CGE Training Materials for Vulnerability and Adaptation Assessment

Chapter 9
Integration, Adaptation, Mainstreaming, Monitoring and Evaluation

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9.1. Introduction

This chapter addresses four components that are important for completing and applying vulnerability and adaptation (V&A) assessments:

- Integration;
- Adaptation;
- Mainstreaming;
- Monitoring and evaluation (M&E).

Integration, in this context, refers to the analysis of V&A assessment outcomes across sectors. The aim of integration is to understand the interrelationships between sector-specific climate change and the relative importance of risks to help inform impact and adaptation priorities. The ***adaptation*** section of this chapter briefly describes different techniques to assess adaptation options. The ***mainstreaming*** discussion is on tools and approaches to incorporate V&A assessment outcomes in national planning – thus ensuring that climate change is considered in development priorities. Finally, monitoring and evaluation (***M&E)*** is the process used to assess the effectiveness of adaptation interventions and identify needed course corrections.

9.2. Integration

Climate change impacts in individual sectors often do not happen in isolation from impacts in other sectors. For example, irrigated agriculture and municipal water suppliers may compete for reduced water supplies in the future if climate change results in a regional decline in precipitation run-off.

It is important for policymakers and stakeholders to understand how a sector, community, region or nation could be affected as a whole by climate change, and what the total impact may be. This is necessary to understand the severity of climate change, to set policy goals for adaptation and mitigation and to understand how climate change affects sustainable development (e.g. meeting Sustainable Development Goals). In addition, it is important to know how different sectors, regions or populations compare in terms of relative vulnerability to help prioritize financing for adaptation projects.

Approaches to integration are discussed separately for (1) impacts and (2) adaptation.

9.2.1. Integrating vulnerability assessment outcomes

In broad terms, the outcomes of vulnerability assessment undertaken in different sectors, such as health, water and agriculture can be integrated in two ways: cross-sectoral integration and multi-sectoral integration.

Cross-sectoral integration: involves integrating impacts across related sectors. It involves examining a small number of sectors that are strongly interrelated, such as water and health. For example, human health and agriculture can be affected by

changes in water resource management. Similarly, human health can be affected by decreases in food security, as a result of declines in agricultural production.

Multi-sectoral integration: involves combining results across all impacts in all sectors. The objective is to estimate the total effects of climate change or to compare relative impacts and vulnerabilities across sectors. This can involve examining impacts across sectors using a common method to sum, compare or contrast results following sector-specific vulnerability assessments. Alternatively, integrated approaches can be used to inform vulnerability assessments overall, helping to 'frame' the approaches used and to ensure that V&A is undertaken in an integrated manner from the beginning.

9.2.2. Cross-sectoral integration

In early national communications, there was often a strong sectoral assessment component to V&A that resulted in challenges in drawing linkages between sectors. As the understanding of the linkages of climate change vulnerabilities across sectors has increased – for example, the links between agricultural impacts, water and health in rural communities – sectoral assessments (Chapters 5–8) are increasingly seeking to address such cross-sectoral issues.

As a result, many recently submitted national communications now mention that some consideration of integration and/or inter-sectoral interactions and dependencies has been undertaken, albeit at a strategic level. For example, the third national communication of Norway states:

> *The next stage in the process will be to have all relevant sectoral agencies develop adequate response strategies for their sectors, and to ensure an overall strategy based on the analyses in the respective sectors.* (Royal Ministry of the Environment, 2002, p. 48)

There are two basic approaches to cross-sectoral integration: qualitative and quantitative. In *qualitative* integration, linkages and, if possible, direction of change are identified. For example, water supply will typically be positively correlated with irrigation. When water supply rises, more irrigation can take place (although demand for irrigation is likely to fall if the increase in water supplies is because of wetter conditions). When water supplies decrease, then less water is typically available for irrigation (although demand for irrigation water would rise if the climate is drier).

In a *quantitative* linking between sectors, numerical estimates of inputs and outputs between sectors are used to estimate impacts in different sectors. For example, a model of agriculture may use changes in water supply as inputs to a crop model. The effect of changes in water supply with climate change can be used to estimate changes in crop yields.

9.2.3. Multi-sector integration

The purpose of multi-sector integration is to help understand how a society as a whole might be affected by climate change. It is intended to help understand the breadth of climate change impacts (e.g. sectors, regions, and populations that might be affected) and the potential severity of impacts (e.g. number of people who could

be harmed, amount of economic output that could change). In addition, multi-sector integration can be applied to determine relative vulnerabilities across sectors. The intention of such integration is both to highlight priorities of specific impacts and also to ensure that the inter-dependence of impacts is explicitly considered.

To be effective, multi-sector integration should be as comprehensive as possible, covering as many affected sectors, regions and populations as possible.

The simplest and most-often used analysis in national communications by non-Annex I Parties is a narrative-based, cross-sectoral analysis – or one that 'tells the story' of how sectoral impacts are judged to interact and the implications of such interactions. The great majority of recently submitted national communications use this approach to discuss multi-sectoral dependencies and interactions, and describe how this narrative assessment has helped shape adaptation priorities.

An extension of the qualitative, narrative-based multi-sectoral analysis is to use a set of common metrics to provide additional rigor to the assessment. Such ranking approaches can employ a range of qualitative indices through 'multi-criteria analysis.' This approach has been used by least developed countries (LDCs) in the national adaptation programmes of action (NAPAs) (UNFCCC, 2002) and also by a number of Parties not included in Annex I to the Convention (non-Annex I Parties) in their national communications (see the 'Akropong Approach' discussion under the section on multi-criteria analysis below, on adaptation).

An example of a simple approach to relative vulnerability ranking is shown in table 9-1, which can be used for ranking current or future vulnerability. The first column of the table lists the sectors of concern, such as coastal resources, water resources, agriculture and human health. For each, current vulnerability can be ranked on a scale from low to high for various categories. Social impacts indicate human vulnerability. The rank assigned indicates the typical climate impact (e.g. impact of reduced run-off on malnutrition, how many lives may be lost because of flooding events). Economic vulnerability ranks the magnitude of climate impacts on, for example, agricultural livelihoods and industrial processes. The rank indicates the magnitude of climate impacts (e.g. how changes in water resources have affected sorghum production with subsequent contraction of the workforce, infrastructure damage due to coastal inundation). Environmental impacts include effects on ecosystems, such as soil erosion and desertification. Other impacts can also be considered (e.g. how drought could affect the ability to meet Sustainable Development Goals). The rankings can then be summed to provide a qualitative assessment of vulnerability.

