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DESIGNING CLIMATE VULNERABILITY ASSESSMENTS

June 2018
This document was produced for review by the United States Agency for International Development. It was prepared by Four Twenty Seven Inc. and Chemonics International for the ATLAS Task Order.

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Cover Photo: Band-e Amir National Park, Bamyan Province, Afghanistan. Photo by: Chemonics International Inc., September 2, 2005.

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Prepared for:

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Climate Change Adaptation, Thought Leadership and Assessments (ATLAS)

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ACRONYMS

ATLAS	Climate Change Adaptation, Thought Leadership and Assessments
CBMS	Community-Based Monitoring System
CIFOR	Center for International Forestry Research
CRM	Climate Risk Screening and Management Tool
CSAG	Climate System Analysis Group
CVA	Climate Vulnerability Assessment
FEWS NET	Famine Early Warning Systems Network
GCM	General Circulation Model
GIS	Geographic Information Systems
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit*
HDI	Human Development Index
HURSAT	Hurricane Satellite
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
NGO	Nongovernmental Organization
NOAA	National Oceanic and Atmospheric Administration
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WHO	World Health Organization

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INTRODUCTION

Climate variability and change present both challenges and opportunities for the achievement of development objectives at the regional, national and local levels. Responding effectively to these challenges and opportunities requires 1) understanding how climate is likely to affect development objectives and interventions, and 2) implementation of appropriate measures to address risks and take advantage of emerging opportunities.

A climate vulnerability assessment (CVA) is a resource that can help USAID staff, implementers and development partners understand who or what is vulnerable to climate variability and change, why and how they are vulnerable, and what opportunities exist to reduce these vulnerabilities. CVAs should be designed to meet the specific needs of a particular strategy, project or activity.

This document can be used as a guide and provides examples on methods for CVAs that effectively address specific goals and development challenges.

The first section provides an overview of typical CVA objectives and summarizes relevant vulnerability assessment methods to orient the reader to the elements of a CVA. The second section provides a decision tree to guide users through typical CVA questions and objectives, and then tailored information on approaches, inputs, user considerations and additional resources. It also examines two examples of previously conducted CVAs to highlight the methods, inputs and outputs of real-world vulnerability assessments.

DEFINING VULNERABILITY

In the context of an assessment, vulnerability is defined as a function of three characteristics of the system:

- ***Exposure*:** the magnitude, character and rate of climate change in a geographic area. Exposure is a function of *location.*
- ***Sensitivity*:** the capacity to suffer harm from exposure to stresses or hazards. This capacity is conditioned by a variety of internal factors that shape the state of the system being exposed. Sensitivity is thus a function of the principal activities of the system (e.g., livelihood activities of communities), as well as the specific resources (e.g., financial, social, human, physical and legal entitlements or rights) necessary to carry out these activities, as well as the impacts on these key activities and resources.
- ***Adaptive capacity*:** the ability of a system to adjust to climate change (including climate variability and extremes), moderate potential damages, take advantage of opportunities or cope with the consequences.

PURPOSE OF THIS DOCUMENT

This document may be used as a resource to inform the design of CVAs by USAID staff, their partners and other development practitioners. It complements existing USAID resources such as Climate Risk Screening and Management Tool (USAID n.d.), Climate Vulnerability Assessment: An Annex to the USAID Climate-resilient Development Framework (USAID 2016a) and Synthesizing Good Practices in Climate Adaptation Assessments Annexes (USAID 2016b).

SECTION 1: A TYPOLOGY OF CLIMATE VULNERABILITY ASSESSMENTS

CLIMATE VULNERABILITY ASSESSMENT OBJECTIVES

A CVA is an evidence-based analysis conducted to identify 1) the extent to which a human, social and/or ecological system has been or will likely be affected by climate variability and change, and 2) strategies to address these impacts (USAID 2014c). The scope and methods used for conducting CVAs vary widely in:

- *Complexity*, from desk-based studies using existing resources to extensive modelling exercises;
- *Consideration of space and time*, covering very localized sites, entire countries, regions or the globe, or current, near-term or long-term future time periods;
- *Purpose*, from identifying climate change impacts to monitoring progress; and
- *Level of expertise* required to carry out the assessment.

The CVA provides a robust information base from which to design interventions aimed at reducing climate risks and/or taking advantage of the opportunities brought about by climate variability and change, both now and in the future. Specifically, CVAs can help one understand:

- What climate stressors (e.g., rainfall changes, temperature change) contribute to vulnerability.
- Who or what is vulnerable to climate variability and/or change (e.g., fishing communities, mangrove forests, coastal tourism infrastructure) and what they are vulnerable to.
- Where vulnerable people, ecosystems, infrastructure and resources are located (e.g., near the coast or in a floodplain).
- When people or resources are or are likely to be vulnerable (e.g., during monsoon or cyclone season).
- What internal and external factors make specific groups of people (e.g., children, elderly individuals) and resources vulnerable (e.g., poor community cohesion).
- What people and communities are doing to reduce their own vulnerabilities.
- How well people's and communities' actions are working to reduce their own vulnerabilities.
- The extent to which climate stressors (e.g., sea level rise) become barriers to development relative to non-climate stressors (e.g., population growth).
- What options are available to help people and communities adapt to the effects of climate variability and change (see text box on estimating the cost of these options).

Choosing when and how to conduct a CVA depends on a number of factors including, but not limited to: the specific objectives of the analysis and the intended application of the results; the time available for conducting the assessment; the spatial and temporal scale of analysis; and the resources and expertise available. Often the need to conduct a CVA is identified after conducting a screening exercise (such as USAID's Climate Risk Screening and Management Tool) that highlights risks that need to be understood. However, a CVA is not linked to screening, and can happen at any point during a project or activity when the need to understand climate risks is identified.

HOW MUCH DOES ADAPTATION COST?

CVAs often lead to the identification of adaptation responses, and the cost of those responses is an important component in determining their feasibility. Two resources provide information on the economics of climate change adaptation:

- The World Bank's Economics of Adaptation to Climate Change
- UNEP/SEI ADAPTCost Project's Analysis of the Economic Costs of Climate Change Adaptation in Africa

KEY TERMS

- **Climate stressors:** Factors that can affect the functioning of a system or limit the potential success of development interventions (USAID 2014c). They can include both climate variability (variations in the mean state of the climate over a shorter period such a month or a year) and climate change (statistically significant variation in the mean state of the climate persisting for an extended period such as a decade or longer) (WMO).
- **Non-climate stressors:** Development challenges such as environmental degradation, corruption, population growth and pollution that can harm the functioning of a system, thus hindering the achievement of development goals (USAID 2014c).
- **Resilience:** The ability of people, households, communities, countries and systems to mitigate, adapt to and recover from shocks and stressors in a manner that reduces chronic vulnerability and facilitates inclusive growth (USAID 2013e).
- **Vulnerability:** The degree to which a *system* is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes. As described above, vulnerability is a function of a system's *exposure*, *sensitivity* and *adaptive capacity* (USAID 2014c).
- **Climate vulnerability assessment:** An analysis of the extent to which human and ecological systems are likely to be affected by climate variability and change (USAID 2014c).

CLIMATE VULNERABILITY ASSESSMENTS AT THREE LEVELS: STRATEGY, PROJECT AND ACTIVITY

While the assessment process is similar at the strategy, project and activity levels, the scope and depth of analysis will differ for each type of decision. For instance, identifying and prioritizing the regions and sectors[1] most vulnerable to climate change may be sufficient for a Regional or Country Development Cooperation Strategy. In contrast, the design of a health project to reduce the incidence and impacts of malaria will necessitate a more detailed understanding of how exposure (e.g., shifts in the geographic distribution of disease vectors due

1 In this document, the term "sector" is used to refer to economic sectors such as agriculture as well as other areas of development investment such as water resources management.

to changing climate conditions), sensitivity (e.g., history of previous exposure to malaria) and adaptive capacity (e.g., ability to implement preventive actions) contribute to communities' vulnerabilities to the disease.

STRATEGY DESIGN

When developing a Regional or Country Development Cooperation Strategy, a CVA can help identify opportunities for targeting and prioritizing investments to address climate risks. CVAs can also provide analyses of sector-specific climate risks and vulnerabilities and serve as the basis for integrating adaptation into the design of a sector portfolio. The CVA process for a strategy starts with identifying questions to help USAID staff understand how climate variability and change may affect development objectives and intermediate results. Table 1 presents common objectives and questions for a CVA at the strategy level.

Table 1. Typical objectives and question types for a climate vulnerability assessment for strategy design

Typical Objectives	Question Types
Understand and identify historical and projected climate risks at the country level	• How are climate variables expected to change and over what period of time? • Which climate variables are expected to experience significant changes in the country/region/sector? • Which climate risks are likely to have significant consequences for development objectives or sectors of concern? • What capacity does the country/sector have to adapt to the potential impacts of climate change?
Identify climate risk "hotspots" within the country	• Which regions, communities or ecosystems are likely to experience the greatest impacts?
Evaluate sectoral climate risks to inform sector programming	• Which sectors are likely to experience the greatest vulnerabilities and/or impacts? • What are the direct and indirect sectoral impacts of climate variability and change, and will these exacerbate the impacts of non-climate stressors?

The results of a CVA for strategy design can also be used to:

- Identify entry points and options for addressing climate stressors in USAID country or sectoral programming;
- Ensure that country-level development objectives are not undermined by climate variability and change;
- Highlight opportunities that may emerge from a changing climate that a strategy might take advantage of;
- Identify adaptation measures (either adapting to the negative effects of climate change or taking advantage of beneficial changes in climate) that can be integrated into strategies and portfolios; and
- Highlight areas for further analysis.

PROJECT DESIGN

CVA objectives for project design are more specific than those for strategy design because specific geographies, target populations, goals and approaches have likely been identified. Table 2 summarizes typical objectives and question types for a CVA for project design.

Table 2. Typical objectives and question types for a climate vulnerability assessment for project design

Typical Objectives	Question Types
Identify climate risks	• Which climate risks are likely to have significant consequences for project goals and activities? • Which climate variables are expected to experience significant changes in the project's geographic area?
Identify climate risk hotspots within the project's geographic scope	• Which communities, ecosystems, species, natural resources or infrastructure are likely to experience the greatest impacts?
Evaluate sectoral climate risks to inform project design	• What are the direct and indirect sectoral impacts of climate variability and change, and will these exacerbate the impacts of non-climate stressors?
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable	• What factors contribute to the exposure and sensitivity of communities, ecosystems, species, natural resources or infrastructure to climate variability and change?
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure	• What physical, social, institutional, human and financial capacities exist to adapt to climate change and where are the gaps?

The results of a CVA for project design can also be used to:

- Identify entry points and options for addressing climate stressors in specific regions and/or sectors;
- Ensure that project interventions are not undermined by climate variability and change;
- Highlight opportunities that may emerge from a changing climate that a project might leverage; and
- Highlight areas for further analysis by the implementing partner.

ACTIVITY IMPLEMENTATION

At the activity level, CVAs provide an understanding of the vulnerabilities of specific groups, places and/or natural resources. This information can help focus adaptation or resilience efforts and inform the identification and incorporation of specific responses to climate stressors. This generally requires in-depth, field-based primary data collection to understand the factors that contribute to climate vulnerabilities in greater detail than was needed for strategy or project design. For this reason, CVAs are generally not carried out by USAID to inform activity design, but are instead designed into projects so implementing partners will carry them out in a

collaborative fashion with local stakeholders and use the findings to guide other elements of the activity. Table 3 provides typical objectives and question types. Appendix A offers more examples of objectives and questions based on concrete examples.[2]

Table 3. Typical objectives and question types for a climate vulnerability assessment for activity design

Typical Objectives	Question Types
Identify critical climate risks to the activity	• Which climate risks are likely to have significant consequences for specific tasks or interventions and what effects will they have?
Identify climate risk hotspots within the activity	• Which regions, communities, ecosystems or natural resources are likely to experience the greatest vulnerabilities and/or impacts?
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable	• What factors contribute to the exposure and sensitivity of communities, ecosystems or resources to climate variability and change?
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure	• What physical, social, institutional, human and financial capacity exists to adapt to climate change and where are the gaps?

The results of a CVA at the activity level should also be used to identify adaptation options that address the activity's identified climate stressors and ensure that that activity's interventions are not undermined by climate variability and change.

CLIMATE VULNERABILITY ASSESSMENT METHODS AND INFORMATION NEEDS

METHODS

Broadly defined, common methods[3] to gather information and conduct a CVA generally fall into these categories:

- *Desktop reviews* to synthesize information from existing resources;
- *Stakeholder consultations and workshops* to obtain input through interviews, roundtables or workshops on the impacts of climate and other factors in determining vulnerabilities;
- *Additional analyses* to determine and characterize climate hazards, vulnerabilities or risks in greater detail. Examples of additional analyses are hazard, vulnerability or risk mapping, impact modeling, institutional assessment and economic impact analysis.

Within each category, a variety of existing tools might facilitate the assessment. For example, desktop reviews might be used to: systematically design impact-response tables or vulnerability matrices; identify and list relevant climate hazards for a specific area based on available

2 USAID's CRM Tool also features sectoral annexes with examples of CVA questions by sector.

3 See USAID 2016a for more detailed descriptions of each of the methods listed here.

disaster databases; highlight key impacts by sector for a specific time period; and many others. Stakeholder consultations might involve a workshop with plenary and small group discussions among government stakeholders or use participatory rural appraisal techniques and apply the use of seasonal calendars and transect walks at the local level. In fact, CVAs often involve more than one method and multiple sources of information. Table 4 summarizes methods that may be used to address typical CVA objectives and questions. The appropriate combination of methods will depend on the type of decision (e.g., strategy design) and the question (or questions) one wants to answer. Practical considerations such as available budget, the type and timing of outputs needed by decision makers, required technical expertise, and data needs and availability will also inform the selection. Detailed information is provided in Section 2.

Table 4. Methods and resources by level, climate vulnerability assessment objective and questions

Objectives and Questions	Methods	Resources
Strategy		
Understand and identify historical and projected climate risks at the country level: - How are climate variables expected to change and over what period of time? - Which climate variables are expected to experience significant changes in the country/region/sector? - Which climate risks are likely to have significant consequences for development objectives or sectors of concern? - What capacity does the country/sector have to adapt to the potential impacts of climate change?	*Desktop review* to: • Understand historical and projected climate risks • Identify climate risks at the country level	• USAID's Climate Risk Country Profiles – Summary of climate risks and stressors • Climate Country Adaptation Profiles – Historical climate information in Climate Baseline section; climate projections information in Climate Future section • Global Climate Data – Climate projections in Future GCM and Future Downscaled sections • United Nations Development Programme (UNDP) Climate Change Country Profiles – Historical climate information in Observed Data section; climate projections in Model Data section • Climate Wizard – Downscaled climate projections • The International Disaster Database –Country Profiles for summaries of past disasters • National weather service or related agency – Historical trends based on weather station data (e.g., Monthly temperature and precipitation average (1981–2010) from Colombia's National Weather Service) • National communications to United Nations Framework Convention on Climate Change (UNFCCC) – Historical trends and/or projections (e.g., Philippines Second National Communication)

Objectives and Questions	Methods	Resources
Identify climate risk "hotspots" within the country - Which regions, communities or ecosystems are likely to experience the greatest impacts?	*Desktop review* to: • Understand which regions or sectors have been/are most vulnerable to climate risks *Stakeholder consultations* to: • Ground truth desktop review findings on vulnerable regions and sectors – targeted participation of technical/regional/sectoral experts and practitioners • Identify or confirm climate risk hotspots – targeted participation of technical/regional/sectoral experts and practitioners, decision makers *Additional analysis to*: • Determine which regions or sectors face greatest risks due to future climate impacts • Conduct geospatial mapping of climate risks and impacts • Create a vulnerability index or GIS analysis to integrate climate data with exposure and socioeconomic data	• Peer-reviewed studies and other secondary sources (e.g., Regional climate model validation and climate change projections)
Evaluate sectoral climate risks to inform sector programming: - Which sectors are likely to experience the greatest vulnerabilities and/or impacts? - What are the direct and indirect sectoral impacts of climate variability and change, and will these exacerbate the impacts of non-climate stressors?	*Desktop review* to: • Understand the direct and indirect climate impacts that key sectors face • Determine which sectors are most vulnerable • Prioritize which sector vulnerabilities to address *Stakeholder consultations* to: • Ground truth desktop review findings on sector risks, vulnerabilities and impacts – targeted participation of sectoral experts and practitioners • Identify or confirm most critical sectoral climate risks – targeted participation of sectoral experts and practitioners, decision makers	• USAID's Climate Risk Screening and Management Tool for Use in Strategy Design – Examples of sectoral impacts of climate change in Annexes • Climate Country Adaptation Profiles – Sectoral data in the Impacts and Vulnerabilities section • Peer-reviewed studies and other secondary information (e.g., on health and climate change) • Sector-specific climate profiles (e.g., World Health Organization (WHO) Health and Climate Country Profiles)

Objectives and Questions	Methods	Resources
	Additional analysis to: • Simulate potential sector impacts due to climate change using impact analysis or sector-specific modeling (e.g., agronomic, epidemiological, hydrological, economic)	
Project		
Identify climate risks - Which climate risks are likely to have significant consequences for project goals and activities? - Which climate variables are expected to experience significant changes in the project's geographic area?	*Desktop review* to: • Understand historical and projected climate risks • Identify the climate hazards most likely to affect the project	• USAID's Climate Risk Country Profiles – Summary of climate risks and stressors • Climate Country Adaptation Profiles – Historical climate information in Climate Baseline section; climate projections information in Climate Future section • Global Climate Data – Climate projections in Future GCM and Future Downscaled sections • UNDP Climate Change Country Profiles – Historical climate information in Observed Data section; climate projections in Model Data section • Climate Wizard – Downscaled climate projections • The International Disaster Database – Summary of past disasters in Country Profiles • National weather service or related agency – Historical trends based on weather station data (e.g., Historical climate average or info from the Philippines Second National Communication) • Peer-reviewed studies and other secondary sources – Historical climate trends and future projections (e.g., Assessment of Climate Change in Nicaragua) • National communications to UNFCCC – Historical trends and/or projections

Objectives and Questions	Methods	Resources
Identify climate risk hotspots within the project's geographic scope - Which communities, ecosystems, species, natural resources or infrastructure are likely to experience the greatest impacts?	*Desktop review* to: • Understand which communities, ecosystems or other resources have been/are most vulnerable to climate risks • Determine which project areas, communities or ecosystems face the greatest risks due to future climate impacts *Stakeholder consultations* to: • Ground truth desktop review findings on vulnerable project areas, communities, ecosystems – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders • Identify or confirm climate risk hotspots – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders, decision makers *Additional analysis to*: • Conduct hazard, vulnerability or risk mapping, impact modeling, institutional assessment, and economic analysis of impacts • Conduct geospatial mapping of climate risks and impacts	• Peer-reviewed studies and other secondary sources that provide insight on particularly vulnerable sites, communities and ecosystems (e.g., Climate Change and its Impacts on Nepalese Agriculture)
Evaluate sectoral climate risks to inform project design - What are the direct and indirect sectoral impacts of climate variability and change, and will these exacerbate the impacts of non-climate stressors?	*Desktop review* to: • Understand the direct and indirect climate impacts that the project's sectors face • Determine which of the project's sectors are most vulnerable • Determine which sector vulnerabilities to address to meet project objectives *Stakeholder consultations* to: • Ground truth desktop review findings on project sector risks, vulnerabilities, and impacts – targeted participation of sectoral experts and practitioners	• Existing peer-reviewed and other studies about the sectoral impacts of climate change – e.g., Potential impact of climate change on livestock production and health in East Africa. • Studies from other regions that have similar characteristics – e.g., Climate Change in the Sonoran Desert • Health – WHO Health and Climate Country Profiles • Biodiversity – Climate Change Vulnerability Index by NatureServe to identify species that are particularly vulnerable to climate change

Objectives and Questions	Methods	Resources
	• Identify or confirm most critical sectoral climate risks for project – targeted participation of sectoral experts and practitioners, decision makers *Additional analysis to*: • Simulate potential sector impacts due to climate change using impact analysis or sector-specific modeling (e.g., agronomic, epidemiological, hydrological, economic) • Ascertain readiness and ability to adapt to climate change using institutional assessment(s) (e.g., USAID's Global Climate Change Institutional Capacity Assessment)	
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable - What factors contribute to the exposure and sensitivity of communities, ecosystems, species, natural resources or infrastructure to climate variability and change?	*Desktop review* to: • Identify which project communities, ecosystems and natural resources are exposed and sensitive to climate risks • Determine which factors contribute to exposure and sensitivity and how they may change • Understand how climate stressors may exacerbate non-climate stressors and which are greater contributors to sensitivity *Stakeholder consultations* to: • Gather information on local exposure and sensitivity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders • Ground truth desktop review findings about exposure and sensitivity factors, and the relationships between climate and non-climate stressors – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders • Understand which factors are the most important contributors to exposure and sensitivity – targeted participation of	• Existing peer-reviewed and other studies about communities', ecosystems' or resources' exposure and sensitivity to climate change – e.g., Coral reefs and climate change: Susceptibility and consequences • Studies from other regions that have communities, ecosystems or resources with similar characteristics (e.g., Vulnerability of Mangroves and Tidal Wetlands of the Great Barrier Reef to Climate Change)

