- of young people in informal networks in public organizations. Active informal networks are assumed to be beneficial for adapcan. They look at integrated environmental policy-making describes the gov- ernance system across different support in Wales. They order to synthe- lessons from you and find evidence for a large number of factors which have promoted the absorbent mat - cases. Eight design principles are young people in the shadow of the network, such as found to promote the promotion of self-organization. "Team Wales"identity, and the tendency for long careers with little out-migration and fostering long-term relationships.	al. (1999) address the question of which variables lead to the self-organ- zation of communities for the management of Natural Resources. A framework for taking action the moment the situation as the unit of analysis	Klein et al. (2007) also a method for mainstreaming climate adaptation concerns into development orga- nizations. The study was conducted inter- views are examined and project documents for several prominent aid organizapo, considering the extent to which climate change has been taken into account in policy and project planning stages.	Dasgupta and baschier (2010) analyse the poverty reduction strategies and climate impacts on the rural poor in Ghana. They find that rural poverty reduction strategies do note that account for climate impacts, and focus on money-metric indicators of poverty. Find that they have mainstreaming climate change into development strategies, which would mean including broader indicators of pov- erty, business required to protect the poverty reduction goals.

3.7 formal decision-making

This section describes and discusses the formal deci- sion-making methods. The first three cost-benefit analysis, cost-effectiveness analysis and multi-cri- teria analysis are summarized in Table 3.7.1 and discussed further below. Decision trees for select- ing the appropriate methods are presented in Section 2.3.3.

3.7.1 *cost-benefit analysis*

Cost-benefit analysis evaluates options in terms of monetary value, the option of weighing the costs against the expected benefits. In general, the option with the highest net benefits or the highest cost-benefit ratio of a set of selected options from the business. Examples of the use of this approach in adaptation studies include Agrawala et al. (2008) with regard to sea-level rise; Callaway et al. (2007) with regard to freshwater systems; and Rosenzweig and Tubiello (2008) with regard to agriculture. One issue that cost-benefit analysis in its conventional form that does note that the address distributional issues associated with a given option. Costs and benefits accruing to the differ- ent actors are generally aggregated, and the issue addressed separately from the winners and losers of business.

Cost-benefit analysis requires the setting of a base- line against which to measure future benefits of an option. Adaptation baselines should be calculated from impacts without adaptation measure. This is particularly challenging because of adaptation for developing baselines must be tailored to the location, sector and Hazard, and therefore encom- pass adaptation understanding and predicting behaviour or "autonomous adaptation". Developing more complex than baselines for adaptation

TABLE. 3.7.1 *Three formal decision-making methods.*

Method	*Cost-benefit analysis*	*Cost-effectiveness analysis*	*Multi-Criteria Analysis*
	One metric by which alterna- tives can be characterized in terms of their costs and outcomes summary	One metric by which the alternatives can be characterized in terms of their costs and a metric by which different alternative that can be characterized in in terms of their benefits i.e. (, outcomes).	Several metrics by which the alternatives can be character- ized in terms of their costs and benefits.
Steps taken	1. Identify a set of options. 2. Choose a baseline against which the benefits and costs will be measured. 3. Calculate the present value cost of (PVC) and present value of benefits (PVB) for each. 4. Decision rule: chose alternative the highest net-benefit or cost-benefit ratio.	1. Choose a metric for effectiveness E (e.g. cost, low impacts). 2. Choose a baseline against which the effects will be measured. 3. Choose a set of alternatives that may be applied to reach the target. 4. For each alternative, calculate cost-effectiveness ratio (CER): Cherry = Ei/Ci. 5. Decision rule: choose alternative i * the highest CER *.	1. Identify a set of options. 2. Identify multiple criteria and weights for each criteria. 3. Associate a value for each criteria for each alternative. This yields a matrix steps. 4. Compute the weighted sum (called the score) for each alternative. 5. Decision rule: choose the alter- native with the highest score.
Results the	A ranking of options		
Issues involved	A standard cost-benefit analysis cannot deal with the indirect bene- fits. A general equilibrium model- ling approach would be needed. Does not consider distributional effects options. Outcomes are highly dependent on the pre - discount rates.	Additional outcomes for metric now (money food) necessary for business cost-effectiveness analysis. This can be difficult for us to identify adaptation.	

mitigation, where more well-established relationships between carbon emissions and macro-Eco- or other variables, such as GDP energy intensity can be used to establish baselines.

3.7.2 *cost-effectiveness analysis*

Cost-effectiveness analysis aims to find the most economically efficient way to achieve a specific outcome in - for example, several options which best protects coastal ecosystems from sea-level rise at the lowest cost. It can only be used to compare the options in relation to a single outcome; thus, it is generally not possible to compare note that adaptation strategies affect different IT support, because it is very difficult to find a common attribute across outcome support it. In contrast, mitigation measures can be easily compared across support, in terms of tonnes of carbon dioxide equivalent (co_2 e) the cost of the avoided unit Thu. The benefits of adaptation measures, however,are quite different depending on the climate risk at the act and setting: it is very difficult to compare, for example, the relative cost-effectiveness of investing in sea-walls to reduce coastal flooding, etc to protect from the extreme heat and air-conditioning (Zhu and van Ierland 2010). See Watkiss and hunt (2011) for an extensive discussion of these issues.

Within IT support, it may be easier to compare adap- in options. For example, Kouwenhoven and Cheatham (2006) assess the cost-effectiveness of different ways to protect freshwater supplies from the Pacific island nations affected by climate change. Based on the financial records and the gun with project teams, they calculate the cost of implemented options and alternatives, and evaluating options on the basis of how much additional water harvesting potential they provide. They find that three different communities, rainwater harvesting the world's most cost-effective option for providing greater access to freshwater. Other options such as improving water main infrastructure are more expensive per unit delivered.

Luz Mendes et al. (2011) address the cost-effectiveness of the options to reduce the transmission/incidence of dengue fever. They also have a dynamic of dengue transmission model that includes the effects of the development of human immunity and the patient to test the effectiveness of this insecticide in terms of DALYs (disability-adjusted life years) 43 different strategies to reduce incidence, including both larval and adult targeted targeted strategies. They find all the interventions that lead to the emergence of insecticide resistance, which will increase the magnitude of future dengue epidem- ics when combined with the loss of community immunity. The model shows that adult-targeted strategies are more cost-effective than larvae-tar- geted strategies.

Now the important consideration is cost-effectiveness analysis is only a relative measure of a set of options defined in relation to a previously outcome - the moment it does not provide an absolute measure costs and benefits of an option to ensure that work is "worth doing", as a cost-benefit analysis would. As with cost-benefit analysis, a baseline must be set against which to compare the outcomes; see the remarks in the previous section.

3.7.3 *Multi-Criteria Analysis*

Multi-criteria analysis uses several metrics to characterize adaptation options in terms of their relative costs and benefits. It is appropriate when the difficult to assign a monetary value to more than one of the outcomes of an adaptation measure. As with cost-benefit and cost-effectiveness analysis, a baseline must be set with the concerns discussed above.

An example of the use of Multi-Criteria Analysis of the adaptation of Business national adaptation Plans for action Lesotho (LMS 2007), which identifies and ranks potential adaptation projects nine on the basis of criteria developed with a group of stakeholders, including the national-level ministries, NGOs,

and local governments. The options are ranked ten of the criteria: i) impact on the economic growth rate of vulnerable communities; ii) frontal impact poverty reduction; iii) multi-lateral environmental agreement synergies; iv) employment creation; and VI) prospects for sustainability.

Belton and Miller (2011) evaluate policy options to improve the management of water facing climate impacts in Yemen. They rank the options according to six criteria: public financing needs, impleme the- barriers, environment, social, economic, and political-institutional. A sensitivity analysis was also conducted in order to investigate how changes in the ranking of criteria weighting of the affected options. They find that combining several options to provide incentives for water use efficiency, and to promote the uptake of a technology portfolio, business preferred option.

3.7.4 *Robust decision-making*

Uncertainty about the mid - to long-term impacts of climate change (and non-climatic conditions) will continue to make it difficult to construct the prob- ability density functions for impacts (Edgar et al. 2009). Due to this uncertainty of climate models at the scales needed for adaptation decisions, opti- mal adaptation decision-making should be aban- doned in favoring robust decision-making when considering the mid - and long term.

Robust decision-making entails running a large amount of different scenarios and analysing these ten options over the scenarios given a set of crite- ria. It does not require to be attached to an existing order with different scenarios. This way, options can be eliminated, which do not perform well in projected futures, the future of the likelihoods Evol even when the Po are not well known.

In some cases, model-based approaches have also been used to identify robust adaptation options and these approaches are also applicable to other contexts. Lempert and Groves (2010) used a robust decision-making process in conjunction with the Inland Empire Utilities Agency (IEUA) in California to determine appropriate adaptation options for Water Management agency. This approach is designed for use in the context of uncer- tainty, as is the case with climate change. It uses simulation models to assess the performance of agency plans over miles of plausible futures, using statistical "scenario discovery" algorithms to concisely summarize the futures where those plans fail to perform adequately, and use these scenarios to help decision makers, resulting in under- stand and assess the vulnerabilities of their plans and the options for ameliorating these vulnerabilities. For IEUA, the agency's analysis suggests that the cur- rent plan, perform poorly and could lead to high costs and a shortage of water provisioning under con- ditions of: (1) large declines in precipitation, (2) larger-than-e impacts of climate change on the availability of imported supplies, and (3) reductions in percolation of precipitation into the region's groundwater basin. Including adaptivity of the current plan eliminates 72% of high- cost outcomes summary. Robust adaptive one promising strategy to accelerate efforts to expand the business after the agency's groundwater banking programs and implement its recycling program, while monitor- ing the region's supply and demand balance and making additional investments in efficiency and storm-water capture if shortages are projected; that approach eliminates more than 80% of the initially identified high-cost outcomes summary.

Robust decision-making and thus can be gener- ally work, combined with cost-benefit, cost-effective- ness or Multi-Criteria analysis. For example, Wilby and Dessai (2010) apply a robust decision-making in the water sector adaptation options help you rank in Wales and England. The method identifies options that address current climate policy goals, then the outcomes of the sensitivity of these tests

future scenarios, across a large number of options. Cost-benefit analysis used to identify a business options for which the benefits exceed the costs across a wide range of impacts of future scenarios of climate change; these are robust options. Those mea- sures that have a negative benefit-cost ratio for the projected future climate, some are not considered robust. The authors find that measures that are flexible and permit updating according to future conditions are likely to be more robust to future cli- mate changes, though there may be other robust options that are not flexible.

3.7.5 *Multiple-shot robust appraisal*

A further challenge for adaptation decision-mak- ing in terms of estimating the value of the clan, the wait- ing for more information before making a decision. This is particularly the case when the set of options includes options with long investment horizons, or a decision when considering the adaptation of the business to mid - to long-term hazards, and when options are considered flexible.

An option business ***flexible*** it allows you to switch to other options in the future it might be preferable that the job once more is known about the changing climate. If one or more options are flexible over the lifetime of the decision, the analyst can then incorporate this into the appraisal of options, and the criterion of options, flexibility becomes important. More knowledge may become available through direct observations and improved scientific knowledge. For example, the analyst may know that in a study on the impacts of sea-level rise in the region will be completed in two years. Of the consideration for coastal defence options should include the expectation that improved probabilistic knowl- Edge will become available.

When the business is at least one option flexible, a set of approaches uses the flexibility of the criterion to decide between alternative strategies. Flexible options are favoured over non-flexible ones, and decisions are delayed to keep future options open (hallegat in 2009). The adaptation pathways approach imple- ments by the criterion characterizing the flexibility of alternative strategies in terms of two attributes: i) adaptation tipping points, which are points beyond which strategies are no longer effective (Kwadijk et al. 2010), and II) what alternative strategies are available before a tipping point has been reached (Haasnoot et al. 2012). Importantly, the exact time when the business reached a tipping point does not matter - it is rather the flexibility of having business alternatives avail- able that drives the decision. Prominent applica- Po of this approach include the Thames Estuary 2100 Plan (Lowe et al. 2009; Penning-Ro et al. 2013), the Dutch Delta Programme (Kabat et al. 2009) and New York City the front panel on climate Change (Rosenzweig et al. 2011).

3.7.6 *adaptive management*

For another method of decision-making under uncertainty, adaptive management approach. Adaptive management allows for the updating of the ten actions of the basis as new information becomes avail- able. In this sense, adaptive management, an ex-post evaluation of options based on the pref- erences of the decision-maker. Adaptive manage- ment requires the availability of new information on the effectiveness of an adaptation, action, and therefore closely related to the business of monitoring and eval- uating, and learning (Armitage et al. 2008).

Some options of the case, this is straightforward. For example, for setting the premiums an insurer, flood insurance in coastal zone can gather information pre-damages and adjust premiums accordingly. For other options, however, such as protective infra- structure adjustments at a later stage - for example, by raising the level of the dike - are much more expensive.