Table 9-1
Ranking vulnerability across multiple sectors

Sector	Economic impacts	Social impacts	Environmental impacts	Other impacts	Ranking
Water resources					
Coastal resources					
Agriculture					
Human health					

For example, Bhutan's second national communication (National Environment Commission, 2011) prepared a matrix to analyse the linkages between the different sectors in the assessment (see table 9-2). Importantly, the analysis in Bhutan provided the context for including specific reference to cross-cutting sectors within the sectoral adaptation priorities.

Table 9-2
Bhutan cross-linkages between targeted sectors

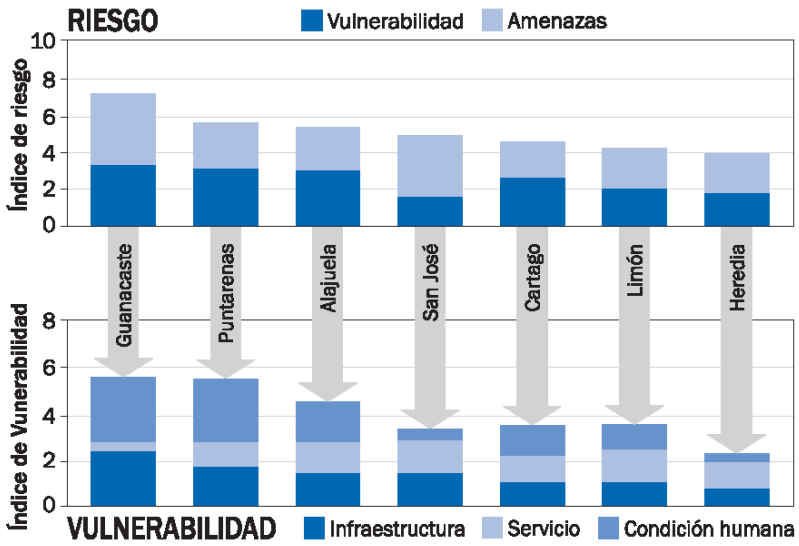
SECTORS	Climate Change	Water Resources	Agriculture	Forests and Biodiversity	Energy Production	Glaciers and GLOFs	Human Health
Climate Change	-	XXX	XXX	XX	XX	XXX	XX
Water Resources	XXX	-	XXX	XX	XXX	XX	XX
Agriculture	XXX	XXX	-	XXX	X	XX	XX
Forestry and Biodiversity	XX	XX	XXX	-	XX	XX	X
Energy Production	XX	XXX	X	XX	-	XX	X
Glaciers and GLOFs	XXX	XX	XX	XX	XX	-	XX
Human Health	XX	XX	XX	X	X	XX	-

X: Little Impact *XX: Significant Impact* *XXX: Very Significant Impact*

Source: Bhutan, second national communication.

In chapter 10, table 10-4, gives further examples of ways to display relative vulnerability across sectors and regions. Figure 9-1 is from Costa Rica's national communication and compares risk and vulnerability scores in different regions and among different sectors.

Figure 9-1
Risk (Riesgo) and vulnerability scoring in Costa Rica



Source: Ministerio del Ambiente y Energía, 2014.

A more comprehensive approach is to apply a common metric of vulnerability across multiple sectors. This is often done in a monetary unit (e.g. United States Dollars), although the number of people affected can also be a common metric (e.g. Arnell et al., 2002). One approach to examining integrated climate change impacts is to estimate the monetary value of climate change impacts in different sectors of a nation's economy. An example is a recent study of potential climate change impacts on the Egyptian economy (table 9-3) (Smith et al., 2013, 2014).

Table 9-3
Estimated economic impacts of climate change on Egypt (billions of Egyptian pounds)

	2030			2060		
Scenario	1	2	3	1	2	3
Welfare loss in agriculture	26	25	20	234	112	41
Annual coastal property losses (excluding agriculture)	1	1	2	7	7	16
Value of deaths from air pollution (using VSL)	3–6	3–6	3–7	6–14	6–14	11–24
Value of deaths from heat stress (using VSL)	2–3	2–3	3	14	14	24
Reduction in annual tourism revenues	18	18	23	82	82	106
Total of selected impacts	50–54	49–53	51–55	343–351	221–229	198–211
Percent of GDP	2.2–2.4	2.2–2.4	1.6–1.8	5.9–6.0	3.8–3.9	2.1–2.2

Scenario 1: High population, low GDP, large decrease in Nile flow, and high sea level rise with no protection.
Scenario 2: High population, low GDP, small decrease in Nile flow, and high sea level rise with no protection.
Scenario 3: Low population, high GDP, small decrease in Nile flow, and high sea level rise with no protection.

Abbreviations: GDP = gross domestic product, VSL = value of statistical life.

One of the most complex forms of multi-sectoral analysis is to undertake an integrated assessment of economic impacts as the common 'currency' across sectors and areas. For example, under the World Bank's Economics of Adaptation to Climate Change (EACC) (World Bank, undated) programme, seven country-level assessments (Bangladesh, Bolivia (Plurinational State of), Ethiopia, Ghana,

Mozambique, Samoa and Viet Nam) were undertaken in parallel with a global-level economic analysis.

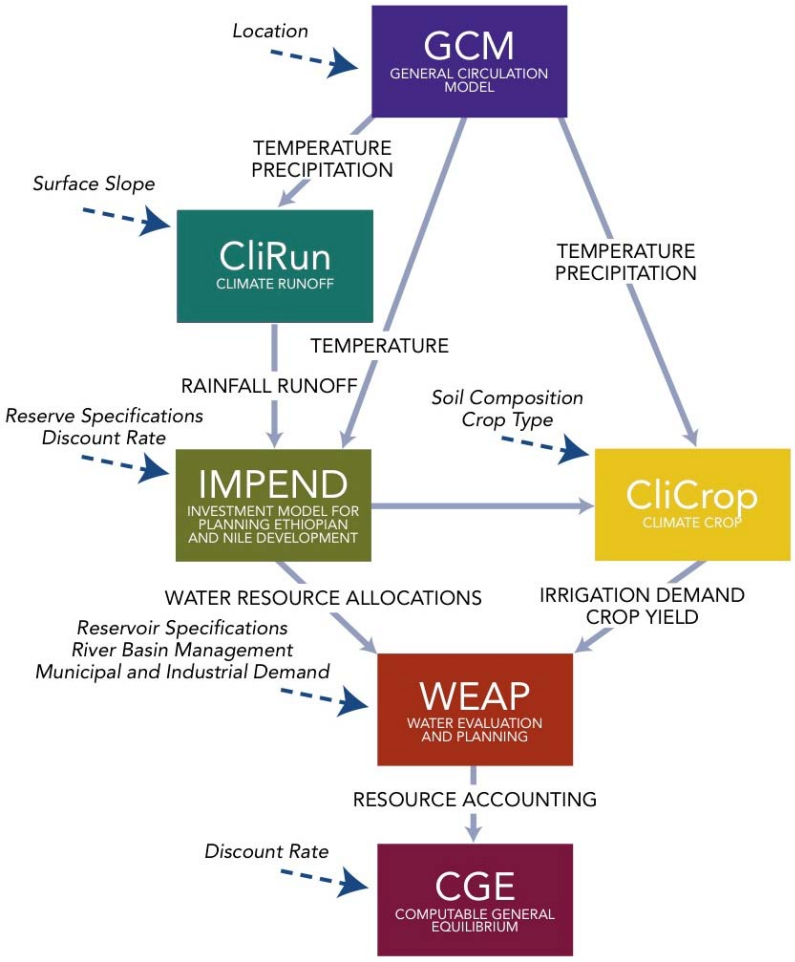
For Samoa, the EACC programme applied records of past economic loss due to natural disasters to develop a macroeconomic model of the interactions between climate and the economy. Estimated costs of impact without adaptation and with adaptation were compared. In addition, the study applied a cost–benefit test to assess the appropriate timing of adaptation projects identified in Samoa's NAPA (World Bank, 2010b). Such data and modelling-intensive approaches are valuable in communicating the need for adaptation and can inform policy design.