Objectives and Questions	Methods	Resources
	community/ecosystem/resource experts and practitioners, community representatives and leaders *Additional analysis to*: • Conduct hazard, vulnerability or risk mapping, impact modeling, institutional assessment, and economic analysis of impacts • Conduct geospatial mapping of climate risks and impacts for a spatial understanding of where climate stressors and vulnerable sites, communities and ecosystems overlap	
• **Analyze the adaptive capacity of groups, ecosystems, species, natural resource or infrastructure** - What physical, social, institutional, human and financial capacity to adapt exists and where are the gaps?	*Desktop review* to: • Identify the historical occurrence of climate-related events. • Understand the capacities that communities, ecosystems and resources have leveraged in the past or currently leverage to respond to climate risks *Stakeholder consultations* to: • Understand what impacts were from specific climate events • Ground truth desktop review findings about adaptive capacity – targeted participation of community/ecosystem/resource experts and practitioners, community/group representatives and leaders • Gather local perceptions about adaptive capacity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders • Determine gaps in adaptive capacity and opportunities to strengthen it	• Peer-reviewed and other studies about communities', ecosystems' or resources' adaptive capacity (e.g., Article analyzing historical responses to climate variability, agriculture sector)

Objectives and Questions	Methods	Resources
Activity		
Identify the critical climate risks to the activity - Which climate risks are likely to have significant consequences for specific tasks or interventions and what effects will they have?	*Desktop review* to: • Identify the climate stressors most likely to affect activity site(s) • Determine how these climate stressors may interact with relevant non-climate stressors • Understand historical and projected climate risks for the activities • Understand past climate vulnerabilities and impacts of tasks and interventions *Stakeholder consultations* to: • Ground truth desktop review findings on risks to activity sites, sectors, communities or ecosystems – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders • Identify or confirm vulnerable communities, ecosystems and resources – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders, decision makers	• National weather service or related agency – Historical trends based on weather station data • Climate Risk Screening and Management Tool for Use in Activity Design by USAID – Illustrative examples of sectoral impacts in Annexes • Peer-reviewed studies and other secondary sources examining climate stressors in activity sites • Peer-reviewed articles and other studies about how similar target sectors, geographies, communities/groups, ecosystems or resources have been affected by climate variability and change (e.g., Mountain Tourism and Climate Change: Implications for the Nepal Himalaya)
Identify climate risk hotspots within the activity - Which regions, communities, ecosystems or natural resources are likely to experience the greatest vulnerabilities and/or impacts?	*Desktop review* to: • Identify the activity groups, ecosystems or natural resources that have been or are most vulnerable to climate risks • Understand the factors that contribute to their vulnerabilities, including the role of both climate and non-climate stressors *Stakeholder consultations* to: • Ground truth desktop review findings on vulnerable activity groups, ecosystems or natural resources – targeted participation of group/ecosystem/resource experts and	• Peer-reviewed articles and other studies about how similar target groups, ecosystems or resources have been affected by climate variability and change (e.g., Impact of Climate Change on Indigenous Australians)

Objectives and Questions	Methods	Resources
	practitioners, group or community leaders and representatives • Identify or confirm most vulnerable groups, ecosystems, natural resources – targeted participation of group/ecosystem/resource experts and practitioners, group or community leaders and representatives, decision makers *Additional analysis to*: • Conduct hazard, vulnerability or risk mapping; impact modeling; institutional assessment; and economic impact analysis • Conduct geospatial mapping of climate risks and impacts	
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable - What factors contribute to the exposure and sensitivity of communities, ecosystems, species, natural resources or infrastructure to climate variability and change?	*Desktop review* to: • Identify which activity communities, ecosystems and resources are exposed and sensitive to climate risks • Determine which factors contribute to exposure and sensitivity and how they may change • Understand how climate stressors may exacerbate non-climate stressors and which are greater contributors to sensitivity *Stakeholder consultations* to: • Gather local perceptions about exposure and sensitivity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders • Ground truth desktop review findings about exposure and sensitivity factors, and the relationships between climate and non-climate stressors – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders	• Existing peer-reviewed and other studies about communities', ecosystems' or resources' exposure and sensitivity to climate change (e.g., Vulnerability to Climate Change of Cocoa in West Africa) • Studies from other regions that have communities, ecosystems or resources with similar characteristics (e.g., Extreme Vulnerability Of Smallholder Farmers to Agricultural Risks and Climate Change in Madagascar)

Objectives and Questions	Methods	Resources
	• Obtain local (traditional and other) knowledge about the exposure and sensitivity of target communities, ecosystems and resources; examples of other methods that may be relevant are participatory mapping and participatory rural appraisal • Understand which factors are most important contributors to exposure and sensitivity – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders	
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure - What physical, social, institutional, human and financial capacity to adapt to climate change exists and where are the gaps?	*Desktop review* of available information to: • Understand the capacities that communities, ecosystems and resources have leveraged in the past or currently leverage to respond to climate risks *Stakeholder consultations* to: • Gather local perceptions about the adaptive capacity of the communities, ecosystems and species that are the focus of the activity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders • Obtain local (traditional and other) knowledge about adaptive capacity; examples of other relevant methods are participatory mapping and participatory rural appraisal • Ground truth desktop review findings about activity-level adaptive capacity – targeted participation of community/ecosystem/resource experts and practitioners, community/group representatives and leaders • Determine gaps in adaptive capacity and opportunities to strengthen it, including local (traditional and other) knowledge about exposure, sensitivity and adaptive capacity	• Peer-reviewed and other studies about communities', ecosystems' or resources' adaptive capacity (e.g., Changes in adaptive capacity of Kenyan communities)

TIME CONSIDERATIONS

The amount of time needed to complete a CVA depends on a number of factors. While desktop reviews can be completed in as little as a few weeks, collection and/or analysis of primary data requires a greater investment of time, often six months to a year. The time needed to organize and conduct stakeholder consultations varies depending on whether one is engaging a focused, internal audience (e.g., sectoral USAID Mission staff) in one location or a broader audience of experts and external stakeholders (e.g., representatives of local government, beneficiaries) in multiple locations. Table 5 provides illustrative timeframes by CVA objective. It should be noted, however, that these timeframes will often depend on the scale, resolution and available information. Scale could be spatial (e.g., community versus country) or temporal (e.g., 5 to 50 years).

Table 5. Illustrative timeframes for typical climate vulnerability assessment objectives

Objective	Examples of Time Considerations
Understand and identify historical and projected climate risks	One to two weeks if profiles are available; one to two months to conduct a desktop review and apply relevant secondary data; and three or more months if the assessment requires digitization and cleaning of field-based rain gauge and weather station data.
Evaluate sectoral climate risks	One to two months if based on secondary sources and expert consultations and six months or longer if based on primary impact analyses and modelling.
Identify climate risk hotspots	One to two months if based on available secondary sources and as long as six months to a year to conduct extensive study on sectoral climate risks and impacts with primary data collection and analysis, participation of multiple experts, and significant stakeholder engagement.
Identify critical climate risks	One to two months to conduct desktop review of secondary sources and three months or more if consultations with relevant stakeholders are needed to confirm results.
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable	One to two months to conduct desktop review of secondary sources and three months or more if consultations with relevant stakeholders are required.
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure	One to two months to conduct desktop review of secondary sources and three months or more if consultations with relevant stakeholders are required.

CLIMATE DATA AND OTHER RELEVANT INFORMATION

Climate data and information needs for a CVA are shaped by factors such as the type of decision (e.g., strategy, project, activity), the timeframe for investments (e.g., for large infrastructure versus project capacity-building efforts), scale of decision making (e.g., country,

ecosystem) and timeline for the CVA. It is important to identify data needs based on the CVA objective and understand what relevant data and information are already available. This information will help determine whether additional analyses are required or if a desktop analysis will provide sufficient detail to move forward.

The types of climate data and information that may be needed for a CVA include historical information and climate trends or projections, including variability and changes in temperature, precipitation, sea level rise, extreme events, etc. Additionally, data and information specific to sector, geography, group or resource can be used to: understand the characteristics associated with each of those categories; assess existing exposure, sensitivity and adaptive capacity; and determine the factors that contribute to vulnerabilities. For instance, to evaluate a community's vulnerability to floods, one may examine data related to living conditions (e.g., housing characteristics) and health conditions (e.g., physical mobility), and economic and social vulnerability (e.g., poverty levels). It may also be helpful to evaluate data and information on non-climate stressors as they can be important contributors to climate vulnerabilities. For instance, population growth and changing land use practices may increase the vulnerability of forest ecosystems to the negative impacts of higher temperatures and more frequent droughts. In that case, data on those non-climate stressors would be important to consider in a CVA for a forestry project or activity.

Table 6 summarizes climate data and information needs by typical objectives. A complete list of sources of climate information is available in Appendix B.

Table 6. Climate data and other information for typical climate vulnerability assessment objectives

Objective	Information Needs
Understand and identify historical and projected climate risks	Data on current climate hazards, risk and variability will aid in answering this question. Possible information sources include: • Inventories, maps and data series of natural events and climate-related risks (e.g., drought, flooding) • National evaluations on desertification • Disaster preparedness plans, inventories and reviews • Meteorological data (observations) • Climate projections (see Appendix B)
Identify climate risk hotspots	Information from climate above, as well as: • Critical assets such as roads, health facilities, building construction types, irrigation, etc. • Poverty, food security, malnutrition (stunting) • Population totals, density, growth rates • Historical occurrence of hazard- or climate-related events (e.g., floods, droughts, cyclones) • Biophysical characteristics such as elevation, slope, water availability, etc. • Information regarding changes in frequency and spatial extent of climate-related events, as well as changes in coping thresholds

Objective	Information Needs

Evaluate sectoral climate risks to inform sector programming or project design	• Sector-specific information such as: yields for agriculture; water withdrawal, recharge rates, river and stream flows for the water sector; disease incidence and seasonality for health, among others
	• Information on the impacts of hazards drawn from:
	  • Disaster preparedness and action plans
	  • Inventories, maps and data related to the impact of past hazards
	  • Intergovernmental Panel on Climate Change (IPCC) Assessment Reports

Identify critical climate risks	• Data and information on sector- (strategy), area- (strategy, project or activity), or community-, ecosystem-, or resource-specific (project or activity) impacts from secondary and peer-reviewed literature, stakeholder consultations
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable	• Development, demographic, socioeconomic and other data to understand and assess exposure and sensitivity • Data and information on past and projected climate risks, vulnerabilities and impacts for specific groups, ecosystems or resources from secondary and peer-reviewed literature, stakeholder consultations, other analyses (e.g., participatory rural appraisals, institutional capacity assessments, livelihoods assessments)
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure	• Data and information on physical, informational, social and institutional, human, and financial adaptive capacity from secondary and peer-reviewed literature, stakeholder consultations, other analyses (e.g., participatory rural appraisals, institutional capacity assessments)

EXPERTISE AND FINANCIAL RESOURCES

The expertise needed for a CVA depends on the assessment objective as well as time and cost considerations and desired outputs. USAID Mission staff may be able to conduct a strategy- or portfolio-level climate risk screening with limited input from an adaptation expert using available guidance and resources such as USAID's Climate Risk Screening and Management (CRM) Tool. However, a more detailed examination of how climate variability and change may affect sectoral, project or activity outcomes may require the engagement of individuals with expertise in climate risks and a specific geography, community context or sector. Expertise in spatial planning or geographic information systems (GIS) may also be needed to map climate risk hotspots. Table 7 provides examples of the types of expertise needed for typical CVA objectives. Table 8 lists the types of sectoral expertise that may be relevant for a CVA.

Table 7. Examples of expertise needed for typical climate vulnerability assessment objectives

Objective	Examples of Expertise Required
Understand and identify historical and projected climate risks	• GIS and spatial planning – to inform the understanding of climate trends and projections by mapping climate data and vulnerabilities to visualize climate impacts • Climate science interpretation – to identify and assess existing climate data and information and apply projections at the relevant scale[4]
Identify climate risk hotspots	• Sectoral (see Table 8 for examples of expertise by sector) – to provide sector-specific information on climate vulnerabilities and impacts • Modeling – e.g., agronomic, epidemiological, hydrological, economic, etc.
Evaluate sectoral climate risks to inform sector programming or project design	• Interpretation of climate data – to identify and assess existing climate data and information and analyze how climate translates to risks in the sector of interest • Sectoral (see Table 8 for examples of expertise by sector) – to provide sector-specific information on climate vulnerabilities and impacts • Group, ecosystem, resource, region – to provide local expertise about the people, industries and regions affected by climate change, the most important risks they face, and the local factors that contribute to vulnerabilities and impacts • GIS or spatial planning – to inform the identification of climate risk hotspots by mapping climate data and vulnerabilities and identifying the intersection of various assets and hazards
Identify critical climate risks	• Interpretation of climate data – to identify and apply existing climate data and information, and identify the potential magnitude of climate risks • Sector, group, ecosystem, resource, region – to provide local subject matter expertise about the people, industries and regions affected by climate change, the most important risks they face, and their greatest risks and vulnerabilities
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable	• Interpretation of climate data – to apply existing climate data and information to relevant groups, ecosystems or resources to evaluate exposure and sensitivity • Sector, group, ecosystem, resource, region – to provide local subject matter expertise about the factors that

4 Often country profiles from USAID or other donors are already available with information on how climate has changed and is expected to change in the future; these resources typically suffice. Climate science expertise is generally only required for in-depth analysis or in cases where projections need to be downscaled or previous analysis is significantly lacking.

Objective	Examples of Expertise Required
	contribute to the exposure and sensitivity of the people, ecosystems and resources affected by climate change
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure	• Sector, group, ecosystem, resource, region – to provide local subject matter expertise about the physical, informational, social and institutional, human and financial adaptive capacity of the people, ecosystems and resources affected by climate change

Table 8. Examples of sectoral expertise for typical climate vulnerability assessment objectives

Sector	Examples of Relevant Expertise
Agriculture	Agricultural economics, crop, food security, nutrition, livelihoods, livestock, gender
Disaster readiness	Disaster risk reduction and management
Economic growth	Macroeconomics, trade/investment, workforce development, finance, insurance
Education, social services and marginalized populations	Education, social and economic services, community engagement, gender
Environment and biodiversity	Environmental science, environmental economics, ecosystem services, conservation, species biology, livelihoods, ecosystem/landscape (e.g., forestry, wetlands, coastal), land tenure
Infrastructure, construction and energy	Infrastructure systems and operations, engineering
Water supply and sanitation	Water resources, water management, hydrology, water infrastructure, governance
Health	Public health, nutrition, epidemiology, gender
Governance, peace and security	Governance, conflict management, human rights, gender

OUTPUTS

The output(s) of a CVA should be based on the decision the assessment is meant to inform, as well as the target audience. For instance, a summary report or qualitative ranking may be appropriate when identifying climate risks to prioritize vulnerable sectors or regions in a country strategy or sector portfolio. In contrast, the design of an agriculture project focused on improving

rice production in a specific country may necessitate a vulnerability index and associated maps; this will help determine which rice production regions are particularly vulnerable to changing temperature and rainfall patterns and would benefit most from interventions. Table 9 provides examples of outputs by CVA objectives.

Table 9. Examples of outputs for typical climate vulnerability assessment objectives

Objective	Illustrative Outputs
Understand and identify historical and projected climate risks	• Charts of historical climate trends and future projections for a region, country or specific area • Country-, region- or location-specific narrative summarizing historical climate trends and future projections
Identify climate risk hotspots	• Maps highlighting hotspots • Narrative describing identified hotspots, the associated vulnerabilities and the factors that contribute to them • Vulnerability index based on exposure, sensitivity and adaptive capacity indicators
Evaluate sectoral climate risks to inform sector programming or project design	• Narrative summarizing sectoral climate risks, vulnerabilities and/or impacts • Qualitative ranking of sectoral climate risks, vulnerabilities and/or impacts to inform bounding of sector programming or project design, based on experts' and/or other stakeholders' inputs
Identify critical climate risks	• Qualitative ranking of climate risks for strategy, project or activity goals based on experts' and/or other stakeholders' inputs • Risk matrix comparing probability and severity of different impacts
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable	• Narrative describing groups', ecosystems', or resources' exposure and sensitivity and the factors that contribute to them • Vulnerability index based on group, ecosystem and/or resource exposure, sensitivity and adaptive capacity indicators • Maps of vulnerable groups, ecosystems or resources
Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure	• Narrative describing physical, informational, social and institutional, human, and financial adaptive capacity • Index based on indicators of physical, informational, social and institutional, human and financial adaptive capacity

Building on the typology presented here, the next step in the process is to design a CVA. In the following section, a decision tree offers information on choosing appropriate CVA methods targeted to specific goals and tasks, as well as examples of the framework in action.

SECTION 2: FRAMEWORK FOR DESIGNING A CLIMATE VULNERABILITY ASSESSMENT

To support USAID staff and their partners in designing CVAs, this section maps questions and objectives to methods and resources at the strategy, project and activity levels. The intended audience for this framework includes:

- *At the strategy level*: USAID staff or development partners who need to understand the climate risks that may affect Country Development Cooperation Strategy (CDCS) sectors, development objectives and/or intermediate results in order to identify important adaptation and resilience approaches at the strategy level.
- *At the project level*: USAID staff or development partners who wish to complete a CVA as part of the project design process for a sectoral project (e.g., agriculture) and understand 1) whether and how the project will affect, or will be affected by, climate change impacts, and 2) if the project's design should be adjusted in consideration of climate change vulnerabilities (USAID's *Project Design Guidance* [2011d]). Vulnerability assessment objectives for project design are more specific than those for strategy design, because specific geographies, target populations, goals and approaches have likely been identified.
- *At the activity level*: Implementing partners, USAID staff or development partners who must understand the vulnerabilities of target populations, sector objectives, ecosystems, natural resources, etc. to design and incorporate adaptation and resilience measures to achieve activity objectives despite climate stressors. This generally requires in-depth, field-based primary data collection to understand the factors that contribute to climate vulnerabilities in greater depth and detail in a specific context than was needed for strategy or project design. CVAs at this level can be included as a requirement in a Request for Proposals or similar tender document.

HOW TO USE THIS SECTION

Figure 1 is an overview of the decision tree summarizing typical questions and objectives. Determine the level at which the assessment will be carried out and then jump to the appropriate decision tree level: strategy, project or activity. From there, select the appropriate question, which then leads to the assessment's objective. Each objective has a corresponding numbered table (Tables 10–21) that provides potential methods, climate data and information resources, example timeframes, relevant expertise and illustrative outputs specific to the objective.