3.8 valuation methods

Valuation type of computing a monetary value on the basis of non-monetary attributes of the outcome of an option. Business valuation is necessary in situations in which monetary values are the outcomes con- sidered important. Monetary aspects are par- ticularly important in situations in which formal decision-making methods are applied, and thus are frequently used valuation methods as part of a formal decision appraisal (Section 2.3). Valuation methods are also important in the impact analysis in order to identify adaptation needs (Section 2.1).

Various issues can complicate the process of assigning monetary values. Some of those issues below are discussed, and different valuation meth- ods to address them are described. The methods are summarized in Table 3.8.1, and further exam- ples are given.

Business valuation point of departure for those people that buy and sell goods on the market, such as bread, butter or bicycles. Their value can be established by observing the average prices people pay for them. Ace prices change over time can be established in a base year, and correc- tion values obtained can be made for inflation or estimated in the past for the future. From the simple case, there are several characteristics of the outcomes that can make it more difficult to assign monetary values.

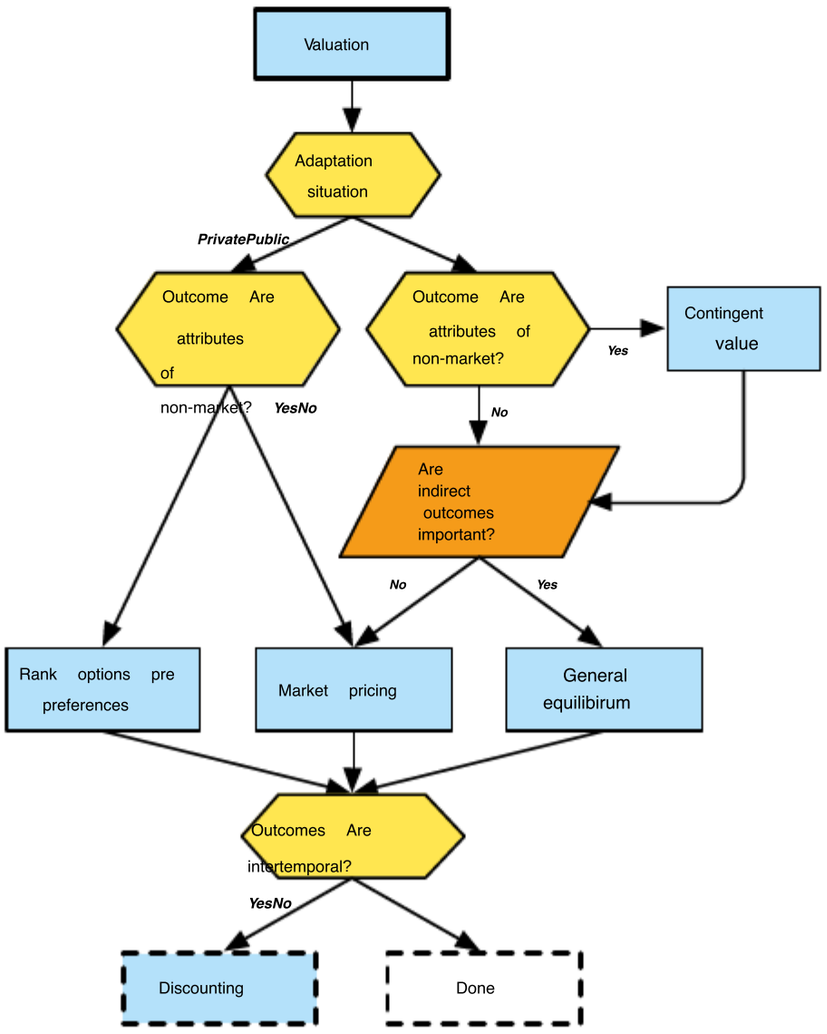


FIGURE 3.8.1 *Choosing methods for valuation.*

The outcomes for markets that are traded on the valuation business straightforward, as prices exist for the attribute in question. For example, assigning a monetary value to the benefits of planting a drought-resistant wheat is straightforward because the market may the price for wheat is relatively stable and well known business. Outcome For other attributes, such as the area of wetland conserved by a change in land use, it may be more difficult to assign monetary values.

TABLE 3.8.1 *Methods to assign a monetary value to the outcomes of adaptation options.*

Feb-types	*Non-market outcomes*	*Indirect outcomes*	*Inter-temporal outcomes*	*Summary of uncertain outcome*
Character-istics of adaptation situation	Assigning a monetary value to the costs and benefits of an adaptation option considered important for decision-making. A common metric, e.g., money, it can be applied across a range of outcomes and implications of a particular choice. Prices change over time; therefore, it is appropriate to specify a base for the valuation year, correcting for inflation. Outcomes the outcomes are to be placed on the value of the value placed on a choice of ten are valued by looking at large-scale business outcomes and outcomes of a business function is a function of the average prices that cause significant indirect time (i.e. the action today of how certain people are willing to pay effects. outcomes will be a future benefit, the utility for them. generation). function can be esti- mated, and the probabil- ity of business outcomes known.			
Results Example cases	Each value assigned to a business via a common outcome metric. Valletta Van Butsic and Robinson et al. (2011; (2011) apply a hedonic 2012) multi-sectoral framework to estimate dynamic regionalized climate of the value of a computable general equilibrium model of change impacts by estimating their impact on a system with Ethiopia in pre-real estate prices in the country-specific ski resorts near the hydrology, crop, road and hydropower engineering western United States and Canada. They use the models to simulate the economic impacts of ten individual data on home sales in the four locations, climate change towards 2050, combined with weather. They find that without data and characteristics of externally funded adaptation of nearby ski resorts to estimate the effects of snow - Ethiopia's investments will fall in GDP in the 2040s changes to the front housing values. up to 10 percent of the hell Arrow et al. (1993) develop a set of guide- lines for applying contingent value of envi- ronmental and Natural resources. Hamilton et al. (2005) apply the travel cost method to develop a model to estimate the impacts of climate change on international tourism flows.	below the counterfac- tual no-climate-change baseline.	Stern (2006) uses the run a dis- count rates to calculate the net present value of climate change mitiga- tion policies.	Yohe et al. (2011) address the question of valuing adaptation options to stochastic events related to sea-level rise in the coastal zone. They find that increases in decision-makers' rebels lair increase the risk to the economic value of adaptations that reduce expected damages and diminish the variance of their inter-annual variability. For engi- neering and other adaptations that require large up-front costs and ongoing operational cost increases the risk of rebels lair increase the value of adaptation and therefore make the implementation of these options, the economics- cally efficient at that earlier date.

continued

TABLE 3.8.1 *continued*

Feb-types	*Non-market outcomes*	*Indirect outcomes*	*Inter-temporal outcomes*	*Summary of uncertain outcome*
Issues involved	The travel cost method the work is challenged by the fact that important costs of a trip may be unobserv- able. On the other hand, multi-purpose trips may cause the method to over value now environmental resource. Contingent valuation has been found to be highly dependent on the pre-question framing, e.g. "willing- ness to accept" surveys produce higher values for resources than "willing- ness to pay" surveys.		Behavioural research shows that most individuals do not apply the exponential model of the moment to their own decisions, but rather a hyperbolic model, in which the dif- Ferenc between the value of an event is occurring now and in the front is occurring a year into the future is much greater than the differ- ence between the value in an event is occurring one year and into the future occurring two years into the future.	

DECISION NO. DE: Public or private decision?

The first decision node whether you are a business relevant options considered for valuation are related to a public or private actor's decision. Valuation methods rel- evant for public and private actors differ in two aspects. First, public actors must consider the social welfare and, therefore, the preferences of other actors. When non-market outcomes are involved in a decision - e.g. clean air, good health, or nature preservation - public actors may have to find out the preferences of other actors regarding those non-market outcomes. Methods which compute monetary values for non-market outcomes and thus enable the actor to discover a public preferences over different outcomes. For example, the public actor may use the contingent value methods to gauge the value that private actors to assign the enjoyment of preserved wetlands for recreation. Private actors, on the other hand, know their own preferences, consciously or otherwise, need not and therefore to apply non-market valuation methods. Second, public actors are usually also interested in landed- rect outcome attributes such as longer-term and cross-sectoral effects of macroeconomic out- comes, which are generally not relevant for note private actors. For private actors, the relevant valuation outcomes for tasks that are far in the future (discount- ing), or uncertain (probabilistic) outcomes.

DEC I SIO N ODE: Outcomes Are non-market?

The next decision node, for both public and pri- vate actors, whether business valuation methods should be applied to note that the outcomes are traded in markets. There are a number of methods to esti- mate the value of such outcomes relative to goods traded on the market. These include, hedonic pricing, contingent valuation and travel cost method (see Patti et al. **2011**). An example of hedonic pricing would be to examine the extent to which a natural wetland located near housing prices differ from houses that are similarly situated note of the wetland near; from this, it is possible to impute a value derived from the landscape for the quality of the wetland. Similarly, Van Butsic and Valletta (**2011**) apply a hedonic framework to estimate the value of climate change impacts by estimating their impact on real estate prices near ski resorts in the western United States and in Canada. They use data from four locations in ten individual home sales, com- bined with weather data and characteristics of nearby ski resorts, snowfall estimate the effects of changes Centre on housing values.

Contingent valuation would be an example of love, people how much they would be willing to pay to preserve a wetland; from this it is possible to impute a value to the wetlands' existence. Arrow et al. (1993) develop a set of guidelines for applying the contingent value of environmental and Natural resources. An example of the travel cost method would be to survey about visitors to the National Park where they came from and how much they are willing to pay for visiting the park and calculat- ing the value of consumer surplus as the park (Patti et al. 2011). Hamilton et al. (2005), meanwhile, apply the travel cost method to develop a model to estimate the impacts of climate change on the front of the inter- national tourism flows.

If non-market outcomes in the interest of public actors may apply any of these methods (see Section 3.4.1). For private actors, non-market out- comes can be ranked according to their own pref- erences; no necessary business elicitation of preferences.

DECISION NODE: *Indirect outcomes Are important*?

Public actors, the subsequent decision node to be addressed whether the indirect outcomes of work are important adaptation option minute. This is relevant only for public decision-makers, as in considering social welfare, outcomes indirect links often have a significant effect. For private actors, it is unlikely that indirect outcomes will be of a magnitude to affect the interest of their own in private. However, indirect outcomes may be produced at more aggregated levels of society, such as through cross-sectoral spillover effects. For example, a particular option may result in a segment of the population having more disposable income. If these individuals save money, there may be no indirect effects - but if they spend it on goods and services, this will create the indirect effects throughout the economy, increasing others' incomes, and possibly chang- ing the relative prices of goods, and the output of different support it. There are various methods for calculating the extent of these ripple effects. The simplest takes a moment for empirically derived multiplier. A multiplier of 3, for example, would mean that for every euro of direct benefits to the society as a whole will experience a €2 additional indirect benefits through the increase in consumption (Patti et al. 2011). The method involves a more involved model- ling through the economy as a whole, e.g., general equilibrium, or input-output models. These partial or general equilibrium models allow one to esti- mate consumption levels, and hence the total value, in the new equilibrium (Patti et al. 2011).

Robinson et al. (2011; 2012) run a multi-sectoral regionalized dynamic computable general equilibrium model of a system with Ethiopia country-specific hydrology, crop, road and hydropower engineering models to simulate the economic impacts of climate change towards 2050. They find that without externally funded adaptation invest- ments in the 2040s Ethiopia's GDP will be up to 10% below the counterfactual no-climate-change baseline.

DECISION NODE: *Outcomes Are inter-temporal*?

Finally, the analyst must consider whether the outcomes of interest are the inter-temporal. This is a complication that often clan, formal decision-making frequently requires comparing the costs and benefits obtained at different points in time. Economists typically use a discounting function to decrease the importance of costs or benefits occurring in the future farther; for example, Stern (2006) uses discount rates to calculate the net present value of climate change mitigation policies. Discount rates relate to future monetary values to the present, corresponding to the empirical reality that actors prefer current consumption to future consumption. Discount rates arise for two reasons. First, there's a macroeconomic basis of discount rates, whereby it would economic growth and inflation rates mean that the real purchasing power of a unit of wealth decreases over time. Second, there

a moral (or social) discount rates of the element when seen from the moment intergenerational perspective, The Discount rate represents whereby it would prefer- ence over consumption of this generation of con- sumption of future generations.

The discount rate used can be extremely import- ant in choosing options, especially in a finished time horizon, an option of work long. $1 million benefit that occurs 10 years from now, for example, a business worth $737,000 today, with a 3% discount rate; a benefit for 20 years of business worth $544,000 and a benefit in business for over 50 years worth of $218,000. This simple exam- ple demonstrates that a reasonable discount rate may provide limited support for the market facilitate the conduct of the benefits of investing that occur beyond one or two decades. Therefore both market and social aspects of discount rates should be considered.