In the Ethiopian EACC project, an economy-wide modelling exercise was undertaken that linked a dynamic multi-sectoral and multi-regional computable general equilibrium model with a range of sectoral climate change impact models that generate quantitative estimates of effects on water systems, agriculture, hydropower and road transport infrastructure (World Bank, 2010a) (see figure 9-2).

The use of integrated economic assessments is an emerging approach within non-Annex I Parties, given the technical capacities required, the data requirements and the treatment of 'nonmarket' values, such as ecosystem services and social/cultural values. There is clearly a trend towards the use of such models, and it is likely that specific training and capacity-building activities will take place in the coming years.

Finally, **integrated assessment modelling** is one of the most sophisticated and complex approaches to integrating climate change impacts. This can involve the use of economic models of a country's economy, a region's economy, or even the global economy in the case of agriculture. Such models can assess economic impacts across sectors and across an entire economy. They can estimate change in total production, employment, prices and other key economic factors. Use of integrated assessment models (IAMs) is discussed in chapter 3: Baseline Socioeconomic Scenarios and chapter 7: Agriculture.

Figure 9-2
Flow chart of model sequencing



Source: World Bank, 2010a.

9.3. Adaptation

This section briefly reviews some alternative approaches for managing climate-sensitive resources in the light of climate change. These approaches are discussed and evaluated with regard to their usefulness for helping to make decisions on adaptation to climate change.

There are two basic types of decision-making approaches: the optimization approach and the uncertainty approach. The former came from the engineering paradigm that it is possible to design systems to achieve the most or optimal benefits. The latter type of decision-making approach recognizes that, because of uncertainty, optimization is unlikely to happen and other approaches need to be taken. These two categories are discussed below.

9.3.1. Optimization approaches

Optimization approaches are traditional decision-making techniques that seek to find the 'optimal' adaptation, that is, the adaptation that provides the greatest net benefits. These approaches attempt to maximize utility across all possible future conditions. A key underlying premise of these approaches is that outcomes and the probabilities of them occurring are known. Decision trees, which use combined probabilities and expected values for different outcomes, can be used.

Two leading types of quantitative optimization approaches are benefit–cost analysis (BCA) and cost-effectiveness analysis. A more qualitative approach is multi-criteria assessment. These analyses are discussed further below.

Benefit-cost analysis

BCA can be used to determine which alternative has the greatest net benefits (difference between benefits and costs) or have a higher ratio of benefits to costs (B:C) (see, for example, Smith, 1986; Boardman et al., 2001). BCA typically relies on expressing all benefits and costs in a common unit (e.g. United States Dollars) so that they can be easily compared. This approach can be used to determine which adaptation alternative has the greatest benefits, net of cost, to society.

BCA can be particularly challenging for the analysis of climate change adaptation for two reasons. The first is uncertainty about climate change outcomes. If probabilities are known, they can be used with estimates of benefits of different outcomes to estimate an expected value of benefits (and costs if appropriate). If probabilities are unknown, it is unclear how different outcomes could be combined. The second is the timing of climate change impacts. Climate is projected to continue changing. Future benefits, particularly if they are monetary, should be discounted.

Cost-effectiveness analysis

Cost-effectiveness analysis is used to compare alternatives that are expected to achieve the same or a similar goal or benefit. Since the benefit is the same, then its value does not need to be estimated. Alternatives are compared based on their relative costs (i.e. which alternative costs the least to achieve the same goal or outcome).

An additional advantage of cost-effectiveness analysis (in contrasted to BCA) is that the probabilities of outcomes, such as different climate change scenarios, may not be needed. The benefits of different options are presumed to be the same, so probabilities are not needed to calculate benefits.

Using cost-effectiveness analysis to evaluate adaptation alternatives is appropriate if the objectives or benefits of the options are clear and consistent. In many cases, however, there can be multiple benefits of different adaptation measures, making it difficult to make comparisons across alternatives. In addition, some options may cause adverse impacts (e.g. coastal barriers causing beach erosion or loss of wetlands). In such cases, the use of cost-effectiveness as a metric for evaluating adaptation alternatives can be more challenging and less informative.

Multi-criteria assessment

A more qualitative approach to evaluating adaptations is multi-criteria assessment. This can be a particularly good tool to use with stakeholders who can identify criteria to be used in assessing adaptations. The criteria need not be measured using common metrics. The stakeholders can rank how well each adaptation does in meeting the criteria, using a qualitative (e.g. high, medium or low) or quantitative scale (e.g. 1–5). If a quantitative scale is used, scores can be summed to determine which options are the highest priority. Criteria can be weighted to reflect relative importance. Adaptation options can also be evaluated for different climate change scenarios. Results can be added using weightings for the likelihood of the scenarios (or also considering present climate and weighting it based on its importance relative to the climate change scenarios).

Kemp-Benedict and Agyemang-Bonsu (2008) use the multi-criteria assessment approach to assess vulnerabilities and adaptation across multiple sectors. They point out that MCA can be an effective way to make comparisons of vulnerabilities and relative criteria across sectors. The approach they use is known as the 'Akropong Approach.' The approach involves assessing the positive and negative impacts of actions in one sector on another.