Figure 1. Decision tree on climate vulnerability assessment questions and objectives at the strategy, project and activity levels

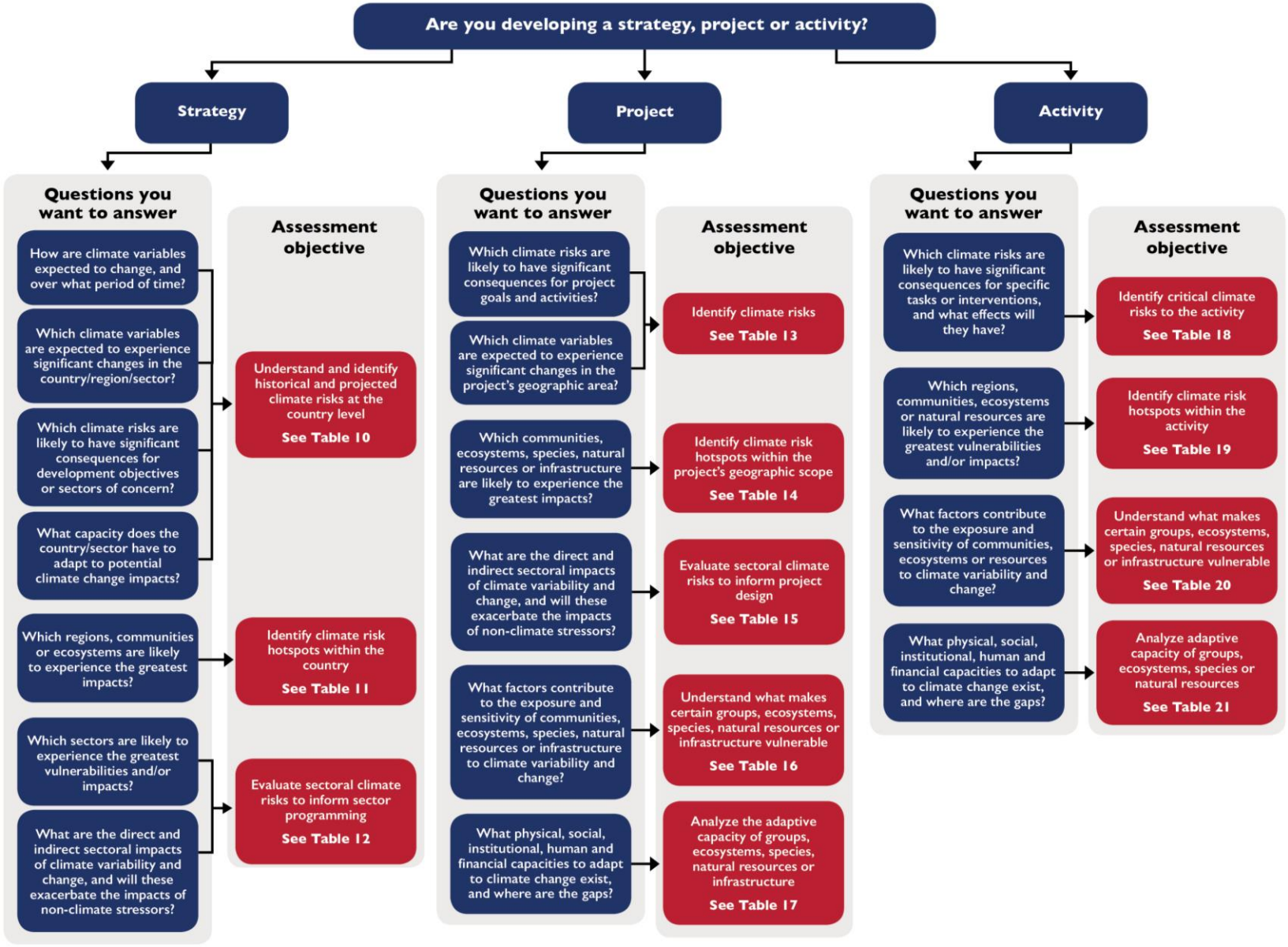

Figure 2. Decision tree on climate vulnerability assessment questions and objectives at the strategy level

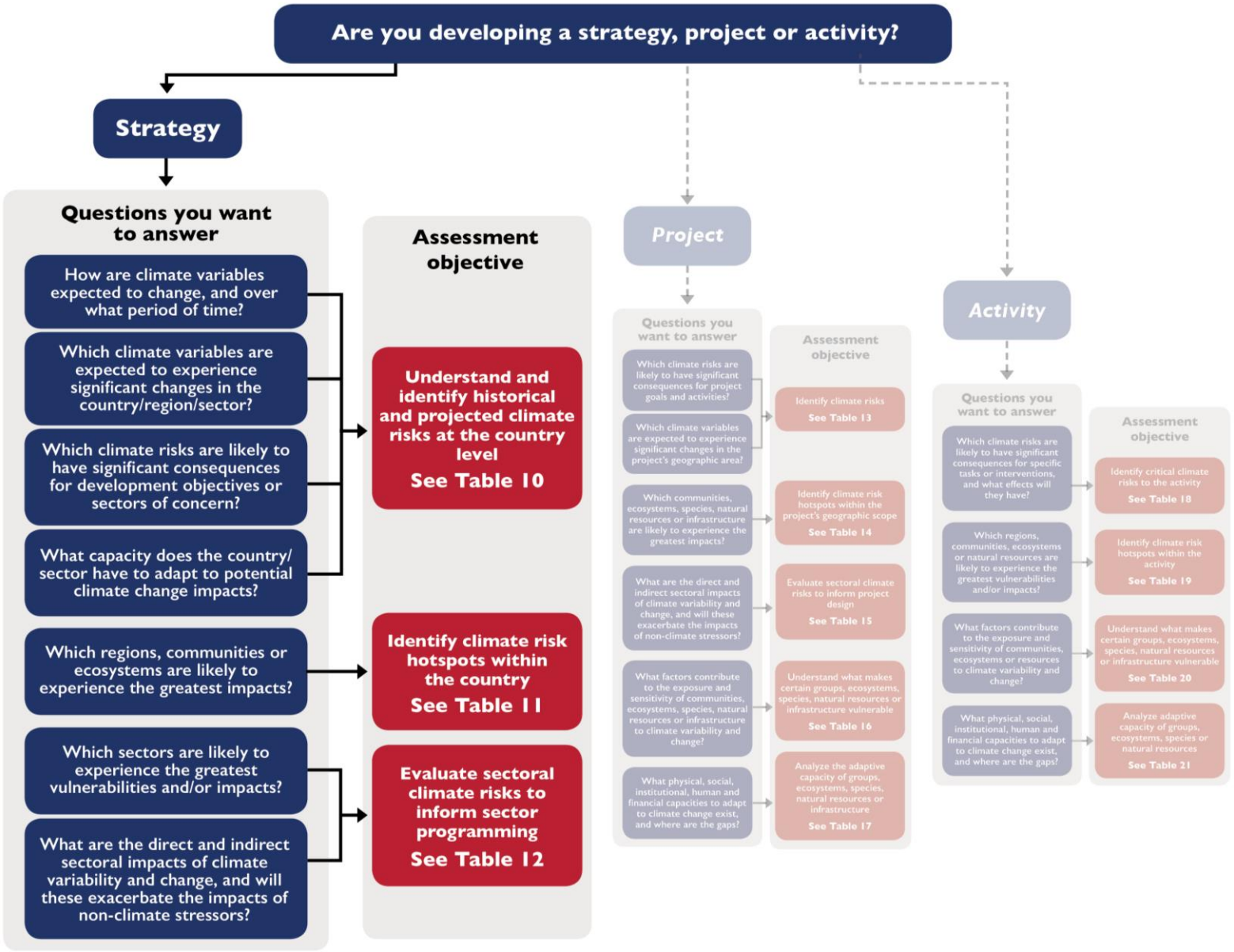

Table 10. Understanding climate trends and projections at the strategy level

QUESTIONS:

- How are climate variables expected to change and over what period of time?
- Which climate variables are expected to experience significant changes in the country/region/sector?
- Which climate risks are likely to have significant consequences for development objectives or sectors of concern?
- What capacity does the country/sector have to adapt to the potential impacts of climate change?

OBJECTIVE: Understand and identify historical and projected climate risks at the country level

METHODS

Desktop review (using existing data and information):

To understand climate risks at the regional, country or sector level, use the following types of information as applicable:

- Inventories, maps and data series on climate events risks such as drought and flooding (e.g., International Disaster Database – Summaries of disasters in Country Profiles)
- National evaluations on desertification
- Disaster preparedness plans, inventories and reviews
- Meteorological observation data (e.g., Monthly temperature and precipitation average for 1981–2010 from Colombia's National Weather Service)
- Climate projections:
  - USAID's Climate Risk/Vulnerability Country Profiles – Future climate information in Climate Summary or Projected Weather and Climate Changes section
  - World Bank Climate Country Adaptation Profiles – Climate projections in Climate Future section
  - Global Climate Data – Climate projections in Future GCM and Future Downscaled sections
  - UNDP Climate Change Country Profiles – Climate projections in Model Data section
  - Climate Wizard – Downscaled climate projections
  - National communications to UNFCCC – Summary of projected climate (e.g., Philippines Second National Communication)
  - Peer-reviewed studies and other secondary sources – Summary of climate projections (e.g., Assessment of Climate Change in Nicaragua)

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 weeks if climate profiles are available; 1–2 months to review secondary sources and consult experts • High estimate: 3 or more months if the analysis requires digitization and	• Climate data interpretation: Identify and assess climate data and information; apply projections at the relevant scale (Existing country profiles with info on how climate has and is expected to change will often suffice; may not be necessary to engage a climate science expert.)	• Country-, region- or location-specific summaries of historical climate trends and future projections • Charts of historical climate trends and future projections for a region, country or specific area	How vulnerable is Bangladesh and what needs to be done (Mani and Wang 2014) World Bank

cleaning of field-based weather station data	• GIS and spatial planning: Inform understanding of climate trends and projections by mapping climate hazards and vulnerabilities to visualize climate impacts	• Maps of climate variables (e.g., historical or projected average annual temperature) to demonstrate the spatial distribution of and changes in climate stressors • Country- or region-specific summary of institutional capacity to address the impacts of and adapt to climate change	

Table 11. Understanding climate risk hotspots at the strategy level

QUESTION: Which regions, communities or ecosystems are likely to experience the greatest impacts?

OBJECTIVE: Identify climate risk hotspots within the country

METHODS

Desktop review (using existing data and information):

- Collect data and reports on vulnerability to climate risks for regions, communities or ecosystems using the following types of information as applicable:
  - Inventories, maps and data series of natural events and climate-related risks such as drought and flooding (e.g., International Disaster Database – Summaries of past disasters in Country Profiles)
  - National evaluations on desertification
  - Disaster preparedness plans, inventories and reviews
  - Meteorological observation data (e.g., Monthly temperature and precipitation average for 1981–2010 from Colombia's National Weather Service)
  - Climate projections:
    - USAID's Climate Risk/Vulnerability Country Profiles – Future climate information in Climate Summary or Projected Weather and Climate Changes section
    - World Bank Climate Country Adaptation Profiles – Climate projections in Climate Future section
    - Global Climate Data – Climate projections in Future GCM and Future Downscaled sections
    - UNDP Climate Change Country Profiles – Climate projections in Model Data section
    - Climate Wizard – Downscaled climate projections
    - National communications to UNFCCC – Summary of projected climate (e.g., Philippines Second National Communication)
    - Peer-reviewed studies and other secondary sources – Summary of climate projections (e.g., Assessment of Climate Change in Nicaragua)

Stakeholder analysis: If the sources for the desktop review are not current, there are gaps in the results, and/or information is not available at the appropriate scale to determine hotspots to inform strategy design, stakeholder consultations can be used to obtain expert inputs and/or local knowledge and perceptions to:

- Ground truth desktop review findings on vulnerable regions, sectors, communities and ecosystems – targeted participation of technical/regional/sectoral experts and practitioners
- Identify or confirm climate risk hotspots – targeted participation of technical/regional/sectoral experts and practitioners, decision makers

Additional analysis:

- Determine which regions, sectors, communities or ecosystems face the greatest future climate risks
- Carry out the additional analysis of geospatial mapping of climate risks and impacts if a spatial understanding of where climate stressors and vulnerable regions, sectors, communities and ecosystems overlap is needed to bound strategy design
- Create a vulnerability index or GIS analysis to integrate climate data with exposure and socioeconomic data on:
  - Critical assets such as roads, health facilities, building construction types, irrigation, etc.

- Poverty, food security, malnutrition (stunting)
- Population totals, density, growth rates
- Biophysical characteristics such as elevation, slope, water availability, etc.
- Historical occurrence of hazard or climate-related events (e.g., floods, droughts, cyclones)
- Information regarding changes in frequency and spatial extent of climate-related events, as well as changes in coping thresholds

RESOURCES

Secondary and peer-reviewed literature

- National communications to UNFCCC – historical trends and/or projections (e.g., Philippines Second National Communication)
- Peer-reviewed studies and other secondary sources (e.g., Regional climate model validation and climate change projections)

Sector-specific climate data

- Health – WHO Health and Climate Country Profiles
- Biodiversity – Climate Change Vulnerability Index by NatureServe to identify species that are particularly vulnerable to climate change.
- Agriculture and food security – Climate Change, Agriculture and Food Security – Climate data portal features global and regional future high-resolution climate datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agricultural and livestock production, and ecosystem services and hydrology.
- Food security – Famine Early Warning Systems Network provides access to geospatial data, climate data, satellite image products and derived data products in support of FEWS NET drought monitoring efforts throughout the world.
- Extreme events – Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation summarizes scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.
- Extreme events – Global Assessment Report on Disaster Risk Reduction provides a summary of trends of disasters and expected future losses.
- Extreme events – International Disaster Database has data on the occurrence and effects of over 22,000 disasters in the world from 1990 to the present day.

Weather and climate data

- National weather service or related agency – historical trends based on weather station data (e.g., Monthly temperature and precipitation average (1981–2010) from Colombia's National Weather Service).
- Climate Hazards Group InfraRed Precipitation with Station data – historical (30+ years; 1981 to near present) global rainfall dataset available to support drought early warning and environmental monitoring. Data are a combination of satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.

- Climate Impacts: Global and Regional Adaptation Support Platform – web-based climate information service to support decision makers in developing and emerging countries to prioritize adaptation needs; service provides sound knowledge on current and projected climate stimuli, climate impacts and adaptation options at the national, subnational and regional levels.
- Climate Research Unit TS Google Earth Interface – temperature and precipitation data covering the period 1901–2015 and all land areas; data allow half-degree cells to be examined.
- Climate Research Unit Updated – data and information on past climate history and its impacts on humanity, the course and causes of climate change during instrumental period.
- Climate Wizard – global historical temperature and rainfall maps and global state-of-the-art predictions of temperature and rainfall.
- Data Distribution Center – data sources from IPCC and includes datasets from multiple data centers around the world, including China, Norway, Canada, France, the United States, South Korea and Japan.
- Global Climate Data – historical data derived from three quality-controlled sources as well as future projections based on downscaled general circulation models (GCMs) under two scenarios for future economic growth and energy use.
- Global Historical Climatology Network – climate summaries from land surface stations across the globe obtained from more than 20 sources.
- HURSAT – tropical cyclone-centric satellite data.
- International Best Track Archive for Climate Stewardship – tropical cyclone data to enable understanding of the distribution, frequency and intensity of tropical cyclones worldwide.
- Optimum Interpolation Sea Surface Temperature (OISST) – global sea surface temperatures constructed by combining observations from satellites, ships and buoys on a regular global grid.
- Tropical Rainfall Measuring Mission – data from a research satellite to improve understanding of the distribution and variability of precipitation within the tropics, as well as interactions between water vapor, clouds and precipitation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months if based on available secondary sources and includes building an index or a GIS component (e.g., to conduct overlay of exposure and poverty data) • Higher estimate: 6 months to a year to conduct extensive study on climate risks and impacts with primary data collection and analysis, participation of multiple experts and significant stakeholder engagement	• Climate data interpretation – Identify and assess data and information on climate stressors and apply to relevant communities/ecosystems/resources • Sector, community, ecosystem, resource, region – Provide subject matter expertise about the people, communities and regions affected by climate change, the most important risks they face, and the factors that contribute to vulnerabilities and impacts • GIS or spatial planning – Inform identification of climate risk hotspots by mapping climate data and vulnerabilities and identifying the intersection of relevant regions, sectors, communities or ecosystems, and stressors	• Hotspot maps demonstrating where climate stressors and vulnerabilities intersect • Narrative profiles describing identified hotspots, associated vulnerabilities and the factors that contribute to them • Vulnerability index based on exposure, sensitivity and adaptive capacity indicators to enable understanding of the factors that contribute to vulnerabilities and comparison across regions, sectors, communities or ecosystems	• Climate Change Vulnerability Mapping for Southeast Asia (Yusuf and Francisco 2009) • Economy and Environment Program for Southeast Asia, supported by the International Development Research Centre; the Swedish International Development Cooperation Agency; and the Canadian International Development Agency

Table 12. Evaluating sectoral climate risks to inform sector programming

QUESTION:

- Which sectors are likely to experience the greatest vulnerabilities and/or impacts?
- What are the direct and indirect sectoral impacts of climate variability and change, and will these exacerbate the impacts of non-climate stressors?

OBJECTIVE: Evaluate sectoral climate risks to inform sector programming

METHODS

Desktop review (using existing data and information):

- Understand the direct and indirect climate impacts that key sectors face
- Determine which sectors are most vulnerable
- Prioritize which sector vulnerabilities to address:
  - Sector-specific information such as: yields for agriculture, water withdrawal, recharge rates, river and stream flows for the water sector; disease incidence and seasonality for health
  - Information on the impacts of hazards drawn from: disaster preparedness and action plans; inventories, maps and data related to the impacts of past hazards; IPCC Assessment Reports

Stakeholder consultations: If there are gaps in the results of the desktop review, information is not available for the sector/subsectors of interest and at the appropriate scale, and/or a more nuanced understanding of sector/subsector impacts is needed, carry out stakeholder consultations to obtain expert inputs and/or local knowledge and perceptions to:

- Ground truth desktop review findings on sector risks, vulnerabilities, and impacts – targeted participation of sectoral experts and practitioners
- Identify or confirm most critical sectoral climate risks – targeted participation of sectoral experts and practitioners, decision makers

Additional analysis: If a more in-depth, detailed understanding of the potential impacts of climate on specific sectors or subsectors is needed, conduct additional analysis, e.g., impact analysis or sector-specific modeling (e.g., agronomic, epidemiological, hydrological, economic) to simulate potential sector impacts due to climate change.

RESOURCES

Secondary and peer-reviewed literature

- Peer-reviewed studies and other secondary information (e.g., on health and climate change).
- Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation – Summarizes scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.
- Global Assessment Report on Disaster Risk Reduction – Summary of trends of disasters and expected future losses.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months to review secondary sources and consult experts • High estimate: 6 months or longer if conducting impact analyses and modelling	• Climate data interpretation – Identify and assess existing climate data and information and analyze sector-specific climate risks • Sectoral – Provide sector-specific information on climate vulnerabilities and impacts • Modeling – Conduct relevant sectoral modeling (e.g., agronomic, epidemiological, hydrological, economic)	• Profiles summarizing sectoral climate risks, vulnerabilities and/or impacts • Qualitative ranking of sectoral climate risks, vulnerabilities and/or impacts to inform bounding of sector programming or project design, based on experts' and/or other stakeholders' inputs	• Protecting Health from Climate Change in Albania – Vulnerability Assessment Report (WHO 2011) • WHO, part of the project "Protecting health from climate change in southeast Europe, central Asia and the Russian North"

Figure 3. Decision tree on climate vulnerability assessment questions and objectives at the project level

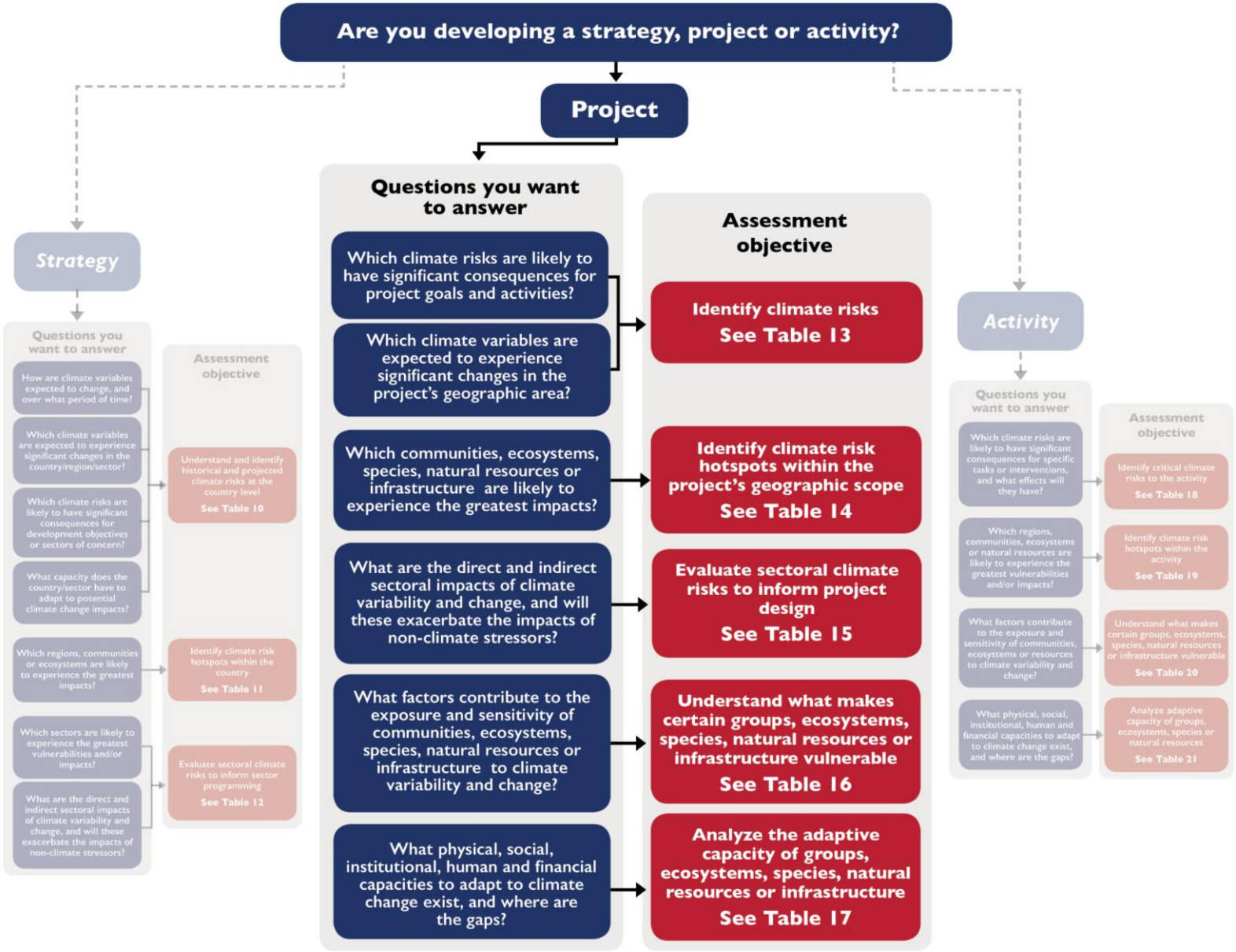

Table 13. Identifying climate risks at the project level

QUESTIONS:

- Which climate risks are likely to have the most significant consequences for project goals and activities?
- Which climate variables are expected to experience significant changes in the project's geographic area?