DECISION NODE: *There is uncertainty about summary of outcomes*?

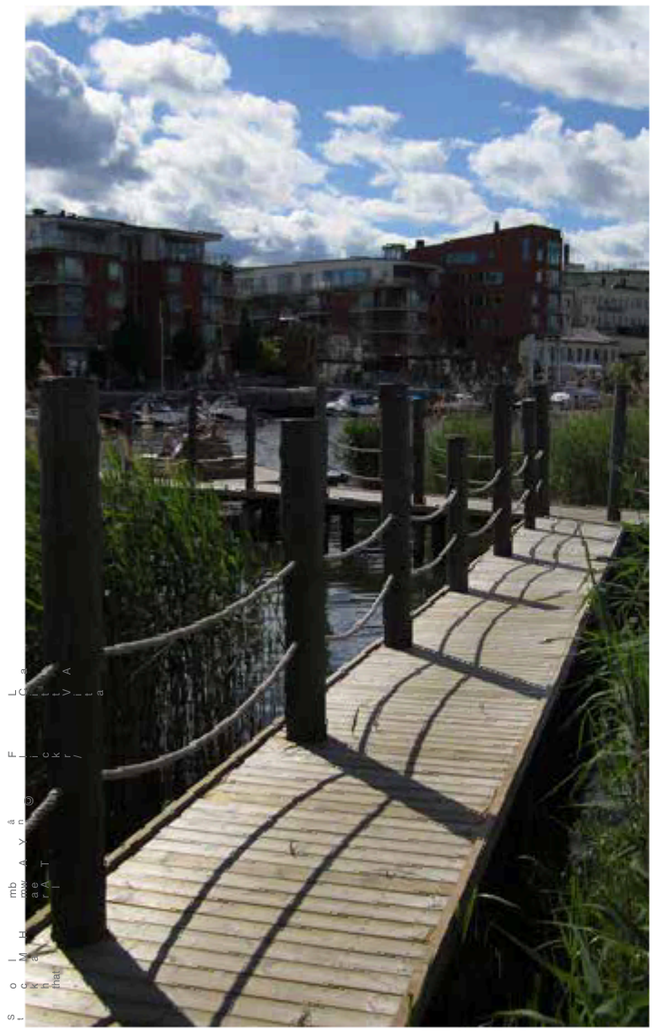
In cases where there is uncertainty about out- comes, further complications arise. The analyst may consider whether there is probabilistic infor- mation pre-summary of potential outcomes. If outcomes can be represented through a probability density function, then an option can be assigned a value according to the expected outcome. However, the outcomes of the uncertainty raises a further issue, as both economic theory and empirical evidence that people generally have next I notice that the front uncertainty. Therefore it can be applied valuation uncertainty in the outcomes. In other words, a relevant question to consider is: how much more people would share an outcome that is certain for an uncertain outcome than they would not, but with the same expected value? In order to address this, it is necessary to estimate a utility function for the individual moment to respect the outcome. In general, the utility function is shaped by diminishing mar- original utility, which reflects the principle that past a certain threshold, increasing quantities of the same good to bring a little additional utility. Because of this the expected utility of an option will differ from the expected outcome at which the outcomes are as expected tail end of an outcome distribution con- tribute little to expected utility. This is another way of saying that people are generally risk-averse, and in general to prefer a certain outcome uncertain outcome, with an equal expected value.

For example, Yohe et al. (2011) address the ques- tion of valuing adaptation options to stochastic events related to sea-level rise in the coastal zone. They find that increases in decision-makers' aver- sion to adjust the a risk to increase the economic value of able- diminish and reduce damages po expected that the variance of their inter-annual variability. For engineering and other adaptations that require large up-front costs and ongoing operational cost increases the risk of adap lair increase the value of the rebels- and therefore make the implementation of these economically efficient options at that earlier date.

A public actor, the utility of the functions affected actors must be aggregated into a social welfare function. These considerations apply to situations in which outcomes can be represented probabi- listically. When future outcomes cannot be repre- sented probabilistically, valuation methods are not applicable.

While the tasks and methods discussed in this sec- tion has been extensively applied, it is important to note that they have also been subjected to Feb- stantial criticisms. Tasks and valuation meth- ods are described in this subsection is largely based on approaches of neoclassical economics welfare economics. Criticism of these approaches has focused on the unrealistic assumptions made about the actor's choice processes in order to sup- port of valuation methods. Critics point to the well-doc- umented cognitive biases in individual deci- sion-making, so that framing effects may influence valuation (Kahneman et al. 1982). Others have crit- icized valuation methods for enabling trade-offs

to be made between outcomes should be seen as incommensurable. There are, for example, the arguments of the valuation to be made against species extinction or human suffering (Vatn 2005). This may encompass a strong sense of valuation applying a normative component, and the analyst should be aware of these issues when deciding whether to finished apply valuation methods. ■



3.9 tools for adaptation planning and implementation

Identifying adaptation needs and finding ways to address them are challenging tasks, but with the support of experts, international organizations and NGOs, many countries, regions and communities have completed them successfully. There are countless examples from studies published in academic journals, to Least Developed Countries' national adaptation programmes of action (NAPAs), a high-profile assessments of major cities in industrialized and developing countries alike.

Yet as Moser and Ekstrom (2010) and others have noted, several adaptation processes have to date reached the implementation, monitoring or eval- uation stages. Often they get stuck in an earlier stage, and finance is often an issue - a subject not addressed in this study. But the other major factor, as Moser and Ekstrom point out the larger social and governance context, which can determine who supports or obstructs the process, what resources are available, and how much action is possible.

Section 2.4 discusses at length these challenges, including the need to engage stakeholders; build the case for adaptation; ensure that information usable by the relevant business actors; define the nature and scope of work; agree ten fundamental prin- ciples; set priorities and decide how ambitious to be: whether to aim for incremental change, a more substantial shift or transformational change.

The participatory tools described in Section 3.1 provide a good starting point for those first steps; see in particular Sections 3.1.2.1 and 3.1.2.2 for tools to help you identify the key stakeholders who need to understand the process and be engaged in their diverse perspectives and how they relate to one another. In Section 3.1.3 of many tools also provide useful guidance on how to engage

stakeholders, community-based adaptation processes, so choose the ones who don't adapmeasures they deem best for their needs, set priorities, make a plan and implement the measures. This can help build a sense of ownership of the process, potentially enabling it to continue well after the intervention has ended. See, for example, the resort Community vulnerability and capacity analysis methodology, which is available in English, French, Spanish and Portuguese (Daze et al. 2009); Oxfam International's guidance on how to adapt to empower people living in poverty (Pettengell 2010); and the Red Cross/Red Crescent vulnerability and Capacity Assessment guide (IFRC 2007).

Below we provide some additional guidance on effective participatory planning and the impleme- in processes, and descriptions of tools that might be particularly useful for community-based adaptation. There is also a growing array of tools geared to local governments, businesses and organizations, and engaging in specific support adopted- tion; we have gathered those tools in Section 3.9.2.

Principles for effective adaptation planning and implementation 3.9.1

As we have discussed throughout this guidance, there is no single formula for success in adap- in: every situation is different, and in many cases, the adaptation is not the main focus of the active- ties - such as when climate concerns "main- streamed" into or sectoral development plans, or when "climate-proofing" is just one step in a larger planning process. When climate risks are not a major concern for stakeholders, even if it may be strategic to de-emphasize the adaptation benefits of a measure; for example, restoring wetlands may be more appealing to the community for their recre- ational value of the benefits for biodiversity, or even to protect from flood risks than existing as protection from uncertain future climate change risks.

This highlights the importance of understanding the context in which adaptation to take place: societal priorities, economic interests, governance structures, etc. In order to succeed in adaptation actions that need to be tailored to context.

Equally important is that the adaptation process is participatory and inclusive. Note This only means engaging the intended beneficiaries of adaptation actions, but also the people whose support and/ or involvement will be needed to successfully implement the plan and measures. That might include elected officials, staff from different ministries, agri- cultural extension officers, local planners, sectoral leaders, businesses or other constituencies; see Section 3.1.2 to help you identify and tools for the"map" of different actors and how they relate to one another.

A key role of participatory processes work to help you reach agreement on the scope of work to be done, priorities, and goals - what would constitute success? Section 3.1 provides extensive guidance on how to work with stakeholders from: ethical issues, effective facilitation, specific tech- niques, methods and tools. It is also essential to have a clear set of guiding principles; for example, the adaptation learning programme for Africa laid out the following guiding principles for participa- tory planning scenario (CARE International, 2012):

- Involve all relevant stakeholders, women and men of different age, livelihood, ethnic or other groups, recognizing their roles and utilizing their specific knowledge and capac- ities to enable a participatory process and coordinated outcomes. Recognize,
- respect and build on pre-both local and scientific knowledge on climate. Encourage
- open discussion, dialogue and feedback among stakeholders. Use a range of methods to ensure participatory workshop and open discussion and reflection are all useful. Pay attention to the language used

to ensure everyone understands and can contribute. Communication should

- be inclusive, reaching all genders and groups (e.g. groups, livelihood, land users, vulnerable groups within the community. Conduct timely PSP as soon
- as possible after the seasonal forecast is available, and timely communication advisories to empower communities, local governments and other practitioners to take appropriate adaptation actions. Encourage participants
- to take their own decisions and actions as well as to support others and seek the necessary support. Be ready with these ten ideas where could be found.

The design process is very important - though often it is neglected. If a project's business and to be owned by all moved forward, and if participants' adaptive capacity to be strengthened work, the process has to work well for everyone involved. That means everyone should understand their own role in the various stages, and how the pieces fit together to achieve the objectives. The visual was held of the decision-making process may help to illustrate this more clearly, and to clarify expectations. Ideally there should be multiple opportunities for the key players to actively engage in the design, devel- ops. A good adaptation of the collaborative process also includes learning and reflection to win either of cycles that allow the group to recognize and respond to changing circumstances and unforeseen out- comes. As Pelling et al. (2008) note, it is also possib import- ant to remember that is very valuable interactions between individuals occur informally, the "shadow space", and ensure that the process provides such opportunities to connect. 3.9.1 Figure below, adapted from the pulhi and O'hara (2006), illustrates another important aspect of effective participa- tory processes: multiple opportunities to reflect, reconsider assumptions and adjust as needed.

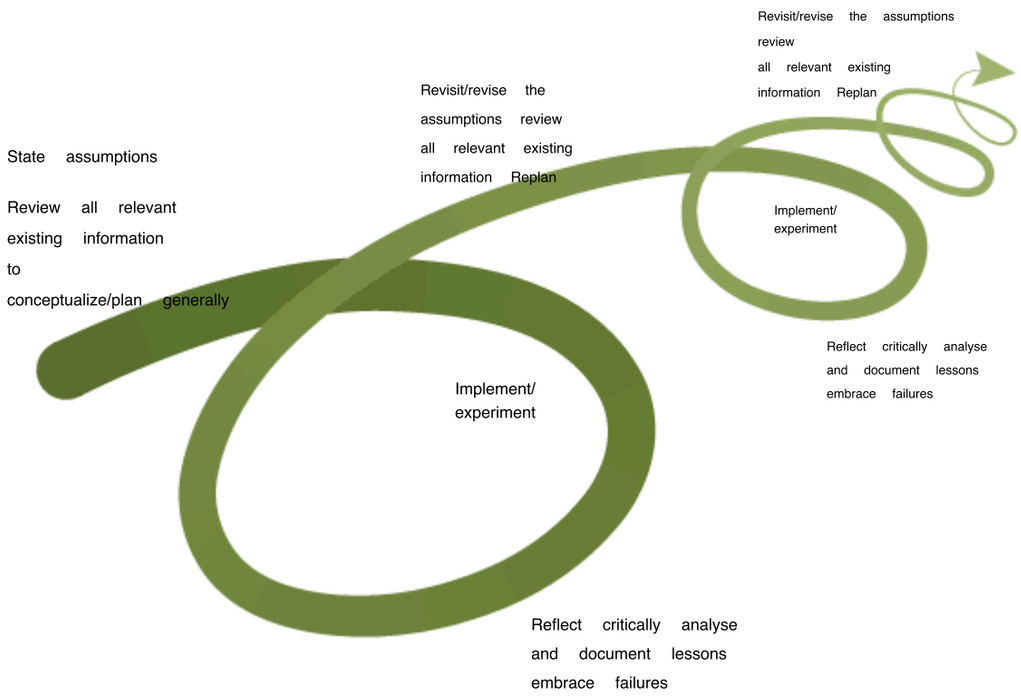


FIGURE 3.9.1 *Participatory action research approach to increase the quality of learning either win now.* Adapted from the pulhi and O'hara (2006).