9.3.2. Uncertainty approaches

Uncertainty approaches recognize that a range of future climate conditions exist and that we probably cannot specify the range of climate change outcomes, or the probabilities of outcomes within the range. These approaches attempt to apply techniques to make decisions in the light of the uncertainties. Many of these approaches share characteristics that are not necessarily mutually exclusive.

No-regrets adaptation

A 'no-regrets' adaptation is one that can be justified under current climate conditions, and one that also makes even more sense under climate change. Thus, climate change is not needed to justify adopting a no-regrets adaptation, but can provide further justification for doing so. The origin of the term is based on the recognition that should climate not change as expected, there is no regret in selecting that option.

No-regrets decisions are often reforms such as the use of market mechanisms to allocate water supplies or removing subsidies that encourage risky behaviour.

One of the appeals of no-regrets decisions is that justification for the adaptation does not rest on arguments about climate change. That can be of help when trying to convince audiences or individuals skeptical of climate change about the wisdom of supporting such adaptations.

A downside to no-regrets decision-making is that it may promote incremental adaptations at the expense of more far-reaching adaptations. Incremental decisions might be fine if climate change is limited. However, more severe climate change might require adaptations that are more far reaching.

Incremental adaptation

Taking action in anticipation of future climate change may make sense when long-term decisions are being made. Incremental adaptations can include changing the design of infrastructure that is intended to last many decades and whose performance may be affected by climate change. For example, reservoirs, sea walls, highways, bridges and other investments are typically intended to last many decades and they may well be affected by climate change. If a sea wall is being built anyway, its height might be increased to account for potential sea level rise.

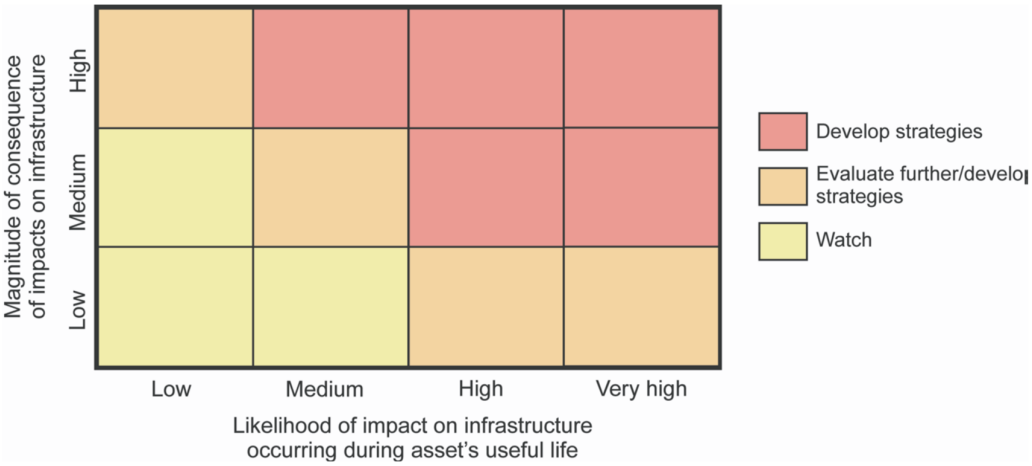
However, there are two significant challenges with trying to make incremental adaptations. The first is knowing what to plan for. A decision would need to be made on whether to increase flood protection against a very likely outcome (e.g. a small increase in flood levels), an unlikely outcome (e.g. a large increase in flood risks), or some intermediate probability outcome. The second is that, when using no-regrets adaptations in preparing for climate change, the benefits of the investment may not be realized for many decades (and in the case of preparing for extreme events, may not be realized during the lifetime of the project). If benefits are discounted back to present values, then only a small investment in the costs of the project may be justified.

Risk management

Risk management is a process by which risks are identified, assessed and then managed as appropriate (NRC, 1983). Risk management considers the impacts and likelihood of outcomes and the expected consequences (impact $\times$ likelihood) in adopting management strategies.

New York City used risk management to assess its vulnerabilities to climate change and develop adaptation strategies (see figure 9-3). Risks are placed in the matrix based on the relative magnitude of impact and the likelihood of occurrence. What kind of response is made – in this case, whether to develop strategies, evaluate strategies, or watch – depends on where outcomes are placed in the matrix. Those outcomes with higher consequences and likelihoods are given the highest priority for response. In this example, outcomes with either low likelihood of occurrence or low consequence did not warrant immediate action. However, it is important to note that applications of risk management could place higher priority on very high-consequence outcomes, even if they are of low probability.

Figure 9-3
Risk matrix used by New York City task force



Source: Major and O'Grady, 2010.

Risk management can be useful to help set priorities regarding which outcomes should receive higher or lower priority for developing adaptations. Further analysis may be needed to determine which adaptations are best or most desirable to address the highest-priority risks.

The next two approaches, adaptive management and adaptation pathways, recognize that climate change will happen over coming decades and adaptation decisions should be able to change in response to changing conditions. As noted in chapter 3, it is not just the climate that changes, but also socioeconomic conditions.

Adaptive management

Adaptive management is a process by which management decisions can be regularly revisited based on monitoring conditions, new science or other information (NRC, 2004). It explicitly recognizes that there are uncertainties about the future and conditions are changing, which creates a process by which adaptations can be made over time. Adaptive management is not a process for selecting specific adaptations, but encourages the selection of adaptations that can be adjusted over time (e.g. building a sea wall where the height may be raised in the future if evidence mounts that sea level rise is proceeding faster than originally believed). Thus, adaptive management stands in contrast to attempting to make a decision in the present that is intended to be good for the lifetime of a project or for many years in the future.

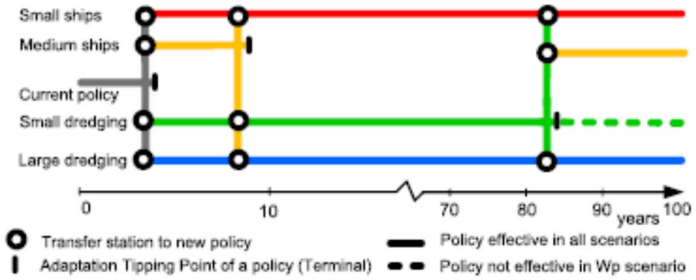
Adaptation pathways

Adaptation pathways is a form of adaptive management in which scenarios of change over time are considered. This approach involves an examination of different adaptation pathways and how far in time they may be functional or work, when changes to different pathways may be appropriate or when a single pathway may work over time (Haasnoot et al., 2012).

Figure 9-4 is an example of the adaptation pathways approach. In the example, current policy is projected to become ineffective in only a few years. Medium-sized ships will be effective for only a few years into the future. Small dredging boats will be

effective for many years and well into the future under some scenarios. Small ships and large dredging boats were found to be effective for a hundred years.