OBJECTIVE: Identify climate risks

METHODS

Desktop review (using existing data and information):

- Understand historical and projected climate stressors at the regional, country or sectoral level and identify the climate stressors most likely to affect the project, using the following types of information as applicable:
  - Inventories, maps and data series of natural events and climate-related risks such as drought and flooding (e.g., International Disaster Database – Summaries of past disasters in Country Profiles)
  - National evaluations on desertification
  - Disaster preparedness plans, inventories and reviews
  - Meteorological observation data (e.g., monthly averages for temperature and precipitation for 1981–2010 from Colombia's National Weather Service)
  - Climate projections:
    - USAID's Climate Risk/Vulnerability Country Profiles – Future climate information in Climate Summary or Projected Weather and Climate Changes section
    - World Bank Climate Country Adaptation Profiles – Climate projections in Climate Future section
    - Global Climate Data – Climate projections in Future GCM and Future Downscaled sections
    - UNDP Climate Change Country Profiles – Climate projections in Model Data section
    - Climate Wizard – Downscaled climate projections
    - National communications to UNFCCC – Summary of projected climate (e.g., Philippines Second National Communication)
    - Peer-reviewed studies and other secondary sources – Summary of climate projections (e.g., Assessment of Climate Change in Nicaragua)
  - Data and information on sector- (strategy), area- (strategy, project or activity), or community-, ecosystem-, or resource-specific (project or activity) impacts. This data can come from secondary and peer-reviewed literature, be collected from stakeholder consultations, or be provided by government institutions such as the meteorological office or state-run universities.

EXAMPLE TIMEFRAME

- Low estimate: 1–2 two weeks if climate profiles are available; 1–2 months to review secondary sources and consult experts
- High estimate: 3 months or more if the analysis requires, for instance, digitization and cleaning of field-based rain gauge and weather station data

RELEVANT EXPERTISE

- Climate data interpretation – Identify data/information; apply projections at relevant scale (Existing country profiles on how climate has and is expected to change will often suffice, many not be necessary to engage a climate science expert.)
- GIS and spatial planning – Inform the understanding of climate trends and projections by mapping climate data and vulnerabilities to visualize climate impacts

ILLUSTRATIVE OUTPUTS

- Summaries of historical climate trends and future projections at the scale relevant to the project
- Charts of historical climate trends and future projections for a region, country or specific area
- Maps of climate variables (e.g., historical or projected average annual temperature, changes in average annual rainfall)

EXAMPLES

- Livelihoods, climate and non-climate threats and adaptation: Bagamoyo District Coastal Villages; Doc 7 (USAID 2013c)
- USAID Pwani Project

Table 14. Identifying climate risk hotspots within the project's geographic scope

QUESTION: Which communities, ecosystems, species, natural resources or infrastructure are likely to experience the greatest impacts?
OBJECTIVE: Identify climate risk hotspots within the project's geographic scope

METHODS

Desktop review (using existing data and information):

- Understand which communities, ecosystems or other resources have been/are most vulnerable to climate risks
- Determine which sites, communities or ecosystems face the greatest risks due to future climate impacts
    - Data and information on past and projected climate risks, vulnerabilities and impacts from secondary and peer-reviewed literature, other analyses (e.g., participatory rural appraisals) (See below for relevant resources.)

Stakeholder consultations: If the sources for the desktop review are not current, there are gaps in the results, and/or information on vulnerable communities, ecosystems and resources is not available at the appropriate scale to inform project design, stakeholder consultations can be used to obtain expert inputs and/or local knowledge and perceptions to:

- Ground truth desktop review findings on vulnerable project sites, communities, ecosystems – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders
- Identify or confirm vulnerable communities, ecosystems and resources – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders, decision makers

Additional analysis:

- Hazard, vulnerability or risk mapping, impact modeling, institutional assessment and economic analysis of impacts – for more detailed information regarding which communities, ecosystems and resources are vulnerable to climate stressors, how and why, to determine target project sites, communities, ecosystems and resources
- Geospatial mapping of climate risks and impacts – for a spatial understanding of where climate stressors and vulnerable sites, communities and ecosystems overlap

RESOURCES

Secondary and peer-reviewed literature

- Peer-reviewed studies and other secondary sources that provide insight on particularly vulnerable sites, communities and ecosystems (e.g., Climate Change and its Impacts on Nepalese Agriculture)

Sector-specific climate data

- Health – WHO Health and Climate Country Profiles
- Biodiversity – Climate Change Vulnerability Index by NatureServe to identify species that are particularly vulnerable to climate change
- Agriculture and food security – Climate Change, Agriculture and Food Security – Climate data portal features global and regional future high-resolution climate datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agricultural and livestock production, and ecosystem services and hydrology.
- Food security – Famine Early Warning Systems Network provides access to geospatial data, satellite image products and derived data products in support of FEWS NET drought monitoring efforts throughout the world.
- Extreme events – Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation summarizes scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.

- Extreme events – Global Assessment Report on Disaster Risk Reduction provides a summary of trends of disasters and expected future losses.
- Extreme events – International Disaster Database has data on the occurrence and effects of over 22,000 disasters in the world from 1990 to the present day.

Weather and climate data

- National weather service or related agency – historical trends based on weather station data (e.g., Monthly temperature and precipitation average (1981–2010) from Colombia's National Weather Service).
- Climate Hazards Group InfraRed Precipitation with Station data – historical (30+ years; 1981 to near present) global rainfall dataset available to support drought early warning and environmental monitoring. Data are a combination of satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.
- Climate Impacts: Global and Regional Adaptation Support Platform – web-based climate information service to support decision makers in developing and emerging countries to prioritize adaptation needs; service provides sound knowledge on current and projected climate stimuli, climate impacts and adaptation options at the national, subnational and regional levels.
- Climate Research Unit TS Google Earth Interface – temperature and precipitation data covering the period 1901–2015 and all land areas; data allow half-degree cells to be examined.
- Climate Research Unit Updated – data and information on past climate history and its impacts on humanity, the course and causes of climate change during instrumental period.
- Climate Wizard – global historical temperature and rainfall maps and global state-of-the-art predictions of temperature and rainfall.
- Data Distribution Center – data sources from IPCC and includes datasets from multiple data centers around the world, including China, Norway, Canada, France, the United States, South Korea and Japan.
- Global Climate Data – historical data derived from three quality-controlled sources as well as future projections based on downscaled GCMs under two scenarios for future economic growth and energy use.
- Global Historical Climatology Network – climate summaries from land surface stations across the globe obtained from more than 20 sources.
- HURSAT – tropical cyclone-centric satellite data.
- International Best Track Archive for Climate Stewardship – tropical cyclone data to enable understanding of the distribution, frequency and intensity of tropical cyclones worldwide.
- Optimum Interpolation Sea Surface Temperature (OISST) – global sea surface temperatures constructed by combining observations from satellites, ships and buoys on a regular global grid.
- Tropical Rainfall Measuring Mission – data from a research satellite to improve understanding of the distribution and variability of precipitation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months if based on available secondary sources (e.g., to conduct overlay of exposure and poverty data) • High estimate: 6 months to a year to conduct extensive study on climate risks and impacts with primary data collection and analysis, participation of multiple experts and significant stakeholder engagement	• Climate data interpretation – Identify and assess existing climate data and information on climate stressors and apply to relevant communities/ecosystems/natural resources • Sector, community, ecosystem, resource, region – Provide subject matter expertise about the people, communities and regions affected by climate change, the most important risks they face, and the factors that contribute to vulnerabilities and impacts • GIS or spatial planning – Inform the identification of vulnerable communities, ecosystems and resources by mapping climate data and vulnerabilities	• Narrative profiles describing vulnerable communities, ecosystems and resources, and the factors that contribute to vulnerabilities • Vulnerability index based on exposure, sensitivity and adaptive capacity indicators to enable understanding of the factors that contribute to vulnerabilities and comparison across sites, communities or ecosystems • Maps demonstrating where climate stressors and vulnerabilities intersect	• Vulnerability Assessment of Central Coastal Senegal and the Gambia Marine Coast and Estuary to Climate Change Induced Effects (USAID 2012) • USAID Ba Nafaa project

Table 15. Evaluating sectoral climate risks to inform project design

QUESTION: What are the direct and indirect sectoral impacts of climate variability and change, and will these exacerbate the impacts of non-climate stressors?
OBJECTIVE: Evaluate sectoral climate risks to inform project design

METHODS

Desktop review (using existing data and information):

- Understand the direct and indirect climate impacts that the project's sectors or sector elements face
- Determine which of the project's sectors or sector elements are most vulnerable
- Determine which sector vulnerabilities to address to meet project objectives
    - Sector-specific information such as: yields for agriculture; water withdrawal, recharge rates, river and stream flows for the water sector; disease incidence and seasonality for health
    - Information on the impacts of hazards drawn from: disaster preparedness and action plans; inventories, maps and data related to the impacts of past hazards; IPCC Assessment Reports

Stakeholder consultation: If there are gaps in the results of the desktop review, information is not available for the sector/subsectors of interest and at the appropriate scale, and/or a more nuanced understanding of sector/subsector impacts is needed, carry out stakeholder consultations to obtain expert inputs and/or local knowledge and perceptions to:

- Ground truth desktop review findings on project sector risks, vulnerabilities and impacts – targeted participation of sectoral experts and practitioners
- Identify or confirm most critical sectoral climate risks for project – targeted participation of sectoral experts and practitioners, decision makers

Additional analysis: If a more in-depth, detailed understanding of the potential impacts of climate on specific sectors or subsectors is needed, conduct:

- Impact analysis or sector-specific modeling (e.g., agronomic, epidemiological, hydrological, economic) to simulate potential sector impacts due to climate change
- Institutional assessment(s) to ascertain readiness and ability to adapt to climate change (e.g., using USAID's Global Climate Change Institutional Capacity Assessment)

RESOURCES

Secondary and peer-reviewed literature

- Existing peer-reviewed and other studies about the sectoral impacts of climate change – e.g., Potential impact of climate change on livestock production and health in East Africa
- Studies from other regions that have similar characteristics – e.g., Climate Change in the Sonoran Desert

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months to review secondary sources and consult experts • High estimate: 6 months or longer if conducting impact analyses and modelling	• Climate data interpretation – Identify and assess existing climate data and information and analyze sector-specific climate risks • Sectoral – Provide sector-specific information on climate vulnerabilities and impacts • Modeling – Conduct relevant sectoral modeling (e.g., agronomic, epidemiological, hydrological, economic)	• Profiles summarizing sectoral climate risks, vulnerabilities and/or impacts • Qualitative ranking of sectoral climate risks, vulnerabilities and/or impacts to inform bounding of sector programming or project design, based on experts' and/or other stakeholders' inputs	• Baseline study, Temeke Municipality, Dar es Salaam (ICLEI 2011) • ICLEI– Local Governments for Sustainability; project – Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action

Table 16. Understanding what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable

QUESTION: What factors contribute to the exposure and sensitivity of communities, ecosystems, species, natural resources or infrastructure to climate variability and change?
OBJECTIVE: Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable

METHODS

Desktop review (using existing data and information):

- Identify which project communities, ecosystems and resources are exposed (subject) and sensitive (susceptible to harm due) to climate risks
- Determine which factors contribute to exposure and sensitivity and how they may change
- Understand how climate stressors may exacerbate non-climate stressors and which are greater contributors to sensitivity
    - Data and information on past and projected climate risks, vulnerabilities and impacts for specific communities, ecosystems or resources from secondary and peer-reviewed literature, other analyses (e.g., participatory rural appraisals, institutional capacity assessments, livelihoods assessments)
    - Development, demographic, socioeconomic and other data to understand and assess exposure and sensitivity (e.g., Sustainable Development Goals)

Stakeholder consultations: If there are gaps in the results of the desktop review, information on the combined impacts of climate and non-climate stressors is limited, a more nuanced understanding of the factors contributing to exposure and sensitivity is required, and/or information is not available for the specific communities, ecosystems or resources of interest and at the appropriate scale, carry out stakeholder consultations to obtain expert inputs and/or local knowledge and perceptions to:

- Gather information on local exposure and sensitivity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Ground truth desktop review findings about exposure and sensitivity factors, and the relationships between climate and non-climate stressors – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Understand which factors are most important contributors to exposure and sensitivity – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders

A*dditional analysis*:

- Hazard, vulnerability or risk mapping, impact modeling, institutional assessment, and economic analysis of impacts – for more detailed information regarding which communities, ecosystems or resources are likely to be affected by climate stressors, how and why, to determine target project sites, communities, ecosystems and specific elements of exposure and/or sensitivity that the project may address
- Geospatial mapping of climate risks and impacts – for a spatial understanding of where climate stressors and vulnerable sites, communities and ecosystems overlap

RESOURCES

Secondary and peer-reviewed literature

- Existing peer-reviewed and other studies about communities', ecosystems' or resources' exposure and sensitivity to climate change (e.g., Coral reefs and climate change: Susceptibility and consequences)
- Studies from other regions that have communities, ecosystems or resources with similar characteristics (e.g., Vulnerability of Mangroves and Tidal Wetlands of the Great Barrier Reef to Climate Change)

Indicator data

- Sustainable Development Goals – Country- and sector-specific indicators are provided regarding 17 goals for meeting the needs of the world's poorest people.
- International Human Development Indicators Profiles – Country-specific social vulnerability based on the UNDP Human Development Index (HDI). The HDI combines indicators of life expectancy, educational attainment and income.
- Climate Change Knowledge Portal – A web-based tool that provides country-specific indicators of sensitivity, including information on water access, sanitation, land use, wealth, age and agriculture.
- Open Data – A data catalog that provides access to a number of indicators that can be used to assess sensitivity.
- Demographic and Health Survey – A 30+-year record for most developing countries of demographic and health survey information.
- Least Developed Countries Factsheets – Country-specific development statistics for least developed countries that can be used to assess sensitivity.
- Government statistics databases – National and local government websites provide information on development indicators.
- Adaptation Learning Mechanism – Web-based information platform that includes case studies of adaptation.

Sector-specific climate data

- **Health – WHO** Health and Climate Country Profiles
- **Biodiversity –** Climate Change Vulnerability Index by NatureServe to identify species that are particularly vulnerable to climate change.
- **Agriculture and food security –** Climate Change, Agriculture and Food Security – Climate data portal features global and regional future high-resolution climate datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agricultural and livestock production, and ecosystem services and hydrology.
- **Food security –** Famine Early Warning Systems Network provides access to geospatial data, satellite image products and derived data products in support of FEWS NET drought monitoring efforts throughout the world.
- **Extreme events –** Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation summarizes scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.
- **Extreme events –** Global Assessment Report on Disaster Risk Reduction provides a summary of trends of disasters and expected future losses.
- **Extreme events –** International Disaster Database has data on the occurrence and effects of over 22,000 disasters in the world from 1990 to the present day.

Weather and climate data

- National weather service or related agency – historical trends based on weather station data (e.g., Monthly temperature and precipitation average (1981–2010) from Colombia's National Weather Service).
- Climate Hazards Group InfraRed Precipitation with Station data – historical (30+ years; 1981 to near present) global rainfall dataset available to support drought early warning and environmental monitoring. Data are a combination of satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.
- Climate Impacts: Global and Regional Adaptation Support Platform – web-based climate information service to support decision makers in developing and emerging countries to prioritize adaptation needs; service provides sound knowledge on current and projected climate stimuli, climate impacts and adaptation options at the national, subnational and regional levels.
- Climate Research Unit TS Google Earth Interface – temperature and precipitation data covering the period 1901–2015 and all land areas; data allow half-degree cells to be examined.
- Climate Research Unit Updated – data and information on past climate history and its impacts on humanity, the course and causes of climate change during instrumental period.
- Climate Wizard – global historical temperature and rainfall maps and global state-of-the-art predictions of temperature and rainfall.
- Data Distribution Center – IPCC data sources, includes datasets from multiple global data centers, including China, Norway, Canada, France, the United States, South Korea and Japan.
- Global Climate Data – historical data derived from three quality-controlled sources as well as future projections based on downscaled GCMs under two scenarios for future economic growth and energy use.
- Global Historical Climatology Network – climate summaries from land surface stations across the globe obtained from more than 20 sources.
- HURSAT – tropical cyclone-centric satellite data.
- International Best Track Archive for Climate Stewardship – tropical cyclone data on the distribution, frequency and intensity of tropical cyclones worldwide.
- Optimum Interpolation Sea Surface Temperature (OISST) – global sea surface temperatures using observations from satellites, ships and buoys on a regular global grid.
- Tropical Rainfall Measuring Mission – satellite data on the distribution and variability of precipitation within the tropics, and interactions between water vapor, clouds and precipitation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months to review secondary sources; 3 months or more if stakeholder consultations are required • High estimate: Several months to a year if conducting extensive field-based primary data collection and ground truthing, and/or mapping	• Climate data interpretation – Apply existing climate data and information to relevant communities, ecosystems or resources to evaluate exposure and sensitivity • Sector, community, ecosystem, resource, region – Provide subject matter expertise about the factors that contribute to the exposure and sensitivity of the communities, ecosystems and resources affected by climate change • GIS or spatial planning – Map climate data and exposure and sensitivity indicators to understand distribution of exposure and sensitivity	• Profiles describing communities', ecosystems', or resources' exposure and sensitivity and the factors that contribute to them • Index based on community, ecosystem and/or resource exposure and sensitivity indicators to enable comparison and inform prioritization • Maps demonstrating where climate stressors intersect with community/ecosystem/resource exposure and sensitivity	• Vulnerability to environmental changes in northern Mali (Djoudi, Brockhaus, and Locatelli 2013) • Tropical Forests and Climate Change Adaptation project executed by Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) and Center for International Forestry Research (CIFOR) and funded by the European Commission

Table 17. Analyzing the adaptive capacity of communities, ecosystems, species, natural resources or infrastructure at the project level

QUESTION: What physical, social, institutional, human and financial capacities to adapt to climate change exist and where are the gaps?
OBJECTIVE: Analyze the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure

METHODS

Desktop review (using existing data and information):

- Identify the historical occurrence of climate-related events
- Understand how communities, ecosystems and resources have responded in the past to historical impacts, and who was most and least impacted and why
    - Data and information on the physical, informational, social and institutional, human, and financial capacities that communities, ecosystems and resources have used to respond to historical impacts from secondary and peer-reviewed literature and other analyses (e.g., participatory rural appraisals, institutional capacity assessments)

Stakeholder consultations: If information on how communities, ecosystems and resources have responded to past disasters and what capacities they have used is limited, carry out stakeholder consultations to obtain expert inputs and/or local knowledge and perceptions to:

- Understand what impacts were from specific climate events – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Ground truth desktop review findings about adaptive capacity – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Gather local perceptions about adaptive capacity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Determine gaps in adaptive capacity and opportunities to strengthen it – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders, policy/decision makers

RESOURCES

Secondary and peer-reviewed literature

- Peer-reviewed and other studies about communities', ecosystems' or resources' adaptive capacity (e.g., Article analyzing historical responses to climate variability, agriculture sector)