3.9.2 *general guidance and tools for adaptation planning*

As noted at the beginning of this section, many of participatory tools and methodologies presented in Section 3.1.3 offer useful guidance for pre-planning and implementing adaptation, espe- cially in community settings. Three other useful resources are:

- ***Designing Climate Change Adaptation Initiatives*** UNDP (2010a) a toolkit for practitioners with the stated purpose of supporting the design of measurable, verifiable, and reportable adaptation initiatives with step-by-step guidance for adaptation planning initiatives.
- CLIMATE ADAPT European Climate Adaptation Platform, who has an adaptation support tool that provides guidance and links to resources to assist with every step of the adaptation process, starting with the basic guiding principles: *climate-adapt.eea.europa.EU/adaptation-support-tool*. GSDRC
- is a partnership of research was the institutes, think-tanks and consultancies, has compiled an online guide to Climate change adaptation that includes the explanatory a collection of materials as well as the guidance and tools: *www.gsdrc.org/go/subject-guides/climate-change-adaptation/adaptation-guidance-and-tools*.

These resources, along with fairly general, there is a growing array of specialized tools and materials to support adaptation planning and implementation in specific settings, such as individual cities or regions, or within individual support: water resources, coastal management, agriculture, etc. The two sections below list some of those specialized tools; note that some of the resources listed 3.9.2.2 especially section, include materials that might be useful in several different settings.

3.9.2.1 *tools for local - and regional-level adaptation planning*

- ICLEI USA has compiled a climate adaptation guidance for the website with an array of free tools, training materials and case studies for local planners: *www.icleiusa.org/climate_and_energy/Climate_Adaptation_Guidance*.
- A particularly valuable work on the source site ***Preparing for climate change: a guidebook for local, regional and state governments*** (Snover et al. 2007), produced by the Climate Impacts Group at the University of Washington (U. S.) in association with ICLEI and the partierpation of King County (Seattle) officials, which offers practical guidance based on the work of ICLEI's Climate Resilient Communities programme: *www.icleiusa.org/action-center/planning/adaptation-guidebook*.
- ICLEI Oceania, meanwhile, has developed a local government climate change Adapin toolkit that builds on the Australian government's risk management framework incorporates and capacity-building to support adaptive management: *archive.iclei.org/index.php?id=adaptation-toolkit* 0 .
- The Canadian Institute of Planners has developed a website, Planning for climate change (*www.planningforclimatechange.ca*in English and in French) provides a model of standard practice, case studies from across Canada, and detailed guidance for planners in different settings, including small rural communities and Nunavut communities. The climate Witness community Tool- kit developed
- by the WWW-the South Pacific through a process should be undertaken ten Hobnail, Fiji, the business was designed to help facilitators work with communities to plan adaptation measures that they can implement themselves: *wwf.panda.org/about_our_earth/all_publications/?uNewsID=*162722.

- The Caribbean climate online risk and Adaptation Tool (CCORAL) designed to help Caribbean countries to plan for climate change adaptation measures and "make more climate-resilient decisions": *ccoral.caribbeanclimate.bz*.
- The Institute for Tribal Environmental Professionals at Northern Arizona University has developed Tribes & climate change minute adaptation of the website that includes resource guide with materials that might be registered trademarks- larly useful Native American tribal leaders in developing and implementing adaptation plans: *www4.nau.edu/tribalclimatechange/resources/adaptation.asp*.

3.9.2.2 *sector-specific tools*

- The U. S. Environmental Protection Agency has compiled a list of tools for adaptation planning and resources for public officials, including specialized tools for public health, coastal planners, water resource managers, and specific regions of officials: *www.epa.gov/climatechange/impacts-adaptation/adapt-tools.html*. The Georgetown
- Climate Center Adaptation Clearinghouse has assembled packages of key resources, expert organizations, assessments and adaptation plans sample for transpor- public health, coasts and water, as well as links to state and local adaptation plans, law and governance materials, and other resources: *www.georgetownclimate.org/adaptation/clearinghouse*.
- Ecosystem-based management tools Network and now, climate change has compiled Tools Matrix - a five-page spreadsheet of commonly used low-cost tools to support adaptation planning, with both generic tools and specialized tools for coastal and land use planners: *www.ebmtoolsdatabase.org/resource/climate-change-tools-matrix*.
- NatureServe, and ecosystem-based management tools Network have compiled a guide called tools for coastal climate

Adaptation planning targeted at practitioners and decision makers involved Coastal Zone Management, Natural Resource Management, Protected Area and habitat management, watershed management, conservation, and local coastal planning in the U.S.: *connect.natureserve.org/toolkit/ebm-tool-network/climate-adaptation-planning-tools*.

3.9.2.3 *Planning tools for businesses and organizations*

- UKCIP has developed BACLIAT (*www.ukcip.org.uk/bacliat*), the business areas Climate Assessment Tool to help businesses identify current and future climate risks and address them. Business tool built as a series of workshops with background information and step-by- step guidance. A "speed BACLIAT" a spread- sheet tool is also available. The Costings tool from ukcip also can be used by both private- and public-sector decision-makers to get a better sense of the economic implications of climate change and adaptation measures: *www.ukcip.org.uk/costings*.
- Another tool UKCIP, CLARA, Climate Adaptation Resource for advisors, designed to help advisors to small and medium-sized enter- prises help them understand climate risks, make the business case for action, and imple- ment adaptation measures; the factsheets can also be accessed directly by businesspeople: *www.ukcip.org.uk/clara*.
- Ukcip's adaptation Wizard is designed to help organizations assess their vulnerability to climate change, identify key climate risks, and there is also a climate change adaptation strategy. The website includes several case studies, as well as a guide to all the information, tools and resources developed by the ukcip; see *www.ukcip.org.uk/wizard*.

3.9.3 *Other planning and implementation tools*

Many of the challenges that arise in adaptation processes are not unique, and in fact, many tools are used in the adaptation based on today methodol- ogies used in the development of the first realm, such as "action research" approaches (see Section 3.1.3). Unlike the tools described in Section 3.9.2, the resources listed below were designed expressly note for adaptation, but they have been used success- fully as a part of adaptation processes. In addition, See section 2.5.7.1 a description for an exam- ple of logical frameworks, see and Hovland (2005) for several more options, including guides to stakeholder and social network analysis, and "prob- lem" tree analysis.

- Participatory mapping has been widely used for more than 20 years in both industrial- ized and developing countries, as a way to visualize the local communities' relationship to the landscape, as well as the social, cultural, economic and historical context. Thus, it is a common approach to gathering local knowl- edge and initiating a dialogue about issues of interest to the community. The International Fund for agricultural development (IFAD) has published an in-depth guide, available as a free download; see Corbett (2009).
- "Mental model" approaches have been used in organizational settings to ensure that team members have a collective vision of the task or issue at hand, so they can solve it more effectively (Langan-Fox et al. 2000). They are also seen as useful when multiple stakehold- ers are assigned with different perspectives

a plan to manage and process together; while modelling mental note to bring with them may be full agreement, it can help them identify differ- ences and commonalities and thus enhance collaboration and collective decision-making (du Toit et al. 2011). The climate change collective learning and Observatory Network

Ghana peculiar to the mental models used to assess how community members to understand climate change, and the process outlined zones with its front web- Site; see CCLONG (n.d.).

- The Johari Window technique, developed by psychologists Joseph Luft and Harry Ingham in 1955, used in business to explore the dif- ferences in how humans perceive themselves , know how, etc. others perceive them, and gaps in knowledge of both sides of the front. For a short explanation, see *www.businessballs.com/ johariwindowmodel.htm*. It can also be used to highlight the differences in people's perspec- tives and preconceptions about an issue. For an example of climate change-focused front-Thu- ceptions in Western Australia, see Gray (2009).
- Soft Systems Methodology, designed by Peter Checkland in the 1960s, grew out of the general systems theory, which views everything in the world as part of an open, dynamic, and interconnected with the system of the various parts of this system are interacting with each other, often in a nonlinear way. It is a way to explore complex situations with different stakehold- ers; numerous goals; different viewpoints and assumptions; and complex interactions and relationships. By acknowledging these perspectives, it becomes possible to explore the potential interactions and impacts of any changes. Not an in-depth guide Check- land and Scholes (1999); for a short, free guide, see Williams (2005).

3.10 Methods for monitoring and evaluating adaptation

3.10.1 *Introduction*

Monitoring and evaluation (M&E) are key compo- nents of the adaptation process. They help ensure that adaptation measures are implemented as planned, anticipated results that they produce, and that indeed they are (or are still) the right things to do - given the high degree of uncertainty about future climate, socioeconomic conditions, and the resulting climate risks. They also provide the crucial lessons about what does and doesn't work, the build- ing local knowledge and adaptive capacity; and, to the extent that findings are shared more broadly, expanding global knowledge about adaptation. Monitoring and evaluation also help ensure that adaptation finance is being used in the business as well as possible - not a small issue given the huge gap between the estimated adaptation needs and avail- able finance (see, e.g., Smith et al. 2011; World Bank, 2010b). And from both funders' and the intended beneficiaries' perspectives, monitoring and evaluation are crucial for transparency and Accountability Act (Klein 2011).

Through a broad range to meet the needs of a single process, and even adaptation practi- tioners, funders and researchers have now been designing, testing, analysing, and M&E frameworks. ■ for several years, this is still a relatively new field of climate adaptation. (Development, however, offers several lessons.) Moreover, as discussed in Section 2.5, the time-scale adaptation of the Bene- fits - potentially years or decades after the end of a programme or intervention - it makes the diff- cult to gauge a measure of the outcome. Often, at best, we can quantify outputs (e.g. number of farmers trained in conservation agriculture techniques, e.g. the number of hectares planted with drou maize), but the amide ever-shifting trends that look for we may never know exactly know how

much, if at all, an intervention reduced the impacts of climate change. Less-quantifiable benefits, such as improved problem-solving capacity among local stakeholders, more effective local institutions, or increased attention to climate change among government officials, are even more difficult to monitor and evaluate, much less compare across different settings. In this context, it may take several decades before, but we truly know what constitutes "successful adaptation", and how best to measure it. Thus, a recent review of M&E frameworks by UKCIP and the sea change Community of practice argues:

> Monitoring and evaluation [adap- can] Links and should serve not only to demonstrate and document the effectiveness of interventions, but also to generate knowledge, learning, and evidence to inform this emerging area of policy and programming. M&E presents a crucial opportunity for gen- competes and dissemination of Applied research in a new field. (Bours et al. 2013, p. 59)

As Bours et al. (2013) note, the existing M&E methods range from fairly technical and theoretical frameworks, often developed in academia to the practical, step-by-step guides geared to ten people working on community-based adaptation and Disaster Risk reduction. Which tools will be most appropriate for a specific project will depend on the nature of the work being done - does it involve building a dike, for example, or building the capacity of farmers to adapt to climate change? Several frameworks, the tools and methods presented here are preliminary discussed the more practical end of the spectrum by Bours et al. (2013). Choosing the moment in approach, it may be useful to look for several common traits of effective M&E systems:

- They begin with a clear, agreed-upon understanding of what constitutes success, and how to measure it;
- They begin with a clear, agreed-upon understanding of who is responsible for what - and who is accountable for the business of each meeting of the differ- ent goals or targets; They track progress over the course of the project, rather than just looking at the end result; they consider, not just ***what*** or the job done achieved, but ***how*** it done - the quality of the process as well as content;
- They question assumptions, asking not only, "We are doing things, right?" but also "we are doing the right things?"
- They recognize that not everything can be measured, and include the qualitative assessments as well; they consider different perspectives on "success" - for example, a funder may be satisfied by a project's outcome, but the intended benefi- ciaries may see no positive change or gender inequalities may have led only to the benefit of breast- minute intervention from ing, but not women; they are flexible, allowing for adjustments over the course of the project, and not overly burdensome for, ensuring that M&E does note of the moment take up the excessive share of the available resources.

Given that, as discussed above, the M&E Business is closely linked to learning and knowledge generation, it may be helpful to read Section 3.11, pre tools for learning and reflection, along with this one. Section 3.1, ten participatory processes, and Section 3.8, pre - adaptation planning, may also provide useful con- text about the role of stakeholders in defining the scope of a project, its intended outcome(S), and measures of success, and monitoring the project before it is under way.

Finally, we should mention three useful online resources:

- The European Union's CLIMATE-ADAPT but a short handpicked website provides a list of resources for adaptation M&E;

see *climate-adapt.eea.europa.eu/adaptation-support-tool/step-6*.

- The Clim-Eval platform (*www.climate-eval.org*) is the online home of a global community of practice that aims to establish standards and norms, support, capacity development, and share good practices in climate change and development evaluation. Members come from government and development cooperation agencies, civil society organizations, and academia. The moment the website includes an electronic library, a blog, videos, news about M&E devel- opments, and other resources.
- The website global environment Fácil- good's office includes Evaluation M&E guidance and discussions (not all adaptation-specific), and many examples; see *www.thegef.org/gef/eo_office*.