Figure 9-4
Example of adaptation pathways



Source: Haasnoot et al., 2012.

9.3.3. Options for selecting adaptations under uncertainty

These approaches can help decision makers to select adaptations recognizing that there is uncertainty about future conditions. Note that these options do not necessarily involve mutually exclusive methods. There are some common attributes across a number of the options.

We do not advocate using one approach over another. Indeed, decision makers could benefit by using a number of these approaches and comparing the results.

Robust decision-making

Groves and Lempert (2007) developed robust decision-making (RDM) as a way of making decisions under deep uncertainty. Under RDM, decision makers can consider many scenarios of future conditions, including many climate change scenarios (the kind of situation that typically confronts decision makers, because of the many climate models and downscaling techniques now available).

Under this approach, adaptations need to provide a sufficient level of benefits (i.e. they need to work under all the scenarios considered). Thus, the decisions need to be 'robust' against a wide variety of conditions. This approach is particularly useful when probabilities are unknown or stakeholders cannot agree on probabilities. Groves, Yates and Tebaldi (2008) point out that RDM can include decisions that can be modified as new information becomes available. See chapter 6, Water Resources, for more discussion on the application of RDM to water resources V&A assessment.

Portfolio management

Portfolio management is a concept that comes from finance and is essentially about risk spreading. In an environment where any single adaptation approach entails risk, one way to reduce risk is to invest in a number of options, rather than putting all resources into one investment which might completely succeed or fail. By making multiple and diverse investments, the chances that a single investment or set of investments will be successful are increased.

However, decision makers must accept the risk that a diversified portfolio will involve some investments that have benefits and others that do not under particular scenarios. Thus, individual investments within a diversified portfolio may not yield positive returns or will yield lower returns than other parts of the portfolio. Optimizing the portfolio to reduce risk can be challenging when the probabilities of outcomes are uncertain – as is the case with climate change.

Regrets analysis

Regrets analysis, also referred to as 'mini-max,' which is short for 'minimizing maximum regret', relies on avoiding the largest potential losses or most unacceptable situation (or situations). Rather than looking for an option that maximizes outcomes or works under all possible future conditions, a regrets analysis approach focuses on avoiding the largest or maximum regret. A decision maker may be particularly concerned with avoiding failure of a system, such as having inadequate water supplies to meet domestic needs (or the need to boil water to make it potable). Under a regrets analysis approach, the decision maker would select options that avoid the undesirable outcome. This option might cost more than others or not have as many benefits under other scenarios, but it would be selected because it would most effectively avoid the most undesirable outcome.

One advantage of regrets analysis is that it does not need to consider probabilities of outcomes. The point is to avoid a worst-case outcome, whatever the probability. Nevertheless, decision makers could use some discretion and not concern themselves with very-low probability outcomes.

A disadvantage of using regrets analysis to select adaptations is that it does not consider the performance of options across all or even many climate change scenarios. For example, in the potable water example above, a decision maker might focus exclusively on ensuring that water supplies are always adequate. One adaptation option might be to invest in a large water storage system at a high financial and environmental cost. This would ensure an adequate water supply even in the face of an extreme drought, but it might result in stranded costs and environmental harm should extreme drought not occur in the lifetime of the project.

Table 9-4 lists selected resources to support adaptation decision making.

Table 9-4
Selected resources on climate change adaptation

Resource	Year	Description	Link
United States Agency for International Development (USAID) Climate Resilient Development	2014	Guidance on integration of climate change adaptation into development planning.	<http://www.usaid.gov/climate/climate-resilient-development-framework>
Caribbean Climate Online Risk and Adaptation TooL (CCORAL)	2013	Provides decision support to decision makers and planning agencies. It provides a toolbox with links to over 150 tools related to climate adaptation. It was created for the Caribbean region, but the screening scenario, guidance document, and searchable toolbox can be used by most regions and sectors.	<http://ccoral.caribbeanclimate.bz/>

Resource	Year	Description	Link
National Adaptation Plans (NAPs)	2012	Guidance on preparing NAPs, which mainstream climate change adaptation.	<https://unfccc.int/files/adaptation/cancun_adaptation_framework/application/pdf/naptechguidelines_eng_high__res.pdf>
USAID Adapting to Climate Variability and Change; A Guidance Manual for Development Planning	2007	Provides guidance on integrating adaptation into development projects. Guides climate-risk screening and climate-proof project design, aimed at development agencies.	<http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf>

9.4. Mainstreaming

Mainstreaming is the process of integrating consideration of climate change into relevant policies, plans, programmes and projects at the national, subnational and local scales (USAID, 2014). The concept was developed based on the recognition that adaptation measures are rarely implemented solely in response to climate change. Rather, adaptation measures also commonly achieve other development benefits by focusing on addressing underlying causes of vulnerability. **Strategic mainstreaming** refers to incorporating climate change within policies and plans (e.g. setting priorities for development investments with climate change in mind); while **operational mainstreaming** refers to the evaluation of risks to achievement of development objectives associated with climate variability and change, and identifying effective, efficient and equitable measures to deal with those changes. Operational mainstreaming may consider climate change at the project level (USAID, 2007).

Adaptation strategies for climate change can also be made more effective when all the parties that can be affected participate in the decision-making process. Involving stakeholders at critical points in understanding vulnerability and identifying, evaluating and implementing adaptation can be critical for success. Examples of stakeholder involvement at the community level are briefly discussed in chapter 2, section 2.3.1. Cote, Pratt and Hurley (2014) describe examples of involving national-level stakeholders in workshops sponsored by the United States Agency for International Development (USAID) aiming to set priorities for incorporating climate change into development planning.

The United Nations Development Programme (UNDP) mainstreaming framework outlines three components to effective climate change mainstreaming (box 9-1) (UNDP and UNEP, 2011).

Box 9-1
United Nations Development Programme mainstreaming framework

1. Understanding linkages, finding entry points and making the case involves understanding the linkages between climate change and national development priorities and understanding the governmental, institutional and political contexts that inform efforts to define pro-poor adaptation outcomes, finding entry points into development planning, and making the case for adaptation mainstreaming.

2. Mainstreaming adaptation into policy processes focuses on integrating climate change adaptation issues into an ongoing policy process, such as national development plans, poverty reduction plans or sector strategies, based on country-specific evidence (e.g. impact, V&A assessments, socioeconomic analysis, demonstration projects).

3. Meeting the implementation challenge aims to ensure mainstreaming of climate change adaptation into budgeting and financing, implementation and monitoring and the establishment of mainstreaming as a standard practice.