Indicator data

- Sustainable Development Goals – Country- and sector-specific indicators are provided regarding 17 goals for meeting the needs of the world's poorest people.
- International Human Development Indicators Profiles – Country-specific social vulnerability based on the UNDP Human Development Index (HDI). The HDI combines indicators of life expectancy, educational attainment and income.
- Climate Change Knowledge Portal – A web-based tool that provides country-specific indicators of sensitivity, including information on water access, sanitation, land use, wealth, age and agriculture.
- Open Data – A data catalog that provides access to a number of indicators that can be used to assess sensitivity.
- Demographic and Health Survey – A 30+-year record for most developing countries of demographic and health survey information.
- Least Developed Countries Factsheets – Country-specific development statistics for least developed countries that can be used to assess sensitivity.
- Government statistics databases – National and local government websites provide information on development indicators.
- Adaptation Learning Mechanism – Web-based information platform that includes case studies of adaptation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months to review secondary sources; 3 months or more if stakeholder consultations are required • High estimate: Several months to a year if conducting extensive field-based primary data collection and ground truthing	• Sector, community, ecosystem, resource, region – Provide subject matter expertise about the physical, informational, social and institutional, human, and financial adaptive capacity of the people, ecosystems and resources affected by climate change • GIS or spatial planning – Map climate data and adaptive capacity indicators to understand distribution of adaptive capacity and compare across communities/ecosystems/resources	• Profiles describing physical, informational, social and institutional, human, and financial adaptive capacity • Index based on indicators of physical, informational, social and institutional, human, and financial adaptive capacity to enable comparison and inform prioritization	• Climate Change Vulnerability Mapping in the Philippines: A Pilot Study (AKI 2012) • PEP (Partnership for Economic Policy)-Asia CBMS Network Office of the Angelo King Institute for Economic and Business Studies of De La Salle University, Manila in collaboration with Economy and Environment Program for Southeast Asia

Figure 4. Decision tree on climate vulnerability assessment questions and objectives at the activity level

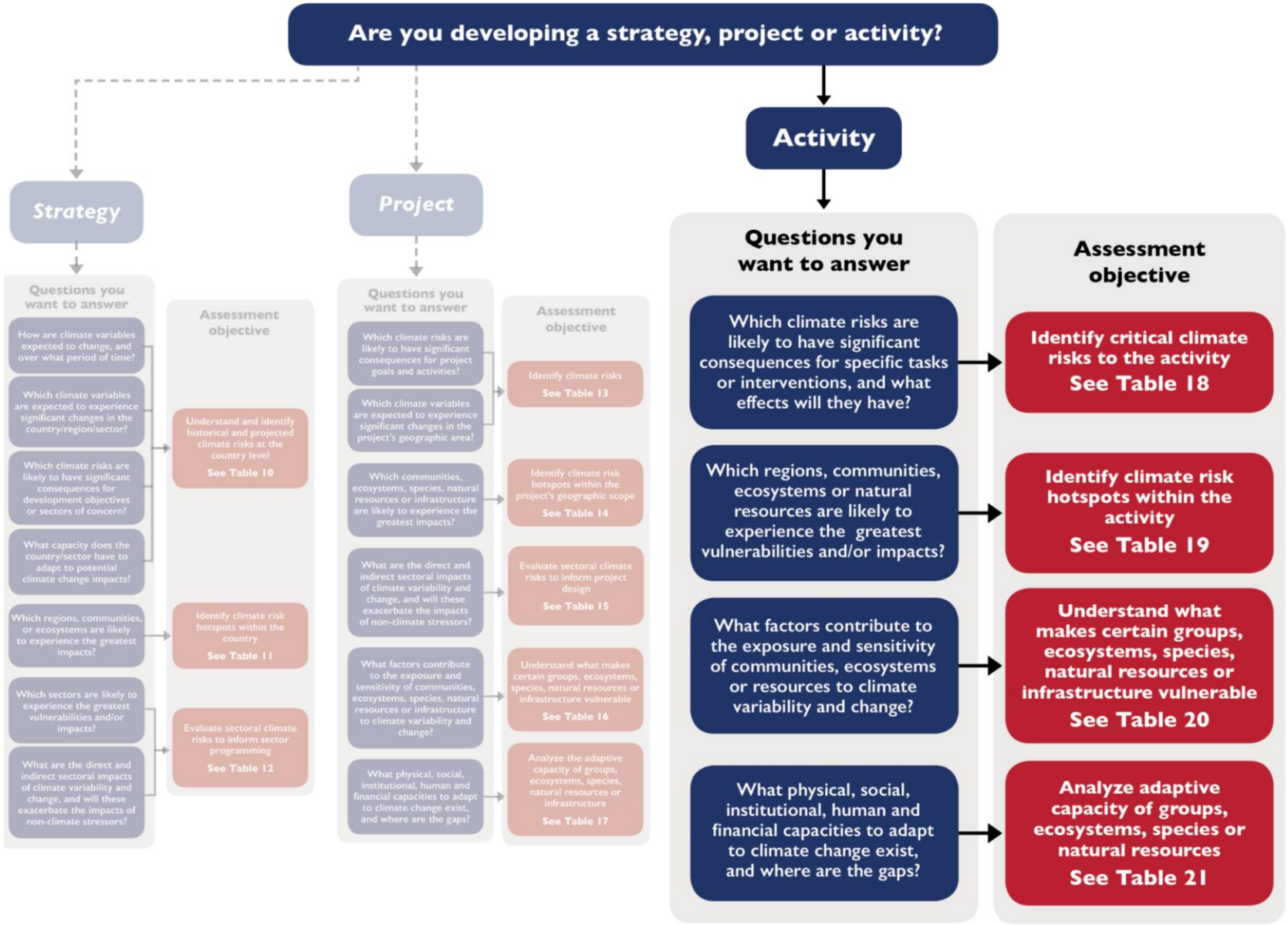

Table 18. Identifying critical climate risks at the activity level

QUESTION: Which climate risks are likely to have the most significant consequences for specific tasks or interventions and what effects will they have?
OBJECTIVE: Identify critical climate risks to the activity

METHODS

Desktop review (using existing data and information):

- Understand historical and projected climate stressors for the activity sites and sectors
- Identify the climate stressors most likely to affect activity site(s) and sectors
- Examine how climate stressors may interact with non-climate stressors:
  - Inventories, maps and data series of natural events and climate-related risks such as drought and flooding
  - National evaluations on desertification
  - Disaster preparedness plans, inventories and reviews
  - Meteorological observation data (e.g., Monthly temperature and precipitation average for 1981–2010 from Colombia's National Weather Service)
  - Downscaled climate projections

Data and information on sector- (strategy), area- (strategy, project or activity), or community-, ecosystem-, or resource-specific (project or activity) impacts from secondary and peer-reviewed literature

Stakeholder consultations: At the activity level, stakeholder consultations should be used to obtain expert inputs and/or local knowledge and perceptions to:

- Ground truth desktop review findings on risks to activity sites, sectors, communities or ecosystems – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders
- Identify or confirm vulnerable communities, ecosystems and resources – targeted participation of sector/area/community/ecosystem experts and practitioners, community leaders, decision makers

EXAMPLE TIMEFRAME

- Low estimate: 1–2 weeks if climate profiles are available; 1–2 months to review secondary sources and consult experts
- High estimate: 3 months or more if the analysis requires, for instance, digitization and cleaning of field-based rain gauge and weather station data

RELEVANT EXPERTISE

- Climate data interpretation – Identify and assess existing climate data and information and apply projections at the relevant scale (Existing country profiles with information on how climate has already and is expected to change will often suffice, so that it is not necessary to engage someone with climate science expertise.)
- Sector, community, ecosystem, resource, region – provide subject matter expertise about the communities, sectors and regions affected by climate change, their greatest risks and vulnerabilities, and the factors that contribute to their vulnerabilities

ILLUSTRATIVE OUTPUTS

- Qualitative ranking of climate risks for goals based on experts' and/or other stakeholders' inputs
- Risk matrix comparing probability and severity of different impacts

EXAMPLES

- Assessing Climate Change Vulnerability in East Africa (2009–2010) (CARE 2011)
- Global Water Initiative, CARE, Action Against Hunger, Catholic Relief Services, International Union for Conservation of Nature (IUCN), Oxfam America

Table 19. Identifying climate risk hotspots at the activity level

QUESTION: Which regions, communities, ecosystems or natural resources are likely to experience the greatest vulnerabilities and/or impacts?
OBJECTIVE: Identify climate risk hotspots within the activity

METHODS

Desktop review (using existing data and information):

- Identify the activity-level communities, ecosystems or resources that have been or are most vulnerable to climate risks and face the greatest risk from future climate impacts, and understand the factors that contribute to their vulnerabilities, including the role of both climate and non-climate stressors:
  - Data and information on past and projected climate risks, vulnerabilities and impacts from secondary and peer-reviewed literature, stakeholder consultations, other analyses (e.g., participatory rural appraisals) (See below for relevant resources.)

Stakeholder consultations: If the sources for the desktop review are not current, there are gaps in the results, and/or information on vulnerable communities, ecosystems and resources is not available at the appropriate scale to inform project design, stakeholder consultations can be used to obtain expert inputs and/or local knowledge and perceptions to:

- Ground truth desktop review findings on vulnerable activity communities, ecosystems or resources – targeted participation of community/ecosystem/resource experts and practitioners, community leaders and representatives
- Identify or confirm most vulnerable communities, ecosystems, resources – targeted participation of community/ecosystem/resource experts and practitioners, community leaders and representatives, decision makers

Additional analysis:

- Hazard, vulnerability or risk mapping, impact modeling, institutional assessment and economic analysis of impacts – for more detailed information regarding which communities, ecosystems and resources are likely to be affected by climate stressors, how and why, to determine target project sites, communities, ecosystems and resources
- Geospatial mapping of climate risks and impacts – for a spatial understanding of where climate stressors and vulnerable sites, communities and ecosystems overlap

RESOURCES

Secondary and peer-reviewed literature

- Peer-reviewed articles and other studies about how similar target groups, ecosystems or resources have been affected by climate variability and change (e.g., Impact of Climate Change on Indigenous Australians)

Sector-specific climate data

- Health – WHO Health and Climate Country Profiles
- Biodiversity – Climate Change Vulnerability Index by NatureServe to identify species that are particularly vulnerable to climate change.
- Agriculture and food security – Climate Change, Agriculture and Food Security – Climate data portal features global and regional future high-resolution climate datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agricultural and livestock production, and ecosystem services and hydrology.

- Food security – Famine Early Warning Systems Network provides access to geospatial data, satellite image products and derived data products in support of FEWS NET drought monitoring efforts throughout the world.
- Extreme events – Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation summarizes scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.
- Extreme events – Global Assessment Report on Disaster Risk Reduction provides a summary of trends of disasters and expected future losses.
- Extreme events – International Disaster Database has data on the occurrence and effects of over 22,000 disasters in the world from 1990 to the present day.

Weather and climate data

- Climate Hazards Group InfraRed Precipitation with Station data – historical (30+ years; 1981 to near present) global rainfall dataset available to support drought early warning and environmental monitoring. Data are a combination of satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.
- Climate Impacts: Global and Regional Adaptation Support Platform – web-based climate information service to support decision makers in developing and emerging countries to prioritize adaptation needs; service provides sound knowledge on current and projected climate stimuli, climate impacts and adaptation options at the national, subnational and regional levels.
- Climate Research Unit TS Google Earth Interface – temperature and precipitation data covering the period 1901–2015 and all land areas; data allow half-degree cells to be examined.
- Climate Research Unit Updated – data and information on past climate history and its impacts on humanity, the course and causes of climate change during instrumental period.
- Climate Wizard – global historical temperature and rainfall maps and global state-of-the-art predictions of temperature and rainfall.
- Data Distribution Center – IPCC data sources, includes datasets from multiple global centers including China, Norway, Canada, France, the United States, South Korea and Japan.
- Global Climate Data – historical data from three quality-controlled sources and future projections based on downscaled GCMs under two scenarios for future economic growth and energy use.
- Global Historical Climatology Network – climate summaries from land surface stations across the globe obtained from more than 20 sources.
- HURSAT – tropical cyclone-centric satellite data.
- International Best Track Archive for Climate Stewardship – tropical cyclone data to enable understanding of the distribution, frequency and intensity of tropical cyclones worldwide.
- Optimum Interpolation Sea Surface Temperature (OISST) – global sea surface temperatures from observations from satellites, ships and buoys on a regular global grid.
- Tropical Rainfall Measuring Mission – data from a research satellite on distribution and variability of precipitation within the tropics, and interactions between water vapor, clouds and precipitation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months if based on secondary sources (e.g., to conduct overlay of poverty and exposure data) • High estimate: 1–2 years to conduct extensive study on sectoral, community-focused or place-based climate risks and impacts with primary data collection and analysis, participation of multiple experts and significant stakeholder engagement	• Climate data interpretation – Identify and assess data and information on climate stressors and apply to relevant communities/ecosystems/resources • Sector, community, ecosystem, resource, region – Provide subject matter expertise about the people, communities and ecosystems affected by climate change, the most important risks they face, and the factors that contribute to vulnerabilities and impacts • GIS or spatial planning – Inform the identification of vulnerable communities, ecosystems and resources by mapping climate data and vulnerabilities	• Narrative profiles describing vulnerable communities, ecosystems and resources, and factors that contribute to their vulnerabilities • Maps highlighting vulnerable communities, ecosystems or resources • Vulnerability index based on community, ecosystem and/or resource exposure, sensitivity and adaptive capacity indicators	• Cubango–Okavango River Basin Climate Change Vulnerability Assessment (USAID 2013a) • USAID Southern Africa Regional Environmental Program

Table 20. Understanding what makes certain activity ecosystems, species, natural resources or infrastructure vulnerable

QUESTION: What factors contribute to the exposure and sensitivity of communities, ecosystems or resources to climate variability and change?
OBJECTIVE: Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable

METHODS

Desktop review (using existing data and information):

- Identify which activity-level communities, ecosystems and resources are exposed and sensitive to climate risks; the factors that contribute to exposure and sensitivity and how they may change; and how climate stressors may interact with non-climate stressors:
  - Data and information on past and projected climate risks, vulnerabilities and impacts for specific communities, ecosystems or resources from secondary and peer-reviewed literature, stakeholder consultations, other analyses (e.g., participatory rural appraisals, institutional capacity assessments, livelihoods assessments)
  - Development, demographic, socioeconomic and other data to understand and assess exposure and sensitivity (e.g., Sustainable Development Goals)

Stakeholder consultations: If there are gaps in the results of the desktop review, information on the combined impacts of climate and non-climate stressors is limited, a more nuanced understanding of the factors contributing to exposure and sensitivity is required, and/or information is not available for the specific communities, ecosystems or resources of interest and at the appropriate scale, carry out stakeholder consultations to obtain expert inputs and/or local knowledge and perceptions to:

- Gather local perceptions about exposure and sensitivity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Ground truth desktop review findings about exposure and sensitivity factors, and the relationships between climate and non-climate stressors – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Obtain local (traditional and other) knowledge about the exposure and sensitivity of target communities, ecosystems and resources; examples of other methods that may be relevant are participatory mapping and participatory rural appraisal.
- Understand which factors are the most important contributors to exposure and sensitivity – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders

Additional analysis:

- Hazard, vulnerability or risk mapping, impact modeling, institutional assessment and economic analysis of impacts – for more detailed information regarding which communities, ecosystems or resources are likely to be affected by climate stressors, how and why, to determine target activity sites, communities, ecosystems and specific elements of exposure and/or sensitivity that activities may address
- Geospatial mapping of climate risks and impacts – for a spatial understanding of where climate stressors and vulnerable sites, communities and ecosystems overlap

RESOURCES

Secondary and peer-reviewed literature

- Existing peer-reviewed and other studies about communities', ecosystems' or resources' exposure and sensitivity to climate change (e.g., Vulnerability to Climate Change of Cocoa in West Africa)
- Studies from other regions that have communities, ecosystems or resources with similar characteristics (e.g., Extreme Vulnerability of Smallholder Farmers to Agricultural Risks and Climate Change in Madagascar)

Indicator data

- Sustainable Development Goals – Country- and sector-specific indicators are provided regarding 17 goals for meeting the needs of the world's poorest people.
- International Human Development Indicators Profiles – Country-specific social vulnerability based on the UNDP Human Development Index (HDI). The HDI combines indicators of life expectancy, educational attainment and income.
- Climate Change Knowledge Portal – A web-based tool that provides country-specific indicators of sensitivity, including information on water access, sanitation, land use, wealth, age and agriculture.
- Open Data – A data catalog that provides access to a number of indicators that can be used to assess sensitivity.
- Demographic and Health Survey – A 30+-year record for most developing countries of demographic and health survey information.
- Least Developed Countries Factsheets – Country-specific development statistics for least developed countries that can be used to assess sensitivity.
- Government statistics databases – National and local government websites provide information on development indicators.
- Adaptation Learning Mechanism – Web-based information platform that includes case studies of adaptation.

Sector-specific climate data

- Health – WHO Health and Climate Country Profiles
- Biodiversity – Climate Change Vulnerability Index by NatureServe to identify species that are particularly vulnerable to climate change.
- Agriculture and food security – Climate Change, Agriculture and Food Security – Climate data portal features global and regional future high-resolution climate datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agricultural and livestock production, and ecosystem services and hydrology.
- Food security – Famine Early Warning Systems Network provides access to geospatial data, satellite image products and derived data products in support of FEWS NET drought monitoring efforts throughout the world.
- Extreme events – Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation summarizes scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.
- Extreme events – Global Assessment Report on Disaster Risk Reduction provides a summary of trends of disasters and expected future losses.
- Extreme events – International Disaster Database has data on the occurrence and effects of over 22,000 disasters in the world from 1990 to the present day.

Weather and climate data

- National weather service or related agency – historical trends based on weather station data (e.g., Monthly temperature and precipitation average (1981–2010) from Colombia's National Weather Service).
- Climate Hazards Group InfraRed Precipitation with Station data – historical (30+ years; 1981 to near present) global rainfall dataset available to support drought early warning and environmental monitoring. Data are a combination of satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.
- Climate Impacts: Global and Regional Adaptation Support Platform – web-based climate information service to support decision makers in developing and emerging countries to prioritize adaptation needs; service provides sound knowledge on current and projected climate stimuli, climate impacts and adaptation options at the national, subnational and regional levels.
- Climate Research Unit TS Google Earth Interface – temperature and precipitation data covering the period 1901–2015 and all land areas; data allow half-degree cells to be examined.
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- Climate Wizard – global historical temperature and rainfall maps and global state-of-the-art predictions of temperature and rainfall.
- Data Distribution Center – data sources from IPCC and includes datasets from multiple data centers around the world, including China, Norway, Canada, France, the United States, South Korea and Japan.
- Global Climate Data – historical data derived from three quality-controlled sources as well as future projections based on downscaled GCMs under two scenarios for future economic growth and energy use.
- Global Historical Climatology Network – climate summaries from land surface stations across the globe obtained from more than 20 sources.
- HURSAT – tropical cyclone-centric satellite data.
- International Best Track Archive for Climate Stewardship – tropical cyclone data to enable understanding of the distribution, frequency and intensity of tropical cyclones worldwide.
- Optimum Interpolation Sea Surface Temperature (OISST) – global sea surface temperatures constructed by combining observations from satellites, ships and buoys on a regular global grid.
- Tropical Rainfall Measuring Mission – data from a research satellite to improve understanding of the distribution and variability of precipitation within the tropics, as well as interactions between water vapor, clouds and precipitation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months to review secondary sources; 3 months or more if stakeholder consultations are required. • High estimate: Several months to a year if conducting extensive field-based primary data collection and ground truthing, and/or mapping	• Climate data interpretation – Use climate data and information to relevant communities, ecosystems or resources to evaluate exposure and sensitivity • Sector, community, ecosystem, resource, region – Provide subject matter expertise on factors that contribute to the exposure and sensitivity of the people, ecosystems and resources affected by climate change	• Profiles describing communities', ecosystems' or resources' exposure and sensitivity and the factors that contribute to them • Index based on community, ecosystem and/or resource exposure and sensitivity indicators to enable comparison and inform prioritization • Maps demonstrating where climate stressors intersect with community/ecosystem/resource exposure and sensitivity	• Climate Change Vulnerability Assessment: Lami Town, Fiji – Abridged Report (UN Habitat 2013) • UN Habitat Cities and Climate Change Initiative

Table 21. Analyzing adaptive capacity of activity groups, ecosystems, species, natural resources or infrastructure

QUESTION: What physical, social, institutional, human and financial capacity to adapt to climate change exists and where are the gaps?
OBJECTIVE: Analyze adaptive capacity of activity groups, ecosystems, or species, natural resources or infrastructure

METHODS

Desktop review (using existing data and information):

- Identify the historical occurrence of climate-related events
- Understand how communities, ecosystems and resources have responded in the past to historical impacts, and who was most and least impacted and why
- Data and information on the physical, informational, social and institutional, human, and financial capacities that communities, ecosystems and resources have used to respond to historical impacts from secondary and peer-reviewed literature and other analyses (e.g., participatory rural appraisals, institutional capacity assessments)

Stakeholder consultations: If information on how communities, ecosystems, and resources have responded to past disasters and what capacities they have used is limited, carry out stakeholder consultations to obtain expert inputs and/or local knowledge and perceptions to:

- Understand impacts from specific climate events – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Ground truth desktop review findings about activity-level adaptive capacity – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders
- Obtain local (traditional and other) knowledge on the adaptive capacity of the communities, ecosystems and species that are the focus of the activity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders (Examples of other relevant methods are participatory mapping and participatory rural appraisal.)
- Determine gaps in adaptive capacity and opportunities to strengthen it – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders, policy/decision makers

RESOURCES

Secondary and peer-reviewed literature

- Peer-reviewed and other studies about communities', ecosystems' or resources' adaptive capacity (e.g., Changes in adaptive capacity of Kenyan communities)

Indicator data

- Sustainable Development Goals – Country- and sector-specific indicators are provided regarding 17 goals for meeting the needs of the world's poorest people.
- International Human Development Indicators Profiles – Country-specific social vulnerability based on the UNDP Human Development Index (HDI). The HDI combines indicators of life expectancy, educational attainment and income.
- Climate Change Knowledge Portal – A web-based tool that provides country-specific indicators of sensitivity, including information on water access, sanitation, land use, wealth, age and agriculture.
- Open Data – A data catalog that provides access to a number of indicators that can be used to assess sensitivity.
- Demographic and Health Survey – A 30+-year record for most developing countries of demographic and health survey information.
- Least Developed Countries Factsheets – Country-specific development statistics for least developed countries that can be used to assess sensitivity.
- Government statistics databases – National and local government websites provide information on development indicators.
- Adaptation Learning Mechanism – Web-based information platform that includes case studies of adaptation.