3.10.2 Adaptation M&E principles and critical reviews of adaptation

After several efforts have been made in recent years to survey the landscape of adaptation M&E approaches around the world and distil lessons and guiding principles. Several are discussed in Section 2.5.4, and that we do not replicate material here - though there is some overlap. Along with the UKCIP/review discussed above sea change (Bours et al. 2013) other useful reviews include:

Monitoring and evaluation for Adaptation: Lessons from Development Co-operation agencies in one of (Lamhauge et al. 2012), the analyses of treatment in M&E of adaptation 106 project docu- ments across one of six bilateral development agencies. It finds that the results-based management, and logical frameworks (see Section 2.5.7 and Section 3.10.4 below) are the most common approaches used for adaptation. The analysis stresses the importance of clearly differentiating between outcomes, outputs and activities, and combining qualitative, quanti- tative and binary indicators. It also notes that the these indicators baselines should include the effects of future climate change, particularly for projects with long-term implications, but acknowl- edges that setting those significant challenges in attributing baselines and longer-term outcomes to interventions.

Making Adaptation Count by GIZ and the World Resources Institute (Spearman and McGray 2011), provides an overview of M&E for adaptation, the draw- ing links Results-Based Management and the aid Effectiveness Agenda (OECD, 2005). By then, it reviews the early efforts at adaptation M&E and all the lessons about the highly contextual nature of adaptation, the adaptation of evaluating the value of diversity, and the need to explicitly state, at the outset, the assumptions being made about future conditions. Spearman and McGray also identify three Prince- ples of effective adaptation M&E Systems: design for learning; managing for results; maintain and flex- ibility in the face of uncertainty.

The manufacturer of the UNFCCC Body for scientific and Technological Advice (SBS) reviewed the Parties' submissions about the adaptation M&E best practices , and other project documents as well as the moment of the array of sources. The synthesis report (UNFCCC 2010) iden- tifies distinct roles for monitoring - and to enable plan- ners and practitioners in adaptation efforts to improve after adjusting processes and targets - and Evaluation - a process for systematically and objectively deter- mining the effectiveness of an adaptation measure in the light of its objectives. It also OECD distinguishes two assessing the effectiveness of key elements: been achieved the objectives and targets, and 2) this can be attributed to the measure taken? The SBS also proposed a framework for adaptation M&E, shown in Figure 3.10.1 which further distin- guishes between outputs (measureable products and services), outcomes (short-term and medi- um-term effects of a measure) and impacts (long- term effects or specific groups of up to ten systems). For best results, suggested in the SBS monitoring and

evaluation should be done at three stages: during implementation, immediately after conclusion, and for some years after the conclusion.

The review also provides a fairly detailed in the SBS overview of the progress to date in applying M&E frameworks in adaptation to different countries, including the kinds of indicators that are being used - with a detailed comparison of the UK and Finland - as well as programme - and project-level applica- po M&E under different funders. One notable finding work how expensive a thorough M&E system can be: for example, the M&E budget of the four-year Pacific Climate Change Adaptation Project implemented by the United Nations Development Programme and the secretariat of the Pacific Regional Environment Programme Business $410,000 USD. Given that such costs would be prohibitive for many community-based adaptation projects, UNDP has developed a simplified tool to monitor and evaluate adaptation locally driven projects.

Monitoring Adaptation to enhance food security, the CGIAR Research Program from pre-Climate Change, Agriculture and food Security (Chesterman and Ericksen 2013), explores how food security outcomes are being addressed in the adaptation M&E. It finds that most documents available only in out-line frameworks, but do not report specific expe-riences, which makes it difficult to summarize the best

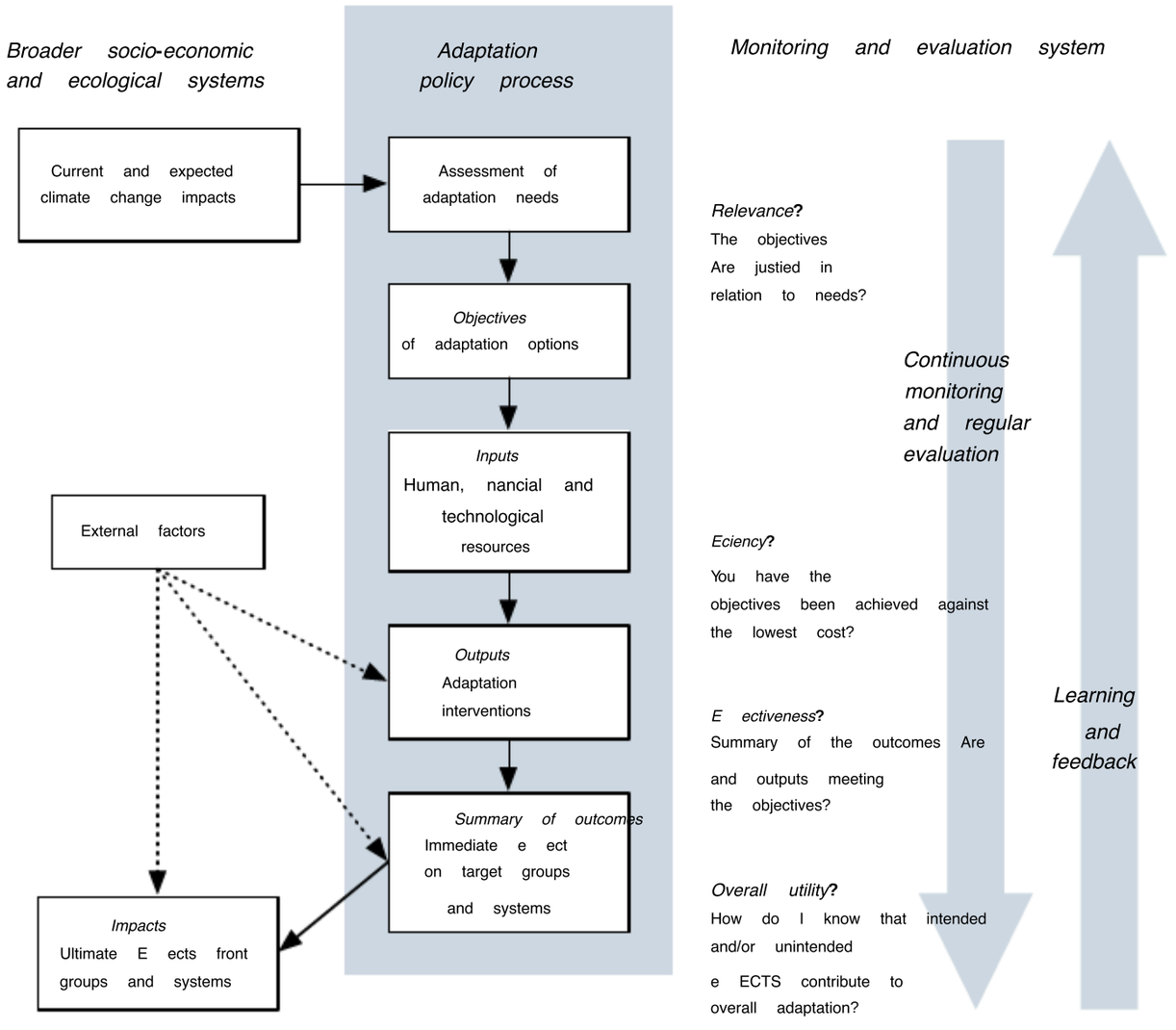


FIGURE 3.10.1 *A proposed framework for adaptation M&E* (UNFCCC 2010).

practices or identify the most reliable indicators to use. It offers six recommendations:

- Agree on a common framework or outcome summary of pathway with clear and agreed
- outcomes. Use scenarios necessary to handle the plan- ning under uncertainty, combined with ex-ante assessments of adaptation invest- ments and interventions to identify robust strategies. Using a
- clear engage in ongoing monitoring , the"logic model" to track the progress of the "robust " strategies on the ground, ensuring that the business model is explicit about what constitutes success. Take a
- learning approach to M&E with stake- holders at multiple institutional levels. Encourage
- data-sharing projects across doing M&E, to contribute to the growing body of knowledge about the most effective agricul-
- type and food security interventions. Develop and use a tool for managing or evaluating the impact given the inevitable tradeoffs among food system outcomes.

3.10.3 *practical guidance for adaptation M&E*

As should be clear from the preceding overview, there are many examples of M&E frameworks and tools, but relatively few provide step-by-step guid- ance. Here we describe two do, aiming to meet the needs of practitioners in particular.

The AdaptME toolkit (Pringle 2011), *www.ukcip.org.uk/adaptme-toolkit*it was developed in response to a growing demand for practical sup- port in progress and evaluating the adaptation of drivers mance and can be used with the UKCIP Adaptation Wizard (*www.ukcip.org.uk/wizard*) or separately. It includes three modules:

Fundamentals:

- What is the purpose of my evaluation?
- Evaluating what am I?
- What assumptions underpin the logic and I will be evaluating intervention? Who
- should I involve the evaluation? Communicate
- the findings, How Should I know?

Adaptation challenges:

- What challenges might I face when evaluating adaptation performance?
- What are the limitations placed on
- my evaluation? How do I evaluate the unintended and unexpected?

Measuring performance:

- Measuring progress and performance;
- Establishing evaluation criteria: indicators and metrics.

CARE International's ***Participatory Monitoring, Evaluation, Reflection and learning for Community-based adaptation*** manual (Ayers et al. 2012) pro- vides a detailed overview of adaptation and key M&E concepts, then outlines a five-step process for designing moment at M&E strategy: • Step 1: Select a facilitator;

- Step 2: Select team members in partnership with the community; Step
- 3: develop indicators; Step
- 4: Measure baselines;
- Step 5: Finalize the M&E plan, budget and resource allocation.

For each step, advice it provides key questions to love, and to apply the suggested tools - which are described in detail in a separate section. It also pro- vides real-life examples, such as visioning exer-a- pee from a project that used in Nepal, the phases of the moon to guide community members through setting baselines for different indicators (p. 49).

The manual also explains what to do with the infor- mation collected through the M&E process, recom- mending that it is fed into a continuous learning and reflection process that asks questions such

ace: what changes are occurring? What is working well? What is not working well? How have changes in context influenced the results? Do we need to do anything to adjust our plans light of changing contexts? Ace data are gathered, they can be used to revise the plans and adaptation indicators and targets as needed, and these should also be fed into the reporting. One suggested way to do the latter job to hold regular feedback meetings" to discuss the findings and their implications with stakeholders.

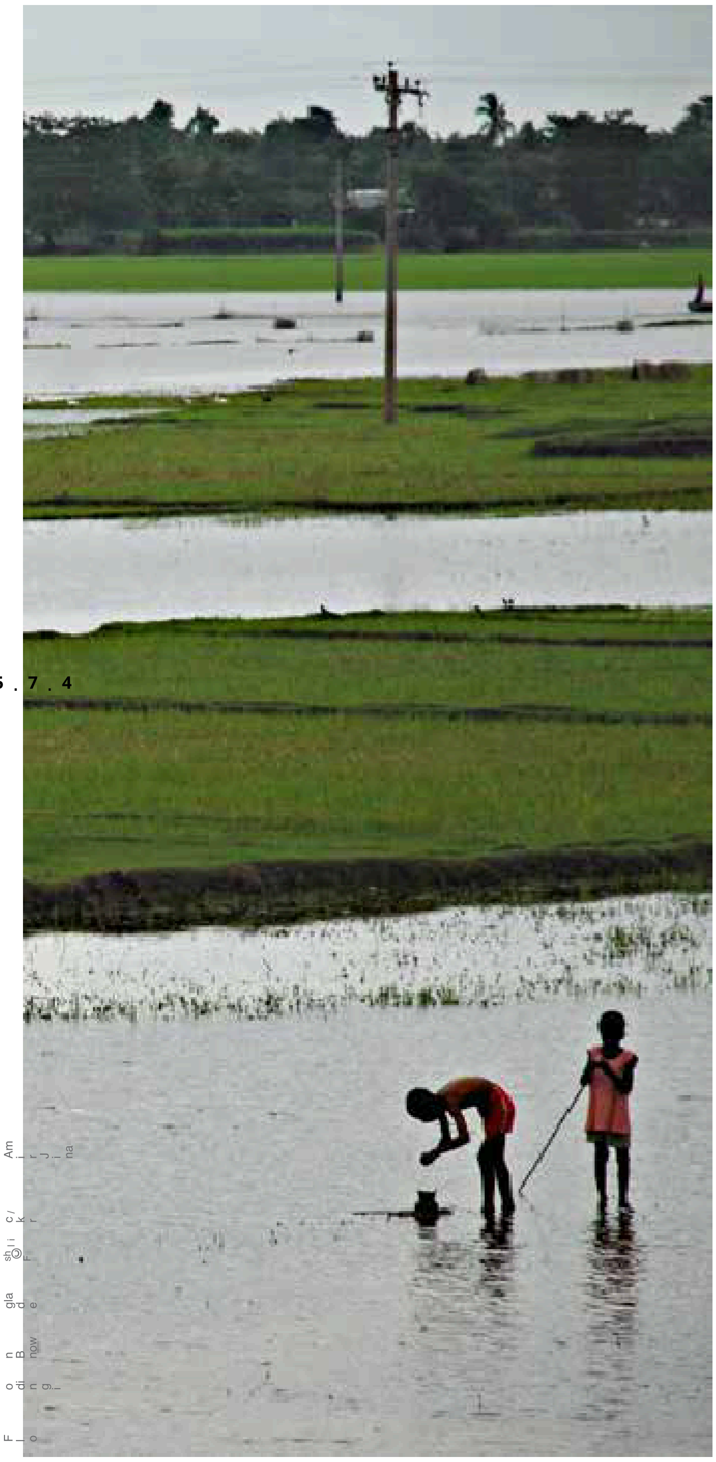
3.1.0.4 *Common evaluation methods and additional tools*

The manual described above, the resort International (Ayers et al. 2012) describes a wide array of one in particular- ipatory tools that can be used at different stages of the M&E process. We describe here a handful of other contexts, development and tools that are being applied to adaptation M&E. We begin with a relatively General tools, and then list a few more narrowly focused tools. For additional resources, see Section 3.1 of this guidance, especially Section 3.1.5, front participatory analytical tools.