Mainstreaming climate change should not be viewed as a one-time measure, but as a long-lived process. While it is important to assess progress in mainstreaming (through the incorporation of climate change into sector policies and national plans), it is also important to monitor the 'process' of mainstreaming. CARE International (2009) outlines a number of elements that provide an enabling environment for mainstreaming at the strategic level:

- ***Staff and financial resources***: Additional work and increased responsibility will be required to incorporate climate change adaptation across all sector programmes. Increased budgets may also be required to employ additional project officers;
- ***Leadership***: It is important that there are 'champions' to promote climate change adaptation within the national government. Without champions, the issues will struggle to gain profile in the short term, and in the long term it may be difficult to achieve coordination and monitoring of progress;
- ***Skills and knowledge***: There is a need to understand the importance and relevance of climate change to achieving sustainable development. Such skills and knowledge are crucial to increasing understanding, ownership and effective implementation of adaptation. Capacity can be developed through briefings, training materials, short courses for staff and partners, and regular knowledge and information exchange between staff and partners working in different sectors;
- ***Time***: Building ownership of climate change adaptation and subsequently achieving 'full integration' is a process that will take time. Understanding how this change can be achieved and how to manage the change will require continued dialogue within the organization to assess progress and approaches.

For information on approaches to monitor the progress in mainstreaming, refer to section 9.5: Monitoring and evaluation. There is a broad range of information available to support parties mainstreaming climate change adaptation actions. A selection of these is shown in table 9-5.

Table 9-5
Selected resources on mainstreaming climate change

Resource	Year	Description	Link
United States Agency for International Development (USAID) Climate-Resilient Development: A Framework for Understanding and Addressing Climate Change	2014	Guidance on integration of climate change adaptation into development planning.	<http://www.usaid.gov/climate/climate-resilient-development-framework>
National adaptation plans (NAPs)	2012	Guidance on preparing NAPs that mainstream climate change adaptation.	<https://unfccc.int/files/adaptation/cancun_adaptation_framework/application/pdf/naptechguidelines_eng_high__res.pdf>
CARE International Mainstreaming Climate Change Adaptation: A Practitioner's Handbook	2009	This handbook provides a comprehensive understanding of what mainstreaming climate change adaptation means, as well as detailed guidance on how mainstreaming climate change adaptation can be put into practice. While the handbook was designed for CARE programme management staff and project partners, it provides a good introduction to mainstreaming climate change into projects and programmes.	<http://cfovn.mpi.gov.vn/Portals/0/Upload/6_CARE%20-%20Mainstreaming%20Climate%20Change%20Adaptation%20Handbook%20CARE%20Vietnam%202009.pdf>
Organisation for Economic Co-operation and Development (OECD) Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance	2009	An excellent resource that provides recommendations to integrate climate change into national, sectoral and project levels. Presents key challenges and priorities for action.	< <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiYgYy33LrxAhW4_7sIHU6yDNIQFjAAegQIAxAD&url=https%3A%2F%2Fwww.oecd.org%2Fenv%2Fcc%2F44887764.pdf&usg=AOvVaw1Y8jI7fsXE1uilERu_L-v4>

9.5. Monitoring and evaluation

This section focuses on the M&E aspects of adaptation implementation. Evaluation aims to systematically and objectively assess progress towards defined objectives (UNDP, 2009). M&E analyses can identify the factors that have shaped the nature and magnitude of results which have been realized via specific strategies, policies and programs. For example, when done well, M&E activities can identify key barriers to progress as well as critical enabling conditions for specific interventions. This type of information can not only enhance one's understanding regarding the past performance of given activities, but can also help ensure that future adaptation actions are properly designed and executed given the context in which they operate.

9.5.1. When evaluation is used

Although M&E activities are most often associated with retrospective analyses, they can be useful throughout all stages of a programme's development and implementation:

- ***Programme design***: M&E activities are often most effective when they are included from a programme's inception. Viewing the programme through an M&E lens can help clarify key programme or policy objectives, the pathways through which they will be achieved and how progress towards such objectives will be measured;
- ***Mid-course review***: Programmes can utilize M&E to identify whether strategic or tactical mid-course corrections are needed. Such evaluations are often planned to occur approximately half way through a programme's planned life, but they may also be needed if conditions change drastically on the ground;
- ***'Real-time' evaluation***: For some programmes, such as those in highly dynamic environments, M&E activities are done throughout the entire life of the programme. While this approach is more time- and resource-intensive than conducting a single, mid-course review, key obstacles and opportunities can be identified as the programme unfolds, which can help to maximize effectiveness;
- ***Retrospective analysis***: Once a programme has been completed, it is often essential to know what gains have been made through its activities over its lifetime and which strategies or tactics were essential to progress. It is also important to identify key barriers to advancement and any missed opportunities, which can help ensure the sound design of future adaptation programmes.

9.5.2. Challenges with the monitoring and evaluation of adaptation actions

While conducting robust M&E activities and analyses can be challenging across all project types, there are specific challenges associated with M&E of adaptation actions (Gigli, 2008; OECD, 2009). These include difficulties in clearly:

- Defining adaptation goals and objectives (i.e. how to define successful/effective adaptation);
- Integrating considerations of the uncertainty of climate change impacts and moving baselines into evaluative frameworks;
- Determining the proper time frame over which the effectiveness of adaptation interventions should be evaluated;
- Accounting for the reverse logic phenomenon (i.e. how to measure success if the event addressed by the intervention does not occur or has not occurred yet).

In addition to these climate change adaptation-specific issues, M&E for adaptation interventions also face challenges that are common to M&E for other programme types. These include the difficulty of assessing the contribution of the programme or policy relative to other actors and contextual factors (i.e. attribution) and the difficulty of identifying appropriate indicators of progress for a given programme.

9.5.3. Brief overview of major monitoring and evaluation components

The specific activities conducted for an evaluation will vary greatly across different programmes, but there are four essential elements that are common to nearly all effective evaluation activities: (1) a list of detailed evaluation questions; (2) an evaluation framework; (3) an evaluation plan; and (4) communications products that share evaluation findings.