EXAMPLE TIMEFRAME	RELEVANT EXPERTISE	ILLUSTRATIVE OUTPUTS	EXAMPLES
• Low estimate: 1–2 months to review secondary sources; 3 months or more if stakeholder consultations are required • High estimate: Several months to a year if conducting extensive field-based primary data collection and ground truthing	• Sector, community, ecosystem, resource, region – Provide subject matter expertise about the physical, informational, social and institutional, human, and financial adaptive capacity of the people, ecosystems and resources affected by climate change • GIS or spatial planning – Map climate data and adaptive capacity indicators to understand distribution of adaptive capacity and compare across communities/ecosystems/resources	• Profiles describing physical, informational, social and institutional, human, and financial adaptive capacity • Index based on indicators of physical, informational, social and institutional, human, and financial adaptive capacity to enable comparison	• Climate Change Vulnerability Assessment: Port Moresby, Papua New Guinea – Abridged Report (UN Habitat 2013) • UN Habitat Cities and Climate Change Initiative

EXAMPLES OF CLIMATE VULNERABILITY ASSESSMENT PROCESSES

To illustrate the mapping of methods to CVA objectives, this section offers examples of CVA processes at the strategy and project levels. Additional examples can be found in Appendix A.

EXAMPLE 1: STRATEGY DESIGN IN GHANA

Ghana Climate Change Vulnerability and Adaptation Assessment (USAID 2011a)

Purpose

The purpose of the Ghana Climate Change Vulnerability and Adaptation Assessment was to inform USAID programming in Ghana by providing an overview of climate change projections and an analysis of the expected impacts of climate change on natural resources and human populations.

Objectives

The objectives of the Ghana CVA were to:

- Identify and understand historical and projected climate risks at the country level, and
- Evaluate sectoral climate risks to inform sector planning.

Questions

- What are the historical trends in climate?
- What are the projected changes in climate to 2080?
- What are the potential impacts of climate change on agricultural systems?
- How is climate change expected to affect fisheries and other marine resources?
- How is climate change expected to affect human populations?

Methods, data and information, and outputs

The methods, data and information sources, and outputs used in the Ghana CVA are summarized in Table 22.

Table 22. Summary of methods used in the USAID Ghana strategy-level climate vulnerability assessment

Objective	Methods	Sources	Output
Identify and understand historical and projected climate risks at the country level	Desktop review of secondary sources	• Country-level climate data summary report for Ghana prepared for UNDP National Communication Support Programme. • A report prepared by Ghana's Environmental Protection Agency and Meteorological Agency that used existing climate data (1961–2000) to analyze historical trends and model scenarios for future climate, including temperature, rainfall, sea level rise and sea surface temperatures. • Climate data summaries and climate change scenarios developed for each eco-climatic zone by Ghana's Environmental Protection Agency and Meteorological Agency.	• Description of Ghana's general climate
	Desktop review of two primary and several secondary sources	• Country-level climate data summary report for Ghana prepared for UNDP. • Climate data summaries and climate change scenarios developed for each eco-climatic zone by Ghana's Environmental Protection Agency and Meteorological Agency. • Peer-reviewed analysis of trends in rainfall in Ghana.	• Climate trends and modeled climate change (See Figure 5.): - Temperature projections - Precipitation projections - Sea level projections - Climate variability
	Collection of primary data	• Data from seven weather stations.	
	Additional analysis: Modeling future climate	• Projections of climate and rainfall modeled using data from seven weather stations. Models were run to project potential change in temperature and percentage change in rainfall for the dry and wet seasons at each station.	
	Stakeholder consultations: Interviews	• Local stakeholders (e.g., fishermen, farmers).	• Perceptions of climate trends
Evaluate sectoral climate risks to inform sector planning	Desktop review of secondary sources	• Peer-reviewed studies and technical reports on relevant sectors (agriculture, livestock and fisheries), non-climate stressors, and climate impacts in Ghana, more broadly in Africa, and globally.	• Description of Ghana's agriculture sector, climate impacts and non-climate stressors (land tenure issues, deforestation, population density, land overexploitation, hydroelectric development) • Soil-crop suitability maps and tables • Profiles and distribution maps for major crops
	Stakeholder consultations: Interviews	• Local stakeholders (e.g., fishermen, farmers).	

Objective	Methods	Sources	Output
			• Profiles summarizing climate risks, vulnerabilities and impacts on agriculture and fisheries • Adaptation options for agriculture
	Desktop review of secondary sources	• Peer-reviewed studies and technical reports on climate change and social vulnerability literature to identify variables and select indicators for index.	• Social vulnerability index based on socioeconomic variables (See Figure 6.) • Social vulnerability map by district and ecological zone (based on index) (See Figure 7.)
	Additional analysis: Statistical approach to assign a vulnerability score to each district, and use of ArcGIS software to map index values	• Data from Ghana's 2000 Population and Housing Census.	

Timeframe

The in-country consultation of the Ghana CVA was conducted over a two-week period. Preparation of the report, which is summarized in Table 22, included collecting geospatial and demographic data from national agencies and electronic public sources, as well an extensive literature review, and took six months to complete.

Expertise

Seven members of the United States Forest Service (USFS) and Ghanaian counterparts comprised the assessment team. One team member served as the team lead; another was in charge of in-country coordination. The other members were experts in climate change, social science, natural resources, biology, fisheries and aquatic ecology.

In addition to their own expertise, the team drew on inputs from more than 100 experts and stakeholders from three different regions including government officials, nongovernmental organizations (NGOs) and the private sector. Among these stakeholders were oil and gas managers, conservation biologists, economic growth officials, natural resource managers, academics, health and agriculture advisors, park managers and many others. Figures 5 to 7 are examples of the outputs from the final report.

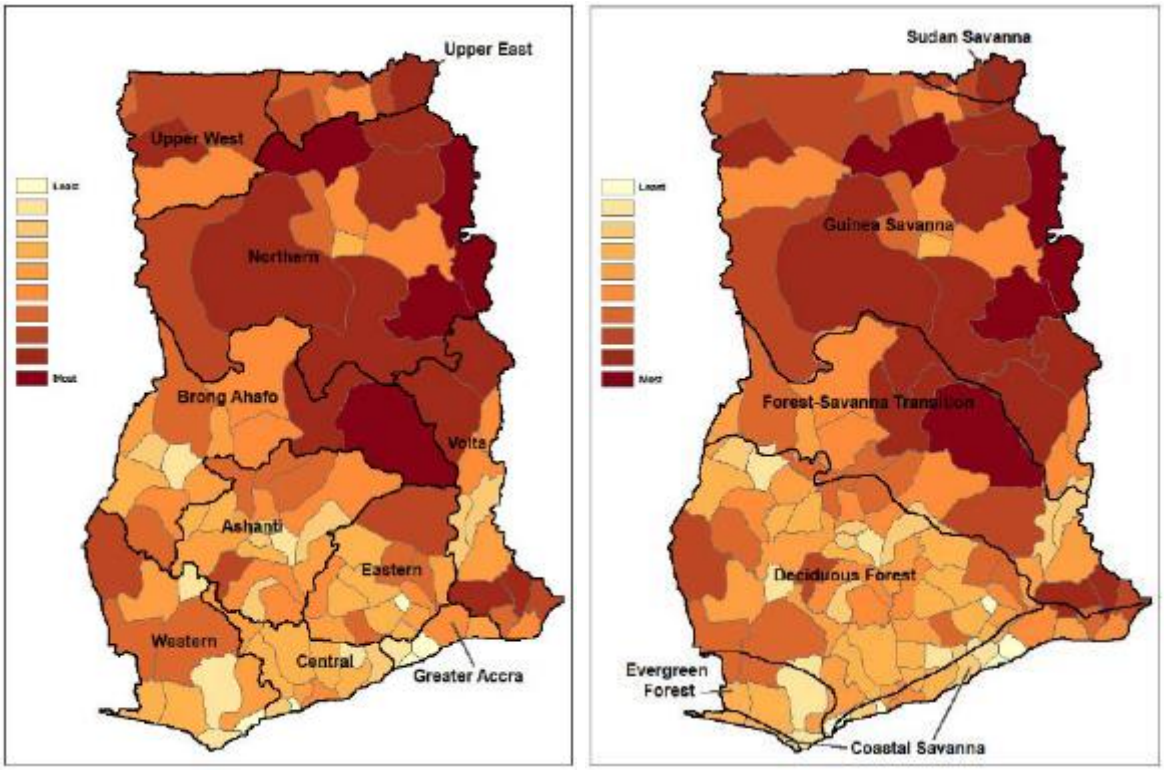
Figure 5. Potential change in temperature and precipitation for the Tamale region, Ghana

Tamale		Dry Season				Wet Season			
		B1	A1B	A2	Mean	B1	A1B	A2	Mean
2050 Temperature	Mean	1.65	2.32	2.17	2.05	1.49	2.06	1.99	1.84
	Std Dev	0.56	0.63	0.88	0.75	0.39	0.40	0.39	0.46
	Min	0.47	0.97	-0.34	-0.34	0.68	1.30	1.23	0.68
	Max	2.43	3.16	3.46	3.46	2.31	2.92	2.74	2.92
2080 Temperature	Mean	2.31	3.36	3.86	3.18	2.01	3.00	3.49	2.83
	Std Dev	0.66	0.86	1.35	1.18	0.55	0.72	0.74	0.91
	Min	1.37	2.01	0.20	0.20	0.85	1.61	1.86	0.85
	Max	3.65	4.80	5.94	5.94	3.25	4.65	5.01	5.01
2050 Precipitation	Mean	14.50	11.25	23.63	16.46	-1.88	-2.13	-0.38	-1.46
	Std Dev	30.32	23.32	31.36	28.44	8.52	11.16	11.67	10.35
	Min	-47.00	-21.00	-26.00	-47.00	-20.00	-19.00	-19.00	-20.00
	Max	63.00	48.00	78.00	78.00	12.00	26.00	21.00	26.00
2080 Precipitation	Mean	15.63	33.13	33.38	27.38	-1.44	-1.88	-3.25	-2.19
	Std Dev	29.19	43.41	52.18	42.58	11.87	16.91	17.31	15.25
	Min	-28.00	-39.00	-53.00	-53.00	-28.00	-36.00	-31.00	-36.00
	Max	73.00	139.00	173.00	173.00	22.00	32.00	31.00	32.00

Figure 6. Selection of indicators in social vulnerability index

Indicator	Description	Data source and year	Impact on vulnerability	Relevance for climate change social vulnerability	Other studies using this (or something similar) as an indicator of climate change social vulnerability
Ability to survive crisis	The percentage of total households within a district that felt either "somewhat" or "very" insecure about their ability to withstand any crisis	Ghana 2003 Core Welfare Indicators Questionnaire Survey Report: Statistical Abstract, Ghana Statistical Service (hereafter, CWIQ II)	High percentage increases vulnerability	Households that already feel insecure about their ability to withstand even a short-term crisis are likely to be equally unable to weather long-term threats to their livelihoods, or have enough extra capital to invest in necessary adaptation measures.	Brooks et al., 2005 Eriksen et al., 2007
Agricultural employment	The percentage of the district's total population > 15 years of age that is engaged in agriculture-related employment (including hunting and forestry related activities).	2000 Population and Housing Census, Analysis of District Data and Implications for Planning, Ghana Statistical Service (hereafter 2000 Census)	High percentage increases vulnerability	Agriculture is an especially climate-sensitive economic activity. Agricultural employment is likely to underestimate the extent to which a district depends on agriculture. However the higher the agricultural employment, the more a district will be impacted by disruptions in production due to changing environmental conditions. Reduced production will cause a similar reduction in disposable income. High agricultural employment also suggests a lack of other employment options, and therefore few opportunities for failing farmers to earn additional income through other economic pursuits (O'Brien et al., 2004b). People are more likely to fail to secure their needs in a time of crisis when they are restricted to a single sector for employment (Eriksen et al., 2007).	Social Vulnerability for Environmental Hazards, 2000 (USC) Brooks et al., 2005 O'Brien et al., 2004a Eriksen et al., 2007 Adger et al., 2004

Figure 7. Social vulnerability to climate change in Ghana by district (left) and by ecological zone (right)



EXAMPLE 2: PROJECT DESIGN

Vulnerability and Resilience to Climate Change in Western Honduras **(**USAID 2014b)

Purpose

The purpose of the CVA was to assess the impact of climate change and variability on social and ecological systems of the Honduran region and departments receiving Feed the Future programming support.

Objective

The objectives of the Honduras CVA assessment were to:

- Screen for climate risks
- Examine the sensitivity of communities, ecosystems and other resources
- Evaluate sectoral climate risks to inform project design, and
- Analyze the adaptive capacity of communities, ecosystems or resources.

Questions

- What are the climate historical trends and future projections in Western Honduras?
- What is the sensitivity of ecological systems in Western Honduras to climate variability?
- How might climate projections affect livelihoods and ecosystems in the region?
- What existing and potential adaptive responses can be integrated into USAID, Government of Honduras and other donor programming in Western Honduras to strengthen the resilience of livelihoods and ecosystems to climate-related impacts?

Table 23. Summary of methods used in the USAID Honduras project-level climate vulnerability assessment

Objective	Methods	Sources	Output
Screen for climate risks	Desktop review of secondary sources	• Fifth Assessment Report of the IPCC projections for Central America • World Bank's Global Historical Climatology Network	• Description of Western Honduras' general climate (See Figure 8.) - Temperature patterns - Precipitation seasonality and rainfall anomalies - Major climate disturbances
	Additional analyses: • Subregional comparison and trend analyses • Department-level characterizations • Validation of precipitation observations	• High-resolution precipitation measurements of the satellite-borne Tropical Rainfall Measuring Mission radar • Berkeley Earth Project data series • World Bank's Global Historical Climatology Network • Data from weather stations from Dirección General de Recursos Hídricos	• Climate change trends and predictions - Temperature trends and projections - Precipitation trends and projections (totals and seasonality) (See Figure 9.)
Examine the sensitivity of communities, ecosystems, and other resources	Desktop review of primary and secondary sources	• Peer-reviewed studies and technical reports on climate change impacts on water resources • Moderate Resolution Imaging Sectroradiometer (MODIS) land cover and land use observations	• Eco-hydrological vulnerability index (See Figure 10.) • Description of possible effects on water resources in Western Honduras
	Stakeholder consultations: Interviews and focus group discussions	• Stakeholder interviews; Interview list not provided in report	
	Additional analysis: Land use data observations	• Moderate Resolution Imaging Spectroradiometer (MODIS) land cover and land use observations	
	Desktop review of secondary sources	• IPCC Fifth Assessment Report • Peer-reviewed studies	• Descriptions of protected areas • Climate envelope diagram of ecosystems in Honduras
	Stakeholder consultations: Interviews and focus group discussions to identify threats that are degrading protected areas	• Stakeholder interviews; Interview list not provided in report	
Evaluate sectoral climate risks to inform project design	Desktop review of secondary sources	• Peer-reviewed studies and technical reports	• Narrative profiles of climate change impacts on crops - Impacts on crop productivity - Impacts on common pests and diseases that affect crops
	Stakeholder consultations: Interviews and focus group discussions	• Farmers and institutional stakeholders	

Objective	Methods	Sources	Output
			• Comparison of the extent of climate-related risk and vulnerability by crop value chain (See Figure 11.)
	Desktop review of primary and secondary sources	• Most recent census data from the Instituto Nacional de Estadística • Women's Empowerment in Agriculture Index • Peer-reviewed studies and technical reports	• Narrative profiles of climate change on livelihoods • Social-ecological vulnerability index of selected subwatersheds (See Figure 12.)
	Stakeholder consultations: Focus group discussions	• Farmers and institutional stakeholders	
Analyze the adaptive capacity of groups, ecosystems, species or resources	Stakeholder consultations: Focus group discussions	• Farmers and institutional stakeholders	• Narrative profile of adaptive capacity of farmers, including frequency of adoption of adaptive practices (See Figure 13.) • List of actions implemented by local agricultural and environmental management institutions to respond to climate-related impacts • Description of institutional capacity gaps

Timeframe

The Western Honduras CVA was conducted in 2014; the duration of the effort was approximately 11 months.

Expertise

A team of eight experts in eco-hydrology, livelihoods, protected areas, phenology, value chains, watershed management and climate conducted the vulnerability assessment.

In addition to the team's expertise, the CVA incorporated input from approximately 70 experts and stakeholders from academic institutions, government, international organizations and others, representing more than 15 municipalities. The team also gathered input from dozens of farmers and community organization representatives. Figures 8 to 13 are elements from the final report.

Figure 8. Narrative profile of climate of Western Honduras

General climate characteristics of Western Honduras

- There is strong seasonality with an annual cycle featuring four distinct seasons.
- Western Honduras falls in the east-west oriented dry corridor of Honduras and adjacent Guatemala, with higher rainfall in areas to both the North and the South.
- Temperature is strongly related to elevation.
- Mountains, valleys, and land use are controlling factors in local climatological behavior, creating complex sub-regional variations in mean conditions.