- ***Ten steps to a results-based monitoring and Rating System*** from World Bank (Kusek and terrorist 2004), available as a free download in English, Spanish, French, Chinese and Vietnamese, is an in-depth guide to M&E in a variety of contexts. The handbook is primarily the job of the officials targeted to facing the challenge of managing for results, especially in develop- ing countries, and presents a strategy that is already being used by seasoned it says programme managers in developed countries and international organizations to gain insight into their performance and make improve- ments. The book can be used alone or in con- junction with workshop materials developed at the World Bank, "Designing and building a results-based monitoring and evaluation system: a tool for public sector management" (available on the website from the sea change, *www.seachangecop.org/node/1350*). The handbook starts with a "readiness Assess- ment," and then takes readers through the steps to design, manage, and ensure the sustainabil- ity of their M&E system. Results-based
- management of business a way whereby it would now managing the organization ensures that all its processes, products and services contribute to the achievement of the desired results. It depends on the front clearly defined account- ability for results, and requires systematic monitoring, self-assessment and reporting on progress. Managing to achieve results not new work, but results-based management provides improved focus and prioritization of all of an organization's work, systematically linking the activities carried out by all units at all locations and under all funding sources. For an overview, see UNDP (2002), or the Global Environment Facility's guide: *www.thegef.org/gef/about_RBM*. An application for adaptation to RBM (combined with logical frameworks), see the Adaptation Fund's project-level RBM guidance and baselines (Adaptation Fund, 2011)
- an analytical frameworks are Logical, prese the- tational and management tool, which can help planners and managers to analyse the existing situation activity during preparation, to establish a logical hierarchy of means by which objectives will be reached; identify the potential risks to achieving the objectives and sustainable outcomes; establish how out- puts and outcomes might best be monitored and evaluated, if desired; present a summary of the activity in a standard format, and Mon- itor and review activities during implementa- tion. For a brief overview and an example, see Section 2.5.7.1 or *portals.wdi.wur.nl/ppme/index.php?Logical_Framework_Approach*.
- Outcome mapping was developed by the International Development Research Centre (IDRC) in Canada as a methodology for

planning, Monitoring and evaluation that focuses on what front outcomes contributes to development interventions made by, rather than trying to attribute specifically to change a particular intervention. The approach is grounded in an understanding of the development of complex and non-linear process that involves multiple actors, some of whom work for, and some who work against change. Outcome Mapping has a lot to offer in the evaluation of adaptation interventions as it gets away from the assumption made in the impact-based methods, it is possible to make a simple cause-and-effect links the finished context of adaptation processes are the most complex systems with open and atten-Dant of all unexpected and unintended conse-quences associated with this. For a wealth of resources on this approach, go to the Out-come of the Learning Community Mapping *www.outcomemapping.we*.

- The most significant change of business a participatory monitoring and evaluation form that asks the people involved in or affected by a project to identify what they consider to have been the most significant change resulting from the project. For an introduction, see the Tools section of Ayers et al. (2012), or section 2.5.7.4 of this guidance.
- Appreciative inquiry is a method of the change in management that can be used at many levels to understand whole systems, organ-zations, networks and teams. It emphasizes inquiry into strengths rather than focusing on their weaknesses and problem-solving. The basic approach to find out what is going well, what conditions that support success,and what might be visioning and creating partier-patory visions dialogues about how this might be achieved; see *www.iisd.orglai*.
- ***Auditing community participation**: **An Assess-ment Handbook***, from the Joseph Rowntree Foundation (burns and Taylor 2000), was written to help assess levels of community involvement in the area of regeneration initiatives in the UK, but it is more widely available. It provides the tools and appraisal exercises for mea- suring the history and patterns of participation; the quality of participation strategies adopted by partners and partnerships; capacity within partner organizations to support community participation; capacity within communities to participate effectively; and the impact of participation and its outcomes. ■



Flooding in Bangladesh © Amir Jina / Flickr

3.11 tools for learning and reflection

Adaptation has been called a process of "learning within the unknowable" - a term coined by Flood (1999a; 1999b) to explain how our human minds must learn to deal with the complexity and uncertainty of social and natural systems. "We are faced with learning within the unknowable," he writes. "We learn our way into a mysterious future" (Flood 1999a, p. 251). As has been emphasized throughout this guidance, learning the business at the core of adaptation: each business cycle is completed and the knowledge it has generated feeds into the next round of analysis, action, and learning. Thus, ***learning to learn*** - from our own experiences and from others' - the business is crucial to successful adaptation, and helping people at all levels to become better learners and critical thinkers an important aspect of building adaptive capacity. However, the business is typically relatively little effort put into understanding ***what needs to be learned***, ***by whom***, and ***how*** (Armitage et al. 2007). Concepts, assumptions and approaches to learning have been applied in "vague and uncritical ways" (ibid.); there is a need for more specific learning goals.

From a practical perspective, ***what*** needs to be learned of questions specific to the business closely linked to monitoring and evaluation. For example, if a project has set out to reduce crop losses due to heat stress, perhaps by introducing new heat-resistant varieties, the M&E process should be note that light not only on how well the project was implemented, but whether those on the front planting heat-resistant varieties actually reduces crop losses - the "Are we doing the right thing?" question discussed in Section 3.10. Yet another step in the process would be to explore in more detail why it is heat-resistant varieties of birds did or did not work - for example, whether rainfall or humidity levels are important, or whether these varieties require, say, more of fertilizers or pesticides. The deeper the inquiry, the more learning that can result.

Who and also learns can vary greatly. Quite often, as discussed in Section 3.1, participatory processes are front-loaded the adaptation cycle: stakeholders are asked to provide information, and perhaps to express their preferences in appraising adaptation options, but after that, there's often no follow-up.

Yet if stakeholders' adaptive capacity to grow the business, they need to speak with the project team. Thus, as noted in Section 3.10.3, CARE International's manual for M&E and learning in community-based adaptation (Ayers et al. 2012) recommends having regular "feedback" meetings to share M&E results with stakeholders, and to use the moment of partier array- patory tools to support collective learning. From there, learning can be taken to a larger scale by sharing insights (formally, e.g. a report or a peer-reviewed journal article, or, informally, a site such as weADAPT - see Section 3.11.13). This can allow for deeper learning by comparing mul- type distilling experiences and best practices, and can also support the replication and scaling-up of the crime- cessful approaches.

How learning occurs will depend, in part, front ***who*** learning business, but a growing body of research shows that there is a large gap between knowledge and application total C C- tice (see, e.g., Klein and Juhola 2013; Lonsdale 2013). Closing this gap requires greater awareness of what makes a "usable knowledge" (Haas 2004; see section 2.4.4), and part of it involves under- standing behavioural and institutional barriers (see Sections 3.5 and 3.6). At the same time - and especially within organizations and communi- ties that are actively engaged in adaptation - there is a need to create conditions that support learn- ing. Pasteur (2004), writing about the development agencies, identifies three key aspects of creating a "learning organization":

- *Guiding ideas*: A fundamental shift assumptions may be needed; several approaches may work, such as an "open learn- ing model" or a complex systems approach, but the key is to work more open and experi- mentalist, holistic and pragmatic, and encour- age greater collaboration.
- *Theory, methods and tools*: The guiding new ideas need to be supported by the application total C C- tical tools and approaches, such as "action learning" (see Section 3.1.6), and changes to current practices - how from the workshops are run, accountability and reporting systems.
- *Innovation infrastructure*: Decentralized structures, allowing for greater participa- tion, flattened hierarchies, and small units that communicate and interact well with one another are likelier to foster learning; strong hierarchies, and "silo" mentalities discourage it.
- *Skills and capabilities*: Skills such as effective listening, dialogue and communication may come naturally to people, and note that typically are not part of professional training; aware- ness-raising and skill development in these areas will likely be needed.

3.11.1 *emotional and relational aspects of learning*

Work of the 1970s onwards explore how people can support learners as we evolve from a position of being dependent on others Ten "hand down the truth" becoming aware of multiple perspectives and having the confidence to state their own views and challenge assumptions. This kind of evolution is an important aspect of the building adaptive capacity and encouraging autonomous adaptation; in the long run, the people exposed to climate hazards cannot depend entirely pre-others' help and expertise to avoid the worst impacts.

Learning is not a neutral process. Both research and experience tell us that people have great attachment to their ideas, opinions and ways of seeing the world and having the bell challenged these feel very threatening. This is one reason why effec- tief in participatory facilitation work is so important pro- cesses: it can help you create "safe spaces for people to speak openly exchange ideas and experiences, and learn together and from one another. (See Section 3.1 for an in-depth discussion of facilita- tion and tools for facilitators.) Another way to look at what the LAN to occur in participatory learning

the processes provided by the business, Collins and Evans (2002), who distinguish between three categories of expertise:

- *No expertise*: Insufficient knowledge to engage even a cursory discussion of the topic;
- *Contributory expertise*: Ability to contribute to the knowledge base on the topic, either abstract/generalizable knowledge (engineering science), or local/practical knowledge;
- *Interactional expertise*: To be able to not only contribute to the knowledge base in one form or the other, but also "interestingly interact" with those possessing the other form.

Such interactional expertise might enable a project manager presenting M&E data to stakeholders to elicit valuable feedback from those stakeholders that enhances overall learning - count observations about the characteristics of heat-resistant crop variet- ies that might have contributed to their success or failure, to go back to the earlier example. It might allow local people's scientist to challenge the assump- tion that groundwater salinization was entirely due to sea-level rise, by showing how a new well drill- ing technique reduced saltwater intrusion. Or it might allow local farmers to challenge the merits of a "successful" intervention - count, if they knew, the heat-resistant crop varieties would be prohibitively expensive for them without the financial support provided by the adaptation project at the moment. The Carola (2006) builds on Collins and Evans' work by adding one more Category, "public expertise", the expertise, the ability to gauge public sentiment and values and incorporate them into deci- sion-making process. This, he notes, is particularly valuable when dealing with environmental risks, "before we begin, what questions to move from 'business' to 'what should be done' ". Pelling and high (2005a; 2005b), meanwhile, emphasize the importance of social capital to build the relationships and trust that are essential for a mutual and collective learning (see a related discussion in Section 3.9.1). S a case study of a group of dairy farmers in New Zealand (see Pelling and high 2005b), find that they have been working clos together over several years, the farmers have become quite effective at learning from one another and from external sources and built up confidence in their ability to proactively adapt to climate change. At the same time, Pelling and high note, "this work won the trust of solid base at the expense of excluding others", so note the work of the group, helping to raise the adaptive capacity of farmers it is outside.

Social learning as an Adaptation 3.11.2

Closely linked to the discussion above, the business con- cept as the adaptation of social learning - learning from Pre - a larger scale than just individuals or groups, up to a societal scale, as a result of social interactions and processes (Reed et al. 2010). Through social learn- ing, successful adaptation strategies and lessons learned from individual projects and actions become part of the collective knowledge base, building adap- tief capacity across entire organizations, commu- nities or support it. Both the adaptation and resilience literatures have thus emphasized the importance of fostering social learning (see, e.g., Pelling and High 2005b; Pahl-Wostl et al. 2007; Collins and Ison, 2009) and the creation of opportunities to sup- port, such as "deliberative workshops" (McCrum et al. 2009). Social learning is also important moment is part of "adaptive co-management", an emerging approach to managing complex social-ecological systems that application of the principles of adaptive management (see Section 3.7.6) with vertical and horizontal collaboration (Armitage et al. 2008).

Pahl-Wostl et al. (2007) describe the social network of stakeholders as "an invaluable asset for dealing with change", and argue that social learning note only increases adaptive capacity, but also leads to the sustained processes of attitudinal and behavioural change through interaction and deliberation.