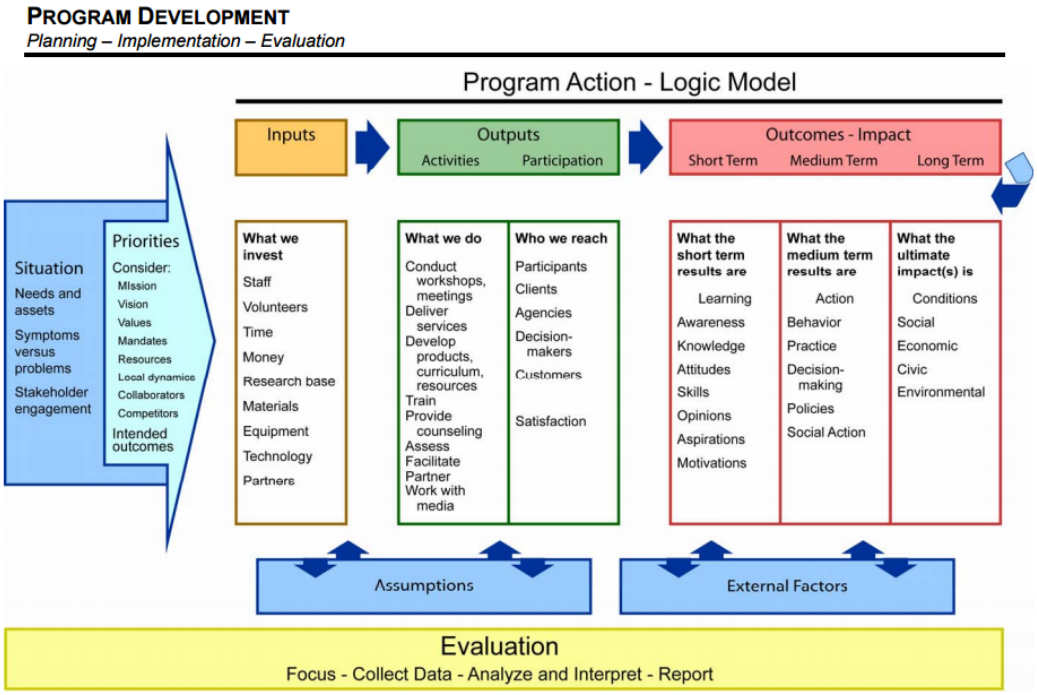
Evaluation questions

The first step in developing a successful evaluation is identifying the questions that need to be answered via the M&E activities. The questions can be developed independently by programme staff or can be elicited via a collaborative effort between programme staff and the evaluator. Clarifying what needs to be learned is critical in setting expectations, and will also guide the design and implementation of M&E activities. For example, if there is a suite of questions that address the engagement of key stakeholders in a policy process, the evaluation will focus on collecting and analysing data specifically about that issue.

Evaluation frameworks

Soon after key evaluation questions have been identified, an appropriate evaluative framework needs to be developed for the programme in question. Typically, this framework is represented either by a logic model or theory of change; we focus here on the former. A logic model may pre-exist or may need to be developed from scratch during an evaluation. A logic model specifies the planned inputs, activities, outputs and short- and long-term outcomes of the programme (see figure 9-5). Inputs represent investments that are required to make the programme a reality (e.g. funding, staff time, equipment). Activities are what people supported through the programme are doing (e.g. conducting policy analyses, developing outreach materials). Outputs represent what was produced as the result of the activities (e.g. reports, press releases, workshops). Outcomes are the changes that are realized from the programme's activities and outputs (e.g. increased policymaker awareness of needed adaptation actions). Logic models can help to articulate how key programme activities are supposed to lead to a desired change.

Figure 9-5
Logic model for monitoring and evaluation



Source: Taylor-Powell and Henert, 2008.

Once activities, inputs, outputs and outcomes have been articulated, appropriate and measurable indicators for each part of the logic model can be identified. Many programmes tend to focus on activity and output-level indicators because these are the most readily available, but assessing progress towards key goals is essential. Activity, output and outcome indicators will be context-specific and should be practical to obtain. If analysed and used effectively, evaluation indicators can be used to prioritize inputs and communicate outcomes (Lamhauge, Lanzi and Agrawala, 2011).

M&E frameworks and associated indicators should be reviewed periodically to ensure their consistency with the overall programme and their ability to address key evaluative questions.

Evaluation plan

Key evaluation questions and a framework are the building blocks of sound M&E analyses. However, a detailed plan for executing the evaluation should also be developed. An evaluation plan describes the roles of key evaluation participants, the methodological approaches for eliciting evaluation findings, and the timeline for conducting and completing the evaluation.

Most often, external, independent evaluators conduct M&E activities. This enhances transparency and accountability. However, internal evaluators can also be used. Such evaluations benefit from the in-depth technical knowledge of the evaluator, but

also can be less effective if the evaluator is hesitant to criticize the programme or its staff.

Communicate results

Evaluation findings can be communicated to a variety of audiences via a wide range of methods (see chapter 10 for a discussion of communication of V&A results). At a minimum, an evaluation report should be developed that details the questions, methods and findings of the analysis. Often, presentations to key audiences, such as internal programme staff, key stakeholders and funders are also delivered. This can be done in meetings, workshops, webinars or a combination of these platforms. The report and presentations will help programme staff to identify any necessary mid-course corrections, or highlight particularly effective approaches for future programmes.

In addition to helping programme staff or those in a related field, evaluation findings can inform reporting in national communications about the contribution of adaptation measures to vulnerability reduction across different sectors and in building national resilience. Box 9-2 discusses indicators appropriate for the health sector.

Box 9-2
Indicators for the health sector

The national M&E framework should incorporate a range of indicators of health vulnerability and risks of climate change, informed by analyses of the diverse pathways by which climate variability and change could affect health and an understanding of the different factors that determine vulnerability to those risks. Health outcome data should be at least disaggregated by age and gender to identify high-risk population subgroups and to facilitate design of tailored interventions. Quantitative measures and indicators are priorities to increase the evidence base. In addition, qualitative metrics are strongly recommended to capture social dimensions such as gender, and perceptions related to vulnerability and adaptive capacity.

Box 9-2 (cont.)
Indicators for the health sector

While mainly health indicators will be included in the M&E plan, essential baselines for monitoring the health risks of climate change include those that will determine different degrees of vulnerability and may be related to health (e.g. priority climate-related diseases), environment (e.g. climatic variables), social (e.g. poverty, demographics), economic (e.g. occupation), and current level of interventions and health system capacity. Possible indicators include the following variables that most relate to outcome.

Vector-borne disease:

- Use of seasonal climate forecasts to predict malaria epidemics.

Food safety and food-borne disease:

- Early warning systems (EWS) on rainfall and emerging food safety crisis situations (e.g. famine early warning systems (FEWS)).

Water-borne disease and access to safe drinking water:

- Proportion of the population with access to improved drinking water sources (climate resilient) and improved sanitation facilities;
- Comprehensive information systems for planning and targeted resource use (e.g. Global Information Management System on Health and Environment, GIMS).