Figure 9. Magnitude of change in rainfall (%) between 1988 and 2013 developed regression statistics for each 27 x 27km pixel with grid cells colorized according to magnitude in 10 percent increments

Figure 10. Eco-hydrological vulnerability index of selected subwatersheds

Sub-Watershed Name	PLCI	Water Production Potential (Hm^3/km^2)	Eco-Hydrological Vulnerability Index	Eco-Hydrological Vulnerability Ranking
Grande de Otoro	0.80	0.44	0.352	8
Mejocote	0.78	0.24	0.187	6
Palagua-Goascoran	0.72	0.15	0.108	3
San Juan-Lempa	0.67	0.14	0.094	2
El Venado-Lempa	0.65	0.12	0.078	1
Gualcarque	0.64	0.44	0.282	7
Higuito	0.55	0.21	0.116	4
Mocal-Lempa	0.45	0.32	0.144	5

Figure 11. Comparison of the extent of climate-related risk vulnerability by crop value chain

Value Chain Stage	Vulnerability	Coffee	Maize	Beans	Potato	Lettuce
Production	Rising temperature threatens suitability for production	++	+++	+++	++	++
	Falling soil fertility reduces yields and makes crop more vulnerable to climatic stresses	++	+++	+++	+++	+
	Poor moisture retention capacity of soils increases vulnerability to precipitation variability	++	+++	+++	++	+
	Pests and diseases increasing with rising temperatures	+++	+++	+++	+++	+++
	Shortages of disease-free planting material, exacerbated by unreliable precipitation	++	+++	+++	+++	0
Marketing and Value Addition	High temperatures and unseasonable rain promote rapid spoilage and threaten quality	+++	++	+	+++	+++
	Climate-related events reduce supply and affect local prices	+++	+++	+++	+++	+
Transport	Extreme precipitation events and flooding affect the state of the roads. Communities without access to roads. Transport is more costly and difficult.	++	+	+	++	+++

Figure 12. Social-ecological vulnerability index of selected subwatersheds

	Social Vulnerability (÷)				Ecological Vulnerability	=	
Sub-watershed	**Pop. Density (P/km²)**	**Poverty Index**	**HDI**	**Social Vulnerability Index**	**Eco-Hydrological Vulnerability Index**	**Social-Ecological Vulnerability Index**	**Social-Ecological Vulnerability Ranking**
Grande de Otoro	97	0.402	0.647	60.27	0.352	171	8
Mejocote	68	0.474	0.596	54.08	0.187	289	5
Palagua-Goascoran	43	0.405	0.635	27.43	0.108	254	6
San Juan-Lempa	58	0.454	0.576	45.72	0.094	487	2
El Venado-Lempa	79	0.446	0.620	56.83	0.078	729	1
Gualcarque	82	0.399	0.623	52.51	0.282	186	7
Higuito	90	0.331	0.610	48.84	0.116	422	3
Mocal-Lempa	66	0.461	0.587	51.83	0.144	360	4

Figure 13. Adaptive practices

Adaptive Practices	Frequency of Adoption
Selection and adoption of local varieties that are more resistant to drought and pests/diseases	+++
Adoption of drip irrigation	+
Adoption of "*cero quema*" to address issues of soil erosion and land degradation	+
Shifting of planting dates; no longer does planting occur on May 3rd (as it did previously) – it now takes place in June or July	+++
Adoption of metal silos for post-harvest storage of maize	+++
Diversification of livelihoods both within and outside of agriculture	+
Higher density planting for maize, beans, and coffee	+++
Soil conservation (contour lines, planting against the slope, live barriers)	+
No-till systems	++
Creation of and participation in *cajas rurales*	+++
Protected agriculture (use of greenhouses, etc.)	+
Participatory investigation, farmer-to-farmer, to identify and learn management practices that reduce impacts of drought and heavy-precipitation events	+
Migration	++
Creation of local emergency committees (CODELES)	+++
Community grain storage	+
Agroforestry systems	+
Key: +: less frequently adopted ++: somewhat frequently adopted +++: widely adopted	

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APPENDIX A: CLIMATE VULNERABILITY ASSESSMENT EXAMPLES

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
STRATEGY DESIGN						
Climate Change Vulnerability Mapping for Southeast Asia (Yusuf and Francisco 2009) **Economy and Environment Program for Southeast Asia (EEPSEA), supported by the International Development Research Centre, Swedish International Development Cooperation Agency and the Canadian International Development Agency**	What subnational areas (regions, provinces or districts) of Southeast Asia are most vulnerable to climate change? What is the sensitivity and adaptive capacity of each area?	Identify and characterize vulnerable communities and sectors identified as priority concerns by the participants of the EEPSEA Climate Change Adaptation Conference held in Bali in February 2008.	***Desktop review and stakeholder consultations*** Overlaid climate hazard maps, sensitivity maps and adaptive capacity maps following the IPCC vulnerability assessment framework; constructed an index of the climate change vulnerability of subnational administrative areas in seven countries in Southeast Asia (Vietnam, Laos, Cambodia, Thailand, Malaysia, the Philippines and Indonesia); used historical records of climate-related hazards, climate hazard maps and population density.	***Historical data of climate-related hazards*** (no projections). Droughts, floods and cyclones data: Peduzzi, Dao and Herlod (2005). Exposure to landslides: Norwegian Geotechnical Institute and Shuttle Radar Topography Mission elevation data. Inundation from sea level rise: Centers for the Remote Sensing of Ice Sheets (CReSIS) University of Kansas and Global Land One-Km Base Elevation (GLOBE) Digital Elevation Model.	***Report, vulnerability index, vulnerability maps*** to produce information for regional policy makers and donors in better targeting support to climate change efforts: 1. To identify which subnational areas/units (regions, provinces or districts, depending on the availability of the data) of Southeast Asian countries (Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and Philippines) are the most vulnerable to climate change. 2. To show these vulnerable areas in a map for ease of reference of interested parties.	Environmental and resource economics specialist, climate change vulnerability experts, economics and development researcher. Timeframe: February 2008–January 2009

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Environment and Climate Change Assessment (2013) **International Fund for Agricultural Development (IFAD)**	What are the potential impacts of climate change on the agriculture and rural development sectors?	Inform IFAD's 2013–2018 country strategic opportunities program (COSOP) for Nepal	***Desktop review.*** Builds on the findings of an International Centre for Integrated Mountain Development assessment.	***Historical data and projections.*** Information gathered from peer-reviewed and other publications, including IPCC 2011 report, government reports, etc.	***Report, vulnerability map and indexes (sourced from previous reports)***. Inputs for IFAD's 2013–2018 COSOP for Nepal.	Agricultural economist, agricultural climate impacts specialist, community-based study specialist. Timeframe: not specified
Climate Change Risk and Vulnerability Assessment for Rural Human Settlements (Linkd 2013) **Department of Rural Development and Land Reform, South Africa**	How can changing precipitation patterns affect crops? How can sea level rise and ocean acidification and warming impact coastal areas? How can climate change alter the risk of wildfires? What is the adaptive capacity of the provinces?	Identify and understand the factors that increase climate change risks for rural human settlements in South Africa and identify areas in which spatial modelling of risks and vulnerability can be improved or needs to be updated.	***Desktop review and stakeholder consultations.*** Local spatial modelling of key indicators in relation to the environmental risks and social vulnerabilities – from local sources. Presentations on risk and vulnerability were prepared and delivered in four regional workshops, the results of which then informed report drafting.	***Historical data and projections.*** Models of climate change impacts on flooding, drought and rainfall patterns from the report. A 2011 Perspective on Climate Change and the South African Water Sector. Models for extreme weather events based on IPCC AR5. Recommends the following sources from South Africa: Statistics South Africa, Digital Census Atlas, University of Cape Town Climate System Analysis Group (CSAG), Climate Information Portal,	***Report, vulnerability maps.*** The national assessment of environmental risk for rural human settlements serves as a broad framework under which more regional and local planning can take place and as a tool for provincial and local governments to understand the environmental risks for rural settlements within their own localities.	Spatial planning expert, climate change impact modeler, climate change risk and vulnerability assessment expert. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
				CSIR Geospatial Analysis Platform. Indicators to analyze hazard exposure.		
Framework for Adaptation to Climate Change in the City of Cape Town (2006) **CSAG-UCT, Energy Research Center-UCT**	How can climate change affect urban water supply, biodiversity, wildfires, coastal zones, livelihoods and health? What adaptation initiatives are currently in place?	An overarching framework for a city-wide consolidated and coordinated approach to reducing vulnerability to climate impacts.	***Desktop review.*** Analysis of available literature for climate impacts (e.g., South African Climate Change response strategy, 2004) – > desktop assessment of current and future vulnerability (no stakeholder consultation or assessment) of city's capacity).	***Historical data and projections.*** Historical precipitation from Hewitson et al. (2005).	***Report, vulnerabilities by sector.*** Climate trends and projections for the Western Cape; sectoral analysis of current and future impacts inputs for a city-wide Adaptation Plan of Action.	Two authors from the Energy Research Centre and Climate Systems Analysis Group at the University of Cape Town Timeframe: not specified
Sea level rise adaptation strategy for San Diego Bay: Executive Summary (2012) **ICLEI–Local Governments for Sustainability**	What impacts can sea level rise have on the coastal zone? What is the long-term risk of inundation? What are the most vulnerable sectors, assets, ecosystems and populations?	Develop common assumptions and consensus-based recommendations that should form the basis of the region's climate adaptation planning going forward.	***Desktop review, stakeholder consultations.*** Modeling, mapping, and intensive consultation with the project's Technical Advisory Committee.	***Sea level rise projections:*** State of California, Sea Level Rise Task Force of the Coastal and Ocean Working Group of the California Climate Action Team. Sea Level Rise Interim Guidance Document.	***Report, vulnerability maps.*** Vulnerability assessment that evaluates how community assets could be impacted by sea level rise, and recommendations for building the resilience of those community assets.	Project work included 1,500 volunteer hours from landscape architects and students, the steering committee, the stakeholder working group and a Technical Advisory Committee. Project partners: ICLEI, The San Diego Foundation, Tijuana River National Estuarine Research Reserve Coastal Training Program. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Vulnerability Assessment for Focal Resources of the Sierra Nevada (2014) **US Forestry Service (USFS), California Landscape Conservation Cooperative (EcoAdapt)**	What are the most vulnerable ecosystems and species to climate change? What is their level of exposure to climate change? What is their sensitivity and adaptive capacity?	Identify how and why focal resources (ecosystems, species populations and ecosystem services) across the Sierra Nevada are likely to be affected by future climate conditions.	***Stakeholder engagement, desktop review.*** Focal resources identified by USFS or by Sierra Nevada stakeholders. Vulnerability Assessment Workshop using model based on the Northeast Association of Fish & Wildlife Agency Habitat Vulnerability Model.	***Historical data and projections.*** Historical projections based on Parameter elevation Regression on Independent Slopes Model (PRISM) data; future projections developed using two global coupled ocean-atmospheric climate models, the Geophysical Fluid Dynamics Laboratory and Parallel Climate Model, based on IPCC business as usual A2 emissions scenario.	***Report, quantitative rankings*** Intended to help managers develop and prioritize adaptation strategies to conserve resources. Information used to inform the development of regional climate change adaptation strategies for a smaller set of resources in Climate Change Adaptation Strategies for Focal Resources of the Sierra Nevada (2013).	Forestry professionals, landscape conservation specialist, biologist and climate exposure assessment specialist. Partners: Participants in the stakeholder advisory committee (federal and state agencies, NGOs, universities, and other groups), science advisory group and vulnerability assessment workshop. Timeframe: 1 year
Sea Level Rise Vulnerability Assessment for the State of Delaware (2012) **Delaware Sea Level Rise Advisory Committee and Department of Natural Resources and**	What areas are exposed to inundation due to sea level rise? What assets or resources are exposed to inundation? Which natural resources are exposed to sea level rise and changes in salinity? What are the	Investigate Delaware's vulnerability to sea level rise Analyze and assess potential impacts of sea level rise to 79 statewide resources, from roads to wetlands to tourism	***Desktop review, stakeholder consultation (including public engagement).*** Identify resources of concern, then data collection, exposure assessment, impact assessment, public engagement and risk assessment	***Historical data.*** Tide gauge information available from NOAA (National Oceanic and Atmospheric Administration). Based on historical data, Sea Level Rise Technical Workgroup recommended three planning scenarios.	***Report, vulnerability map.*** To be used for the Adaptation Planning Phase, in which governments, businesses and citizens can adapt their policies and business practices to reduce the impact of sea level rises on the state's citizens, economy and natural resources. Sea	Delaware's Sea Level Rise Advisory Committee and staff of the Delaware Coastal Programs section of the Dept. of Natural Resources and Environmental Control – environmental scientists, planners, program manager, and environmental

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Environmental Control	potential social, economic and environmental impacts of sea level rise?				Level Rise Advisory Committee will not oversee implementation of adaptation measures.	engineer. Partners: Sea Level Rise Advisory Committee. Timeframe: November 2010–July 2012
Summary Report: City of Benicia Climate Change Vulnerability Assessment and Adaptation Plan (2015) **ICF**	Which current hazards could be exacerbated by climate change? What areas are more likely to be inundated due to sea level rise and future storms? What community facilities and services are exposed to flooding and sea level rise? What are the potential impacts of climate change on the transportation sector, natural habitats, health services and energy provision?	Identify actionable adaptation measures that are sustainable, equitable, economically viable, cost-effective and where feasible, able to be integrated into existing and future city plans.	***Desktop review, stakeholder consultations.*** Based on San Francisco Bay Conservation and Development Commission's Adapting to Rising Tides project, which had NOAA support. California Ocean Protection Council 2013 sea level rise planning guidance projections and public sea level rise mapping tools. Vulnerability and Risk Assessment framework (exposure, sensitivity, adaptive capacity). Input from asset managers, academic literature, expert judgment of the consultant team.	***Historical data and projections.*** Temperature projections derived from the World Climate Research Programme's Fifth Coupled Model Intercomparison Project (CMIP5) existing datasets. Sea level rise projections from California Ocean Protection Council and publicly available sea level rise mapping tools (NOAA Digital Coast Sea Level Rise Viewer and Climate Central's Surging Seas Tool). To determine effects on coastal flooding, FEMA study of average water level depths.	***Report, vulnerability maps, identification of exposed assets.*** Inputs for Adaptation Plan.	Consultants, City staff. Partners: Technical Advisory Committee and Community Advisory Group. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Xeni Gwet'in Community-based Climate Change Adaptation Strategy (2011) **Ecolibrio (consulting firm) under the Indian and Northern Affairs Canada adaptation program**	What are the expected biophysical impacts of climate change on wildlife, vegetation and fisheries? How will water resources be affected as a result of increased snowmelt and loss of glaciers? How can food supply, shelter and infrastructure be impacted? What are the potential impacts of climate change on governance structures?	Improve community knowledge of climate change and climate adaptation, to come up a number of adaptation recommendations, which covered biodiversity conservation, food security, water conservation, livelihood diversification, shelter and infrastructure improvements, and health and safety.	***Desktop review, stakeholder consultations.*** The main framework was provided by Centre for Indigenous Environmental Resources' Community Adaptation Framework (manuals), which was complemented by the Climate Vulnerability and Capacity Analysis Methodology used by CARE International and the Tyndall Group's vulnerability assessment framework (WEHAB+).	***Historical climate data, computer modeling*** used to develop projections. Climate data by ClimateBC. Future climate projections based on the Canadian Global Circulation Model version 2 (CGCM2) as defined by IPCC.	***Report, maps conveying bio-geoclimatic changes.*** Adaptation recommendations and adaptation plan that community started implementing.	Sustainable development consultancy, tribal representatives. Timeframe: 10 months
Analysis of vulnerability and adaptation strategies to the variability and climate change in the Cuenca Canton (2105) **World Bank**	What species could be at increased risk of extinction due to climate change? How can climate change increase the risk of flooding? What regions are most vulnerable to climate change?	Identification and prioritization of areas where impacts from climate change and variability will be most severe and where institutional coordination for government intervention is needed. Also, to determine adaptation strategies to increase ecosystem and human resilience.	***Desktop review, stakeholder consultations.*** Literature review; climate trends analysis and GIS analysis; preliminary socio-environmental vulnerability analysis; dialogue with local experts	***Historical data and projections.*** Trends were identified based on data from 20 weather stations from inside and around the basin. Future projections were collected from previous studies (Muñoz 2010)	Analysis used for preliminary mapping of sensitivity, adaptive capacity, and socio-environmental vulnerability for the canton; four priority strategies for the canton (municipal government and environmental management commission)	Collaboration between the World Bank and the Municipality of Cuenca, promoted under the leadership of the "Commission of Environmental Management." Timeframe: not specified.

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Ghana Climate Change Vulnerability and Adaptation Assessment (USAID 2011a) **USAID**	What are the potential impacts of climate change on agricultural systems? What regions are most vulnerable to climate change-associated desertification? How could climate change impact fisheries and other marine resources? How could climate change affect human populations?	To identify opportunities for incorporating or "mainstreaming" climate change, climate variability, vulnerability and adaptation into USAID programming in Ghana.	***Desktop review, stakeholder consultations.*** Interviews, geospatial data collection from agencies/public sources, literature review.	**Historical data and climate projections**. Report prepared for the UNDP's National Communication Support Programme, which used existing climate data (1960–2003) to characterize Ghana's observed and projected climate. A report prepared by the Environmental Protection Agency and Ghana Meteorological Agency, which used existing climate data (1961–2000) to analyze historical trends and model scenarios for future climate, including temperature, rainfall, sea level rise, and sea surface temperatures.	Options for interventions by sector.	US Forest Service scientists and Ghanaian counterparts. Timeframe: 2 weeks
Vulnerability and Impacts Assessment for Adaptation Planning in Panchase Mountain Ecological Region (PMER). (2015)	Which wards are more vulnerable to climate change risks? How are subwatersheds vulnerable to climate change?	Presentation of the tools and methods of a vulnerability and impacts assessment of both climatic and non-climatic changes on ecosystem services and community livelihoods in the PMER.	***Desktop review, stakeholder consultations.*** Literature review, regional and local shared learning dialogues, consultations with key informants, questionnaire for wards.	Data from three meteorological stations in the study area and eight from the surrounding area (Department of Hydrology and Meteorology). Extrapolated triangulation from	Recommendations.	Authors from Institute for Social and Environmental Transformation (ISET) – International, forestry experts and researchers. Implemented by Ministry of Forest and Soil

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
IUCN, UNEP, UNDP	Which ecosystem services are at risk as a result of climate change?			historical climate trends. Local perceptions.		Conservation, Department of Forests. Timeframe: not specified
Ecosystem based adaptation in Mt. Elgon Ecosystem (2013) **UNDP, IUCN, UNEP, Government of Uganda**	What are the potential implications of climate risks for local communities? Which communities are at highest risk of flooding due to climate change? Which sites are at highest risk of drought as a result of climate change? What are the potential impacts of climate change on water sources? Which ecosystem services are at risk as a result of climate change?	Articulate past and forecast future climate variability in the Mt Elgon ecosystem and thereafter recommend strategic priorities for monitoring and management of adaptation options.	***Desktop review, stakeholder consultations.*** Review of archives, expert opinions, community consultations.	Data from online sources and Intergovernmental Authority on Development (IGAD) EumetCast eStation in Nairobi. Landsat imagery.	Conclusions and recommendations.	Consortium of 11 experts from National Forestry Resources Research Institute and the School of Forestry, Environmental and Geographical Sciences of Makerere University. Timeframe: 6 months

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Protecting Health from Climate Change in Albania – Vulnerability Assessment Report (WHO 2011) **WHO, part of project "Protecting health from climate change in southeast Europe, central Asia and the Russian North"**	What are the potential health impacts of heat waves, droughts and fires, floods and coastal erosion that are expected to occur as a result of climate change? Which diseases can emerge as a consequence of ecosystem degradation and a warming climate?	Evaluate the progress of national developments in all areas related to environmental issues and climate changes in Albania, including a detailed analysis of hydro-meteorological challenges, extreme weather events including floods, droughts and fires, air quality issues, as well as major problems and challenges pertinent to environmental pollens and vectors.	***Desktop review and stakeholder consultations***. Analysis of documents, reports and policy papers. Mainly based on grey literature (health reports, strategies, working documents from government institutions).	***Historical data and projections.*** Historical data – temperature, precipitation, wildfires from Nuri (2002). Projections taken from IPCC AR4.	***Report***. Inputs to the forthcoming strategy on climate change in Albania.	Key experts and health professionals operating at the Albanian Ministry of Health, the National Institute of Public Health, Regional Health Directorates, as well as university professors from Tirana University and other academic institutions in Albania. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Vulnerability Assessment for Boeung Chhmar (2014) **IUCN (Mekong Water Dialogues Program)**	How can changes in hydrology impact wetland habitats? What changes in physical and ecological processes are expected as a result of changing precipitation and temperature patterns? How will the different habitats be affected?	Complement IUCN livelihood assessments near Boeung Chhmar as a part of developing the management plan for the Ramsar site, by identifying climate threats to the biodiversity, ecosystem services and livelihoods and to develop adaptation and management measures to ensure the continued existence of the wetland, its biodiversity and ecosystem services.	***Desktop review, stakeholder consultations.*** Guidance provided for the Mekong River Commission's case studies on climate change vulnerability of Mekong wetlands, the VCA analysis for community vulnerability, and the ICEM Climate Change Vulnerability Assessment and Adaptation. Climate change threat profiles for Kampong Thom province were taken from the USAID Mekong ARCC study.	GCMs by IPCC. Data from peer-reviewed articles (Kummu et al 2011, Cai et al 2008, Eastham et al. 2009). Local perceptions of trends.	A vulnerability assessment of the impacts of climate change on the Ramsar site at Boeung Chhmar.	Vulnerability assessment specialists, rangers, community leaders, wetland and coastal zone expert and regional species experts. Timeframe: not specified
Water Resources in South Asia: An Assessment of Climate Change Associated Vulnerabilities and Coping Mechanisms (Final Report) (2004) **Asia-Pacific Network for Global Change Research**	What are the impacts of climate variability and extreme hydrological events on water resources? What are the socioeconomic impacts of climate change and variability and extreme hydrological events? How are water resources vulnerable to climate change?	Study the climate change in the participating countries of the region during the last century and trends for the next 25 years, the impact of climate change on water resources and the incidence of extreme events.	***Desktop review, stakeholder consultations.*** Surveys, country-level case studies, workshops.	National data sources (meteorological departments and central water resources development organizations). Historical climate records from selected weather stations. Trends were projected for 2020 and 2050.	Stakeholder meetings, including: • Inputs to national development strategies • Final report dissemination • Capacity-building meetings	Climate scientist, hydrologist, water resource manager, climate adaptation specialist and development specialist. Timeframe: 3-year project