Such a perspective is at the core of the business HarmoniCOP, a European project focused front participatory river Basin Management, which is used for the key mes- sage of "learning together to manage together" (HarmoniCOP 2005). Importantly, Pahl-Wostl et al. note that the governance structure has a strong influence on the nature of multiparty cooperation and social learning processes", citing empirical analyses show that centralized political and economic systems, privatization, commercial- ization of the environment, rigid bureaucratic systems, and political secrecy and poor public access to information can impede social learning. You and Johannes Hahn (2013), meanwhile, the stress that social learning does occur even when - as they find the context of flood risk management in Kristianstad, Sweden's most flood-prone munici- pality - effect change it to fail if it goes against a well-established paradigm (in this case, the notion of being safe behind embankments), and if it is not supported by national-level policies and governance systems.

Lonsdale et al. (2010) note that social learning can also be enhanced by rethinking how organiza- po operate themselves and engage with others: their priorities, how staff are expected to spend their time and what work is valued and rewarded. Sometimes, they write, organizations' stated goals do not match their practices, as when staff are encouraged to make connections with the com- munity but are not given time to do so. Lonsdale et al. (2010) go on to identify several characteristics of an organization with a learning culture:

- It includes both support and benefit to be able to work from the formal and informal
- structures. Open innovation in terms of both the way it managed and operational activities.
- It supports creative thinking, innovation and exploration of the change from the personal to the organizational level, allowing this to to contribute more formal governance and accountability structures. It encourages
- and supports learning from experience at various levels (e.g. through attention to what is being learned, e.g. facts and skills, learning from the incorporation of eval- uations, support for action learning sets and other processes properly, etc.) towards improv- ing practices, policies and
- programmes. It includes both that attention needs to be paid to all stages of the cycle of learning (experience, reflection, writers, planning and implementation) and learning to occur for change to happen.

They also identify several "attributes indicative of" learning organizations:

- Actively seeking new ideas and other ways of working, including examples from outside the organization;
- Dissonant information that does not fit with current thinking and practice and experi- ence are welcomed and seen as taboo, but is not actively explored; and support for the Creation
- of the "informal space," to experiment and innovate, and support for dialogue processes that enhance collabora- tion rather than debate and argument;
- processes of learning and support for properly, such as action learning sets, learning histo- ries, appreciative inquiry at all levels of the organization; Mistakes are seen as the moment of opportunity
- to learn; professional development
- and Ethos of providing support for individuals who act as champions or change agents; accepted Practice
- of actively examining ways of doing things and creating novel the Manage- ment systems to facilitate adaptation; Willingness
- to explore new and innovative adaptation options; Ability to retain institutional
- learning and knowledge.

3.1.1.3 *tools for learning and reflection*

Quite a few of the tools and resources discussed in previous sections of this guidance, especially in Sections 3.1 and 3.10, life support collective learning and reflection; CARE International's manual for M&E and learning in community-based adaptation (Ayers et al. 2012), discussed above, and Section 3.10, provides a particularly useful step-by-step approach. In addition, appreciative inquiry (*www.iisd.org/ai*), also listed in Section 3.10, should be useful in many settings. Below are some more resources to support learning and reflection:

- weADAPT is an adaptation knowledge-sharing platform invites users to share their own experiences and knowledge and to network with others working on similar issues of ten, individ- ually or through the "initiatives" (communities of practice); see *www.weadapt.org*.

- ***Tools for knowledge and learning: a guide for development and humanitarian Organisations*** (Ramalingam 2006), available as a free down- load in English and Spanish, a made- bones and well explained collation of tools that it can be applied to adaptation processes. Learning
- for sustainability is a business knowledge portal geared to people seeking to improve collaboration and social learning in the con- text of environmental decision-making. IT Pro- vides a range of the moment, Annotated Guide to online resources, including papers, handbooks, tips, theory and techniques in a number of related fields; see *learningforsustainability.net*.
- ***The Barefoot guide to learning practices in organisations and social change*** (Barefoot collective (2013) Free a practical resource for leaders, facilitators and practitioners involved in social change, who want to improve and enrich their learning processes. This business guide to the the joint effort of a group of development practitioners from across the globe, and includes topics such as mobilizing the community and development, Adult Learning, funding, evaluation, facilitation, and creative writing. There is also a Companion Booklet with application total C C- tical ideas and tips for designing and facilitat- ing learning processes.
- Can be used as a tool for Learning journals individual reflection. Reflective diaries/learning journals/portfolios records are kept on a regular, often daily, basis by people under- going learning process and are commonly used in action research and other reflective approaches. Learning in two kinds of reflection are important: reflection as a group and as individual reflection moment. Bell Journals regu- larly capture moments of dissonance, confu- sion, surprise, etc. and help identify patterns and start-challenging assumptions and biases. Smith (2013) provides a useful introduction to the blogpost for free. ■

4 Example cases

Situations can be described by means of the Adaptation characteristics (see Section 1.3), which has now landed on the identification of the cation and critical task to be addressed. In Section 2, the relationship between specific characteristics of an adaptation challenge and the critical task was indicated illustrated through Decision Trees. In this section, we provide three case studies of how the approach can be applied to. Each case study begins with a narrative description of the complex situation, which describes the actors adapting to the hazards of climate and geographic location. Next, the key characteristics of the situation are analysed in order to identify critical tasks. Finally, a schematic diagram is presented which illustrates the sequence of the questions to be addressed within a given case.

It should be noted that the characteristics of an adaptation situation may be known from the outset, or they may be discerned through the application of a method. The characteristics of the situation may also change because of adaptation action taken in the business, or for other reasons (e.g. changes in socio-economic or political conditions). In these case studies, the situations are initially characterized on the basis of the knowledge available at the outset. As critical tasks are performed with the knowledge they generate, can lead to additional tasks, which are shown in the sequence diagrams.

In this section we describe the cases of two sorts: two research one of the cases adaptation, and adaptation policy case. In general, one can say that Adaptation research cases, as they aim at generating knowl- edge, are more closely related to the first stage of the adaptation cycle, identifying adaptation adaptation policy needs while cases are likelier to stretch into the second stage, identifying adap- in options, and beyond - and may even start at that stage, building on research that has iden- tified specific needs. As discussed in sections 2.5 and 3.9, adaptation projects to date relatively few have made it to the implementation stage or later - though at the community level, in particular, sev- eral have. Here, however, we focus on pre-adaptation research and Policy cases, the first three stages of the adaptation cycle.

We should note that in the case of adaptation policy in the cases, at least some of the methods used may be prescribed by the policy context (see also Section 1.3). For example, the application of cost-benefit analysis of adaptation options may be required by national legislation. Where the choice of the methods stipulated by the business policy context, we point this out. ■

4.1 Research cases

4.1.1 *Guadiana River Basin*

The upper and middle Guadiana River Basin, in Spain, climate change is expected to reduce water availability through reduced rainfall and more frequent droughts. Landed in decreased levels of climate- cate that the river's flow could decrease by 11% by 2030, increasing water stress, resulting press and more frequent droughts (CEDEX 2011; Junta de Extremadura 2013). Guadiana business in agriculture is highly sensitive to climate conditions. Temperature increases will affect crop yields and less water availability that will make agricultural systems more dependent on irrigation front, both potentially affecting farmers' incomes.

The upper Guadiana, irrigation systems use groundwater, which is more resilient to prolonged droughts than the surface waters also used for irri- gation of the middle Guadiana. However, there are larger storage capacities the middle of the Guadiana, which could potentially reduce the impacts of decreasing precipitation. The aquifer from which the upper Guadiana farmers draw water also maintains an internationally significant wetland at the moment. Climate change impacts, precipitation, reducing

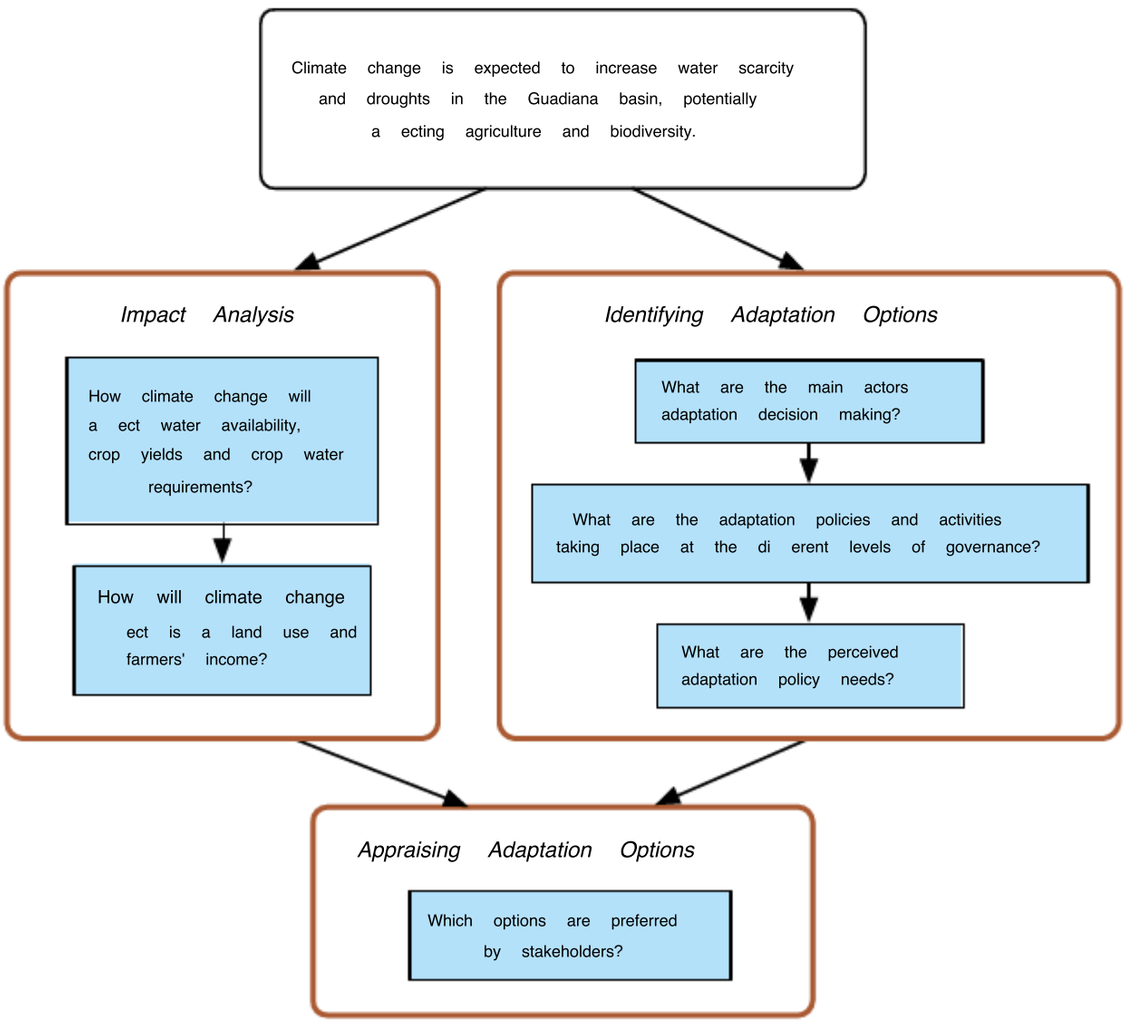


FIGURE 4.1.1 *Schematic diagram of the mediation of the Guadiana case study Project.*

may exacerbate the environmental problems linked to water resources, over-exploitation, e.g. through loss of wetland biodiversity loss from decreasing groundwater levels.

Thus Reducing the pressure of the moment aquifer business is import- ant consideration in adapting agricultural produc- tion to increasing drought frequency. Because adaptation options affect groundwater extraction from a shared aquifer for agricultural production, private actors are interdependent, and the adap- situation involves influencing public actors in collective adaptation. Further, because the adaptation options considered include long-term water infra- structure investments, the long-term business important to adaptation decision-making.

Figure 4.1.1 shows a diagram of the Guadiana , with three stages of Case Study analysis. The front left Business Impact Analysis, which asked questions about future climate changes and their impacts preliminary Water Resources, crop yields and farmers' income. These questions have been addressed by project- ing the residual impacts, water and crop models (Varela-Ortega et al. 2013). The methods implemented to address these tasks are described in Section 3.2.

The Guadiana, levels affect adaptation options from a shared aquifer extraction of groundwater for agricultural production. Collective Business Action Now therefore important component of adaptation options. For example, improving the technical efficiency of water management through regula- tion or market-based instruments would require collective action for successful implementation. Understanding of the institutional context and how this supports or constrains collective action is therefore salient to address a business challenge. The second type of assessment, the right branch of the diagram, therefore, focuses on identifying front adap- measures by understanding the institu- tional context. The sequence of tasks (formulated as questions) addresses of the actors involved, the policies should be undertaken that are relevant to adaptation in the agricultural and water support, and perceived adaptation policy needs. Case study team applied the Guadiana social network mapping techniques to identify gaps and linkages between key organizations for adaptation, as reported in Varela-Ortega et al. (2013).