Airborne and respiratory disease:

- Percent of households using solid fuels;
- Respiratory/allergic disease and mortality related to increased air pollution and pollens

Occupational health risks:

- Percent of heat alerts and/or EWS to minimize heat vulnerability in working environments.

Extreme weather events (e.g. extreme temperatures, droughts, floods):

- Percentage of districts/provinces with heat wave action plans implemented;
- Existence of flood or drought-warning systems and response plans;
- Percent of municipal mitigation plans for urban heat islands;
- Emergency preparedness measures/plans for extreme weather and climate events.

Cross-cutting issues to be considered:

- Environmental determinants of health (e.g. different geographical settings, urban vs. rural environments, housing);
- Gender, equity and other social determinants of health;
- Resilience of health systems (e.g. availability and accessibility of health services, climate-resilient and health promoting strategies in health care facilities, new climate-resilient hospitals built, built environments not prone to flooding).

9.5.4. Resources for learning more about monitoring and evaluation for adaptation

Because adaptation itself is a relatively new field, approaches for effectively conducting M&E for adaptation are also relatively nascent and are rapidly evolving. Table 9-6 provides a selection of resources that can provide more detailed guidance for conducting these activities.

Table 9-6
Selected resources on monitoring and evaluating climate change adaptation

Resource	Year	Description	Link
Organisation for Economic Co-operation and Development (OECD) National Climate Change Adaptation: Emerging Practices in Monitoring and Evaluation	2015	Reviews the processes and progress of monitoring and evaluation (M&E) and barriers to M&E. Provides examples of how nations have used climate risk, vulnerability and M&E tools.	<http://dx.doi.org/10.1787/9789264229679-en>
GIZ (Deutsche Gesellschaft für International Zusammenarbeit) The Vulnerability Sourcebook: Concepts and Guidelines for Standardised Vulnerability Assessments	2014	Sourcebook outlines a framework for how to apply vulnerability assessments to M&E. However the handbook does not provide specific steps or guidance on how to perform M&E.	https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi0kb-w17rxAhWGgP0HHeFQBiwQFjABegQIAxAD&url=https%3A%2F%2Fwww.adaptationcommunity.net%2F%3Fwpfb_dl%3D203&usg=AOvVaw1f_3qDMnKMRABs469xn_PR
Learning to ADAPT: Monitoring and Evaluation Approaches in Climate Change Adaptation and Disaster Risk Reduction – Challenges, Gaps and Ways Forward	2011	Describes key practical challenges for M&E in the context of climate change and examines current M&E efforts in adaptation and disaster risk reduction. Presents a set of principles – Adaptive, Dynamic, Active, Participatory and Thorough – to facilitate the development of adaptation M&E frameworks.	< https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/2509 >
OECD Monitoring and Evaluation for Adaptation: Lessons from Development Co-Operation Agencies	2011	Compares approaches used in evaluating projects and programs with adaptation-like activities. Focused on developing an understanding of (1) characteristics of M&E in the context of adaptation and (2) whether there are best practices in the choice and use of indicators for adaptation.	<https://www.oecd-ilibrary.org/environment/monitoring-and-evaluation-for-adaptation-lessons-from-development-co-operation-agencies_5kg20mj6c2bw-en >

Resource	Year	Description	Link
United Nations Development Programme (UNDP) Handbook on Planning, Monitoring and Evaluating for Development Results	2009	Replaced earlier UNDP handbook and recognizes that planning M&E requires a focus on nationally owned development priorities and results, and should reflect the guiding principles of national ownership, capacity development and human development.	https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiqu93x2LrxAhVAg_0HHSEJD-wQFjAAegQIAxAD&url=http%3A%2F%2Fweb.undp.org%2Fevaluation%2Fhandbook%2Fdocuments%2Fenglish%2Fpme-handbook.pdf&usg=AOvVaw2TqNs3YCGUsORJM_1ldJ93
World Bank Monitoring and Evaluation: Some Tools, Methods and Approaches	2004	Provides an overview of a sample of M&E tools, methods and approaches, including their purpose and use; advantages and disadvantages; costs, skills and time required; and key references.	< https://openknowledge.worldbank.org/handle/10986/23975 >
United Kingdom Climate Impacts Programme (UKCIP) *Climate Adaptation: Risk, Uncertainty and Decision Making* AdaptME	2003	UKCIP created the Adaptation Wizard as a framework for V&A assessments, which has tools for specific steps. AdaptME is the toolkit included as part of their M&E framework. The framework outlines steps, questions and resources for M&E of adaptation actions.	<http://www.ukcip.org.uk/wizard/adaptme-toolkit/>
UNDP Monitoring and Evaluation Framework for Adaptation to Climate Change	2002	Addresses six thematic areas (TAs): TA1: Agriculture/food security, TA2: Water resources and quality, TA3: Public health; TA4: Disaster risk management, TA5: Coastal zone development and TA6: Natural resources management. The UNDP framework states, "ultimately, interventions should be guided by stakeholder priorities and agency expertise, and this framework can be used as a reference for adapting a sensible monitoring approach."	< https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjn9Y3A2brxAhWJ_7sIHYsHCukQFjABegQIAxAD&url=https%3A%2F%2Fwww.un.org%2Fesa%2Fsustdev%2Fnatlinfo%2Findicators%2F15Oct_2008%2Fpresentations_pdf%2FBo%2520Lim.pdf&usg=AOvVaw3IPPc8HxiqfVIpU-Xyc4q_ >

9.6. Concluding thoughts

This chapter has covered a number of important topics that are needed to complete a V&A assessment and to begin to address adaptation and implementation.

With regard to completing a V&A assessment, it is important to keep in mind that climate change does not happen in isolation to individual sectors or regions. Impacts in one sector or region can affect others. Integration examines those interactions and

the total level of climate change impacts. It is important to integrate climate change impacts to communicate the extent of climate change vulnerability as well as relative vulnerability across sectors and regions.

Adaptation analysis involves assessing the benefits, costs and feasibility of adaptation options. With uncertainties about climate change, different approaches to assessing adaptation may be appropriate. Some approaches focus on optimizing adaptations, while others more explicitly address uncertainty and risk associated with climate change.

Mainstreaming is a way to integrate climate change as a component of broader development initiatives, by incorporating climate change considerations into relevant policies, plans, programmes and projects at the national, subnational and local scales. It is an important tool to ensure a holistic approach in managing the impacts of climate change.

An M&E framework will provide the required mechanism to evaluate the performance and effectiveness of adaptation measures. It can provide a transparent and accountable mechanism to report internally and externally on the progress being made in enhancing resilience to the impacts of climate change. M&E can also support adaptation approaches such as adaptive management. Importantly, implementation of an M&E framework will enable transparent reporting on the progress made between the national communications.

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