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Vulnerability and Impact of Climate Change on Major Tourism Attractions and Activities (2011) **GIZ**	How is South Africa's tourism sector vulnerable to climate change? What are the perspectives of the tourism sector? How might the country's reputation for emissions affect the tourism industry? Could climate change-related factors affect international investment in tourism? How could changes in weather conditions affect tourist visits? Could there be a risk in terms of health conditions, diseases or increased pest load?	Conduct a baseline assessment of climate change vulnerabilities that may affect the tourism industry in South Africa (climate risk factors and potential impacts).	***Desktop review, stakeholder consultations.*** Literature review, vulnerability workshop Identify climate risk factors and tourism sector vulnerability; review current response programs/initiatives.	GCMs downscaled using techniques developed by the Climate Systems Analysis Group at the University of Cape Town. Scenarios derived from IPCC.	Summary of key vulnerabilities at tourism hotspots to serve as input to a guidelines document.	Golder Associates Africa (Pty) Ltd. (Golder), in partnership with Haley Sharpe Southern Africa (HSSA). Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Assessing the Vulnerability of Watersheds to Climate Change: Results of National Forest Watershed Vulnerability Pilot Assessments (2013) **USDA Forest Service (USFS)**	What are the projected hydrologic changes and anticipated hydrologic response? What are the potential consequences to watershed resources?	Identify (for each unit) highest priority areas for implementing actions to maintain or improve watershed resilience. Assessments of potential hydrologic change resulting from ongoing and expected climate warming in 11 national forests for more efficient and effective allocation of resources and better land and watershed stewardship.	Flexible methodology to account for different staffing levels and data availability. USFS Watershed Condition Framework steps: identify water resource values and scales of analysis; assess exposure; evaluate watershed sensitivity; identify adaptive management responses; critique the assessment.	Historical data from Wisconsin Initiative on Climate Change Impacts (WICCI). Downscaled climate models from the Climate Impacts Group at the University of Wisconsin.	Priority areas and management actions to maintain or improve watershed resilience in response to a changing climate. The pilot efforts also identified key principles important to conducting future vulnerability assessments.	USFS (one author per site with contributing authors). Timeframe: not specified
How vulnerable is Bangladesh and what needs to be done (Mani and Wang 2014) **World Bank**	What is the impact of climate variables on disease incidence? What is the projected health burden? What is the expected future distribution of vector-borne diseases?	Key objectives are (1) to identify the temporal and spatial distribution of major water- and vector-borne diseases; (2) to assess the health impact of both climate variability and socio-environmental conditions and project the future health burden of climate variability; and (3) to identify cost-effective health adaptation interventions.	Multilevel (hierarchical) modeling and econometric analysis using household survey data; correlation analysis of disease incidence and climate variables; vulnerability assessment using geographic targeting; and cost-effective analysis of possible adaptation interventions.	Data from 35 weather stations from the Bangladesh Meteorological Department since 1970.	Recommendations for policy makers and the Climate Change and Health Promotion Unit.	Eight-member core team; Climate Change and Health Promotion Unit of the Ministry of Health and Family Welfare, the International Centre for Diarrheal Disease Research, Bangladesh and the World Bank. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Vulnerability Assessments: An Assessment of Climate Change Vulnerability, Risk, and Adaptation in Albania's Energy Sector (2009) **World Bank; Part of Country Energy Sector Vulnerability Assessments Program; Energy Sector Management Assistance Program (ESMAP)**	How might climate change affect seasonal weather patterns, weather variability and extreme events? How might these changes affect the production of energy, transmission capacity, oil and gas production and the integrity of transmission pipelines and power distribution networks?	Pilot vulnerability, risk and adaptation assessment undertaken for Albania's energy sector to raise awareness and initiate dialogue on energy sector adaptation. It identifies key direct risks to energy supply and demand and options for adaptation to establish where to focus subsequent in-depth analyses. It also identifies additional research needed to better understand the implications of extreme climatic events for the energy sector as well as potential indirect impacts.	ESMAP's Climate Vulnerability Assessment Framework Climate risk screening of the energy sector to identify and prioritize hazards, current vulnerabilities and risks from projected climate changes out to the year 2050. Identification of adaptation options to reduce overall vulnerability. A high-level cost-benefit analysis of key physical adaptation options.	Data sourced from previous report (Bruci 2008).	Pilot assessment.	Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Pro-Poor Adaptation to Climate Change in Urban Centers: Case Studies of Vulnerability and Resilience in Kenya and Nicaragua (Moser et al. 2010) **World Bank**	How do severe weather conditions represent a hazard to health and well-being? What are the levels of vulnerability that different groups face? What are some sources of resilience?	To better understand what poor households, small businesses and communities are doing to cope with such climate change impacts (experienced as increasingly variable and capricious weather patterns). To identify how policy and institutional systems can best build on local realities to develop pro-poor urban climate change adaptation actions, particularly relating to resilience.	participatory climate change adaptation appraisal methodology (PCCAA) undertaken in four urban settlements in each city, an urban-level rapid risk and institutional appraisal (RRIA), and finally a consultation and validation process conducted with a range of key selected stakeholders from government, civil society and local communities.	Data from national meteorological agencies used to determine historical trends. Local perceptions.	Model methodology (annexed) for how urban vulnerability assessments and urban adaptation planning could include a component (recommended) that looks in detail at the current realities of climate change for the urban poor.	Four-person team from the World Bank Social Development Department and the University of Manchester — Global Urban Development Center (GURC), along with research partners specializing in Participatory Climate Change Adaptation Appraisal and Rapid Risk and Institutional Appraisal in Kenya and Nicaragua, including a social anthropologist. Timeframe: less than 1 year

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Adaptation of Roads to Climate Risk and Climate Change in Morocco (2015) **World Bank**	What are the expected impacts of snow and rain on roads? What is the uncertainty associated with these impacts?	To improve the resistance of sections of Morocco's roads to climate change. The goal is to show the feasibility of technical adaptation measures for road infrastructure in Morocco.	1. Analysis of existing data on current climatic conditions, climate change and a situational analysis of the road sections; definition and prioritization of the road sections' vulnerability is suggested. 2. Workshop for Direction of Roads and Ministry of Equipment, Transport and Logistics.	Precipitation data from the Direction of National Meteorology; intensity-duration-frequency curves from Direction of National Meteorology.	Technical recommendations in hydrology, hydraulic and geotechnics for adapting road infrastructure to climate change. Simplified guide for Direction of Roads.	Led by the engineering company INGÉROP, with the collaboration of two other companies, NOVEC, a Moroccan company specializing in the infrastructure field, and ACTERRA, a company specializing in the study of climate change. Timeframe: 2014–June 2015
FHWA Climate Change Vulnerability Assessment Pilot Project (2014) **US Department of Transportation, Metropolitan Transport Commission**	Which shoreline assets are vulnerable to flooding under sea level rise scenarios? Which transportation assets are most vulnerable to increased seismic impacts in the face of climate change?	Enable the Bay Area's transportation planners to craft effective adaptation strategies based on improved vulnerability and risk assessment practices.	Inventory available data sources, workshops and GIS to categorize assets and develop maps.	Existing datasets.	Identified vulnerable assets and potential adaptation options.	Multistakeholder (San Francisco Bay Conservation and Development Commission, NOAA, Adapting to Rising Tides, Metropolitan Transportation Commission (MTC), California Department of Transportation (Caltrans)) Timeframe: 1 year

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
PROJECT DESIGN						
Climate Vulnerability Assessment – Serbia (2012) **WWF, Environmental Improvement Center**	How are the different economic sectors vulnerable to hydrometeorological events and disasters? What is the current adaptive capacity to respond to disasters? What are the potential impacts on water resources? Which diseases are likely to be influenced by climate change? How might the prevalence of diseases change? What is the exposure of agricultural systems in different regions? What is the vulnerability of the energy supply system?	Climate change vulnerability analysis of Serbia, predominantly focusing on adaptation measures, (i.e., on development possibilities of adaptation systems to climate change)	Desktop review and stakeholder consultation: scientific papers, publications and projects; international, regional and national legal and strategic documents; reports published by state authorities and public institutions; publications, projects and initiatives of the civil sector; statistical data that are important for individual sectors' consultations with experts from the relevant fields and members of the South East European Forum on Climate Change 3 workshops.	Climate projections from Serbia's First National Communication to UNFCC (Ministry of Environment, Mining and Spatial Planning).	Goal: "at initiating the process of adaptation planning and in-depth discussions" Recommendations to serve for improvement, better definition and cooperation of all initiatives in the field of climate change, as well as to direct the activities of the "Climate Forum," which consists of 17 civil society organizations in Serbia – part of South East European Forum on Climate Change Adaptation	Four main authors, researchers, analysts, some statisticians, experts from relevant fields, and member organizations of the South East European Forum for Climate Change Adaptation. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Vulnerability Mapping in the Philippines: A Pilot Study (AKI 2012) **PEP (Partnership for Economic Policy)-Asia – Network Office of the Angelo King Institute for Economic and Business Studies (AKI) of De La Salle University, Manila in collaboration with Economy and Environment Program for Southeast Asia (EEPSEA)**	Which regions are most exposed to climate hazards? What is the adaptive capacity of the different regions?	To assist local government units in developing countries in preparing appropriate plans and programs to address evolving pressures on the environment particularly that of climate change.	Using modified EEAPSA framework (see "Climate Change Vulnerability Mapping for Southeast Asia") categories and indicators, identified through expert consultations and weighted using Analytical Hierarchy Process in a workshop with selected experts from different government and nongovernmental agencies working on climate change-related initiatives. Data sources: CBMS, LGU administrative data and secondary data from national government agencies.	Climate data based on previous report.	1. Pilot test EEPSEA Framework using data generated by community-based monitoring systems (CBMS) and other available subnational-level-data. 2. Generate climate change vulnerability index (CCVI) and maps at the village level showing empirical evidence and analysis on the impacts of climate change. 3. Recommend adaptation strategies based on the results of vulnerability assessment and mapping that can be integrated in disaster and other environment management plans of LGUs in the pilot areas. Results can be used as inputs to draft/formulate or enhance existing Disaster Risk Reduction and Climate Change Adaptation Plan.	Experts from different government and nongovernmental agencies working on climate change-related initiatives. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Impact Modeling and Vulnerability Assessments for Koh Kong and Mondulkiri Provinces in Cambodia (2014) **CIF – Strategic Climate Fund of the Climate Investment Funds**	Which climate hazards might most severely affect the different communities? What is the seasonal distribution of climate risks on livelihoods? What is the exposure, sensitivity and adaptive capacity of agricultural systems?	Conduct a community-/village-based vulnerability assessment at household level in the GMS Biodiversity Conservation Corridors project sites of Koh Kong and Mondulkiri, for which there is additional financing provided to Cambodia by Pilot Program for Climate Resilience. Findings can be used to aid integrated community development planning.	***Desktop review, stakeholder consultations.*** Impact modeling: simulations used bias-corrected sea surface temperatures from six global coupled atmosphere-ocean models to drive a global atmosphere-only model at 50-km horizontal resolution, and these 50-km simulations were then used to drive regional models at about 10-km resolution Vulnerability Assessment: Literature review, IPCC conceptual framework (exposure/sensitivity/adaptive capacity), quantitative and qualitative data collection. Primary data collection methods are (1) participatory focus group discussions; (2) structured household questionnaire surveys; (3) key informant interviews; and (4) secondary literature and statistical data collection through online resources and local government offices).	Sea level rise pressure, temperature and rainfall data from GCM simulations obtained from CSIRO (Commonwealth Scientific and Industrial Research Organization) and extracted from IPCC. Simulations driven by Representative Concentration Pathways. Observed global surface air temperature and mean sea level pressure data taken from ERA data server (land and ocean areas). Land-only global rainfall data taken from Climate Research Unit (CRU) and ERA interim archives for land and ocean areas.	***Report, seasonal calendar and climate impacts, qualitative ranking.*** Summary of commune-level climate change vulnerability and adaptation priorities.	One international and one national vulnerability assessment consultant, together with a group of survey assistants and enumerators experienced in conducting field surveys and household interviews from the Faculty of Agricultural Economics and Rural Development, Royal University of Agriculture, Cambodia. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Baseline study, Temeke Municipality, Dar es Salaam (2011) **ICLEI – Local Governments for Sustainability; project – Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action**	How are changes in climate change likely to impact on resources and livelihoods? How can more frequent and intense impacts disrupt activities and services? What are the potential impacts of drought on water and sanitation services and facilities? How might droughts and coastal flooding affect the transport sector? What are the potential impacts of drought on the health sector?	Focus on drought to identify and discuss the relevant literature pertaining to climate change in Africa with reference to past and projected climatic variability and how this is likely to impact upon local governments as service providers.	Baseline literature review of documented risks and impacts associated with climate change.	Projections from IPCC and peer-reviewed reports (New et al. 2006; UNECA 2010).	First stage. Subsequent stages are: -A Southern African climatic variable overview of the past, present and projected changes for: sea level, temperature, wind speeds, rainfall and precipitation patterns. -A cost-benefit analysis of present and projected risks at the local level. -Identification of mechanisms that increase adaptive capacity and climate preparedness thus enabling local governments to cope with such impacts.	Climate variable analyst, cost-benefit analysis specialist and literature review lead. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Baseline study, Cape Town (2011) **CLEI – Local Governments for Sustainability; project – Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action**	How might food security and access to food be affected by climate change? What is the risk of aggravated water stress? What are the expected impacts on ecosystems? How might climate change affect the incidence of infectious diseases?	Focus on impacts of increasing temperatures to identify and discuss the relevant literature pertaining to climate change in Africa with reference to past and projected climatic variability and how this is likely to impact upon local governments as service providers.	Baseline literature review of documented risks and impacts associated with climate change.	Projections from IPCC and peer-reviewed reports (New et al. 2006; UNECA 2010).	First stage. Subsequent stages are: -A Southern African climatic variable overview of the past, present and projected changes for: sea level, temperature, wind speeds, rainfall and precipitation patterns. -A cost-benefit analysis of present and projected risks at the local level. -Identification of mechanisms that increase adaptive capacity and climate preparedness thus enabling local governments to cope with such impacts.	Climate variable analyst, cost-benefit analysis specialist and literature review lead. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Baseline study, Walvis Bay (2011) **ICLEI – Local Governments for Sustainability; project – Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action**	How might food security and access to food be affected by climate change? What is the risk of aggravated water stress? What are the expected impacts on ecosystems? How might climate change affect the incidence of infectious diseases? How might the increased frequency and/or severity of extreme events affect human vulnerability?	Focus on sea level rise to identify and discuss the relevant literature pertaining to climate change in Africa with reference to past and projected climatic variability and how this is likely to impact upon local governments as service providers.	Baseline literature review of documented risks and impacts associated with climate change.	Projections from IPCC and peer-reviewed reports (New et al. 2006; UNECA 2010).	First stage. Subsequent stages are: -A Southern African climatic variable overview of the past, present and projected changes for: sea level, temperature, wind speeds, rainfall and precipitation patterns. -A cost-benefit analysis of present and projected risks at the local level. -Identification of mechanisms that increase adaptive capacity and climate preparedness thus enabling local governments to cope with such impacts.	Climate variable analyst, cost-benefit analysis specialist and literature review lead. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Baseline study, Port Louis (2011) **ICLEI – Local Governments for Sustainability; project – Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action**	How might food security and access to food be affected by climate change? What is the risk of aggravated water stress? What are the expected impacts on ecosystems? How might climate change affect the incidence of infectious diseases? How might the increased frequency and/or severity of extreme events affect human vulnerability?	Focus on increased storm activity (tropical cyclones) to identify and discuss the relevant literature pertaining to climate change in Africa with reference to past and projected climatic variability and how this is likely to impact upon local governments as service providers.	Baseline literature review of documented risks and impacts associated with climate change.	Projections from IPCC and peer-reviewed reports (New et al. 2006; UNECA 2010).	First stage. Subsequent stages are: -A Southern African climatic variable overview of the past, present and projected changes for: sea level, temperature, wind speeds, rainfall and precipitation patterns. -A cost-benefit analysis of present and projected risks at the local level. -Identification of mechanisms that increase adaptive capacity and climate preparedness thus enabling local governments to cope with such impacts.	Climate variable analyst, cost-benefit analysis specialist and literature review lead. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Baseline study, Maputo (2011) **ICLEI – Local Governments for Sustainability; project – Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action**	How might food security and access to food be affected by climate change? What is the risk of aggravated water stress? What are the expected impacts on ecosystems? How might climate change affect the incidence of infectious diseases? How might the increased frequency and/or severity of extreme events affect human vulnerability?	Focus on flooding (Chamanculo community) to identify and discuss the relevant literature pertaining to climate change in Africa with reference to past and projected climatic variability and how this is likely to impact upon local governments as service providers.	Baseline literature review of documented risks and impacts associated with climate change.	Projections from IPCC and peer-reviewed reports (New et al. 2006; UNECA 2010).	First stage. Subsequent stages are: -A Southern African climatic variable overview of the past, present and projected changes for: sea level, temperature, wind speeds, rainfall and precipitation patterns. -A cost-benefit analysis of present and projected risks at the local level. -Identification of mechanisms that increase adaptive capacity and climate preparedness thus enabling local governments to cope with such impacts.	Climate variable analyst, cost-benefit analysis specialist and literature review lead. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Current vulnerability in the Tri-National de la Sangha landscape, Cameroon (2013) **CIFOR; Climate Change and Forests in the Congo Basin: Synergies between Adaptation and Mitigation (COBAM) project**	How have climate-related disturbances changed in the past decades? What is the vulnerability of social groups, livelihoods and natural resources to climate risks? What are the perceived effects of climate-related disturbances?	Focused mainly on current vulnerability, which includes an analysis of past trends and coping strategies, as well as present conditions. The analysis centered mainly on the social aspects of vulnerability, In the context of multiple stresses and development processes in the sites. One of 5 assessments conducted in landscapes of the Congo Basin.	Literature review, field work and feedback workshop.	Historical data and local perceptions.	Inform scenario analysis. Basis for the evaluation of possible adaptation strategies that can be synergistic with mitigation efforts in the Congo Basin. First step in identifying opportunities in the Congo Basin landscapes for the implementation of pilot actions that take advantage of co-benefits between adaptation and mitigation.	Researchers and participatory process specialist. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Vulnerability assessments in Burundi – integrated analysis from national to local scale (2014) **GIZ, Adaptation au Changement Climatique pour la protection des resources en Eau et Sol » (ACCES) project**	What is the vulnerability, sensitivity and adaptive capacity of the different regions?	Objective of the national vulnerability assessment was to identify the most vulnerable regions to climate change ("hotspots of vulnerability") in Burundi to help determine the zones of intervention for the GIZ project ACCES. In a second step, a local assessment was carried out in three hotspot regions to enable the development and monitoring of appropriate adaptation measures in the zones of intervention.	Based on Vulnerability Sourcebook project (GiZ); data collection, participatory review; and field-based testing.	Existing data from first and second National Communications to UNFCCC. Climate projections.	Summary for policy makers (English and French); integrated analysis.	Seven authors. Timeframe: 10 months

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Vulnerability and Adaptive Capacity in Garissa County, Kenya (2011) **CARE**	What are the interconnections of climate change factors with non-climate stressors? What is the gender-related adaptive capacity? How can increasingly erratic rainfall undermine the efficacy of traditional pastoral practices?	Impacts of climate change on livelihoods in pastoral and agropastoral households, using the villages of Shant'abaq and Kone to illustrate the realities of climate change in vulnerable communities. It also aimed to highlight the existing adaptive capacity within these communities and the issues that constrain people's ability to put this capacity into action. Focus on gender-related issues within the Adaptation Learning Program as part of its community-based adaptation process.	Methodology not detailed.	Initial efforts to downscale climate change projections using Regional Climate Models.	Recommendations that are applicable to community-based adaptation initiatives in Garissa County and beyond; Adaptation Learning Program is already acting on these recommendations, working with communities and other stakeholders in Garissa County to plan for and implement CBA actions in an informed way.	One author with inputs. Timeframe: not specified
Vulnerability to environmental changes in northern Mali (Djoudi, Brockhaus, and