Further, this line of inquiry may address the ques- tion of why droughts have negatively impacted farmers in the past. For example, in 2005, was one is particular- ularly bad for crop yields in the Guadiana. Such a line of inquiry assesses the potential and actual capac- ity from the farmers' perspective, and explores the causes of the impacts of current climate variability. Such questions are raised with the aim of identify- ing able to adjust to the cognitive and institutional barriers- tion which can be addressed by measures which do not require further knowledge about climate impacts (Sections 3.5 and 3.6).

Finally, the third stage of the analysis addresses the question of appraising adaptation options. This is especially challenging because the Guadiana outcomes of interest are thus broader than only economic productivity, and include the ecolog- ical conditions of the wetland (Varela-Ortega et al. 2013). Case study team also applied the moment of The analytical hierarchy process to appraise different water management options, including increas- ing storage capacity, changing crop varieties, and the moment developing insurance system. This method allowed stakeholders to consider multiple criteria options over longer time scales. The approach was favoured over formal a robust decision-mak- ing analysis, given the timeframe of the case study, because of the resource-intensive nature of pro- jecting adaptation options over longer time-scales and multiple scenarios.

4.1.2 *impacts of drought in Serbian agriculture*

In central Serbia, increasing drought impacts threaten the agricultural production of small-holder farmers. Irrigation canals are in poor condition, having fallen into disrepair following land reform and land fragmentation in the base during the post-communist transition. The restoration and maintenance of the irrigation system, which requires collective action due to the shared nature of irrigation canals, would reduce the impacts of current climate variability and future climate change. Therefore, understanding the influence of institutions in constraining and supporting collec- action tief salient challenge.

Case study team carried out semi-structured gun and workshops in order to identify key institutions of collective action influencing the irrigation system, and report on this in Bisaro et al. (2013). Corruption encountered in your past experiences with agricultural cooperatives and government officials has led to a lack of trust and social capital eroded, making coordinated action more difficult. Accessing government support and economic incentives requires farmers to register their farms. However, there is a very low rate of farm registration, particularly among small-scale farmers. Farmers created this unique barriers to acting collectively to maintain the irrigation infrastruc- type. The team found that the institutions, thus affecting the farm registration and property taxes are key to understanding the conditions and opportuni- ties for collective action.

Figure 4.1.2 a diagram was developed based on the work of the mediation case study project.

The analysis focused on the front barriers to understanding collective adaptation options. Institutional analysis was applied and provided insight into why existing irrigation systems collectively are not maintained or improved, and into the possible measures for improving this. Results of the institutional analysis identified farm registration, and factors influ- encing it, such as farm size and social benefits, as key barriers to collective action. The conclusion was that cross-sectoral planning to address specific legal and procedural barriers are needed, combined with building stakeholder networks, and should be informed by further research to understand and explain the role of the barriers identified.

The case study, an initial decision was made to focus on the front of the identifying adaptation measures rather than impact analysis due to pragmatic criteria such as the availability of data and resource carry out an impact regionally downscaled projection (see Section 2.1.1). Available knowledge of large-scale trends in climate and climate risks of existing institutional motivated now instead variability anal- analysis, which may inform the design of a "no-regrets" options for facilitating collective action in irrigation restoration and maintenance of the system. ■

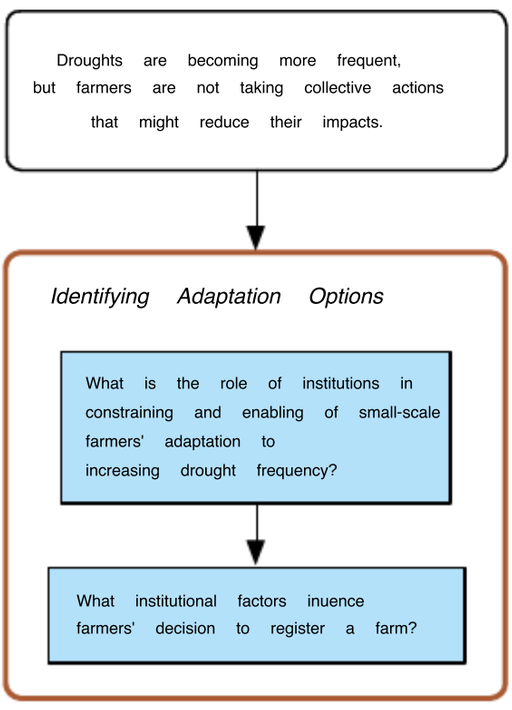


FIGURE 4.1.2 *Schematic diagram of the Serbian case study of the Mediation Project.*

Policy 4.2 case

4.2.1 *climate change and ground-level ozone in the UK*

Ground-level ozone, a major air, in accordance with job cre- ated when nitrogen oxides and volatile organic compounds, fumes from traffic, industrial processes and other sources react together in the presence of sunlight. Ozone pollution is a known problem in the UK, primarily in the southeast, and during heat waves, when ozone production increases, it adversely affects human health, especially among people with cardiovascular and respiratory prob- lem, and business associated with premature deaths. Decreased levels of future climate change for the UK sug- gest that heat waves may become more frequent and severe.

There are already policies in place to address cur- rent ozone, European, national and local air quality legislation and measures. Previous impact studies have estimated that around 800 to 1,500 additional ozone-related deaths per year by 2020 due to climate change may be expected. Further, studies estimate the annual impact of the increase from climate change could increase the mean ozone concentrations by 7-33% and 5-20% in urban and rural areas, respectively, for the 2080s.

Projection of future ozone concentrations from climate change is extremely uncertain, however. Preliminary air quality and ozone concentrations depend mitigation policy. Moreover, the physical processes linking climate change to ozone formation are well understood, note. Other variables, such as age distribution, are important determinants of the health impacts, public health and health levels are as pol- icies. There is a further large degree of uncertainty on the levels of physical impact, because it is not known if a threshold in accordance with ozone - meaning that severely impacts might increase health, and non-linearly above a given concentration level.

The immediate risk of ozone ten health - an existing problem. It is associated with some thresh- old issues, but these thresholds are dominated by other factors (existing and planned air con- troll). The impact of ozone pre-health business episodic in nature, thus also related to changes in extremes as well as general trends of warmer weather.

The climate change Act (2008) created a frame- work to build the UK's ability to adapt to climate change. It requires the secretary of State to imple- ment a National Adaptation Programme, and to lay before Parliament the moment assessment of the risks posed by the UK climate, the climate change risk assessment (CCRA), with an update every five years. Supporting this work, the business and economics of Climate Resilience study, which is assessing the costs and benefits of adaptation, the scale of the challenge, and the benefits of acting, and identify- ing priorities. The focus is on what the government needs to do to respond to climate risks identi- fied, and how much it will cost.

Of particular relevance for the policy background that you can work in the UK for an existing business framework for action on adaptation, and all government depart- ments has been published now initial Departmental adaptation plans (DAPs), setting out how they are assessing and managing the risks from climate change (together with their mitigation plans). These policy frameworks are relevant and deter- mine, for the formulation of air pollution extent to which policy takes into account the adaptation to cli- mate change.

The following diagram has been developed based ten expert consultations.

Involve The critical tasks identified the three stages of identifying adaptation needs, identifying adaptation measures, and appraising adaptation options. Due to the scale of the analysis methods- cial considerations and available resources, it was

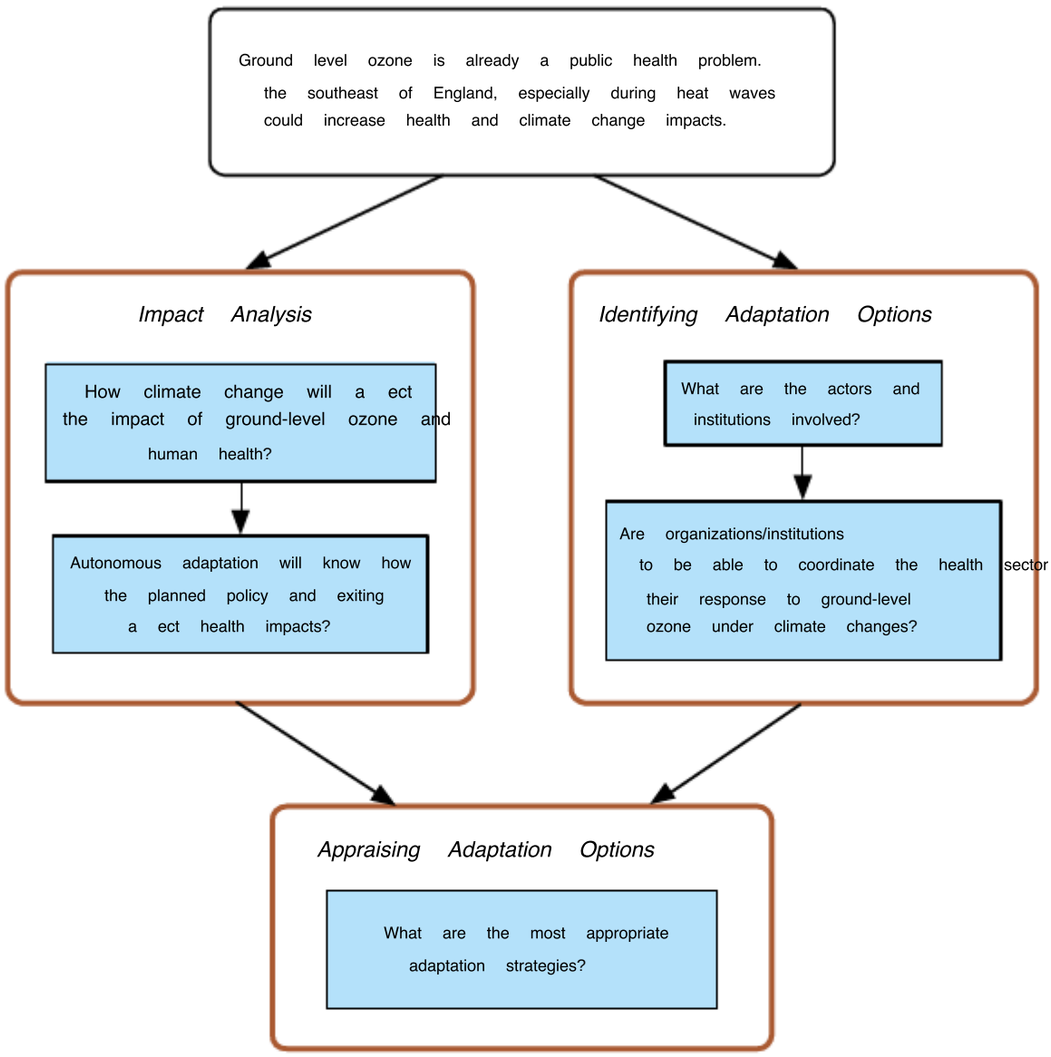


FIGURE 4.2.1 *Schematic diagram of the ozone and climate change policy in the UK case.*

the moment considered appropriate to carry out impact analysis. Potential impact was carried out in order to identifying the level of climate risk is presented then the projection of the residual impact while aimed at better representing autonomous adaptive behaviour. In order to include the influence of other relevant policies in support, an institutional analysis of governance through the description was carried out. Then, a self-assessment method was applied by actors to assess public awareness and their ability to co-ordinate a cross-sectoral response to the health impacts of ozone, particularly with respect to future increases in temperatures and the heat wave frequency climate changes. Deciding on a preferred adaptation option involving public and private stakeholders of planned future step. ■

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The global programme of research on climate change Vulnerability, impacts and Adaptation (PROVIA) is a global initiative which aims to provide direction and coherence at the international level for research on vulnerability, impacts and adaptation (VIA). Launched with the support of the leading scien- tists and decision-makers, the scientific community responds to the urgent call by PROVIA more cohesive and coordinated approach, and the critical need to engage, mobilize, and communicate the growing knowledge-base via the front. PROVIA also acts as a growing network of scientists, practitioners and decision-makers working towards identifying research gaps and needs in policy meeting on climate change vulnerability, impact and adaptation research. The Secretariat is currently hosted by the United Nations Environment Programme PROVIA in Nairobi, Kenya.

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PROVIA aims to meet a growing demand for knowledge of the pre-climate change vulnerability, impacts and adaptation by providing clear technical guidance that application with explicit consideration of user needs robust science at the local, national and international levels, both developed and develop- ing countries. This document updates and improves existing guidance, dis- cussing the key issues at each stage of the adaptation cycle and covering the wide array of approaches, methods and tools available to address them. The resulting guidance should be useful to researchers, adaptation practi- tioners, planners and policy-makers alike.

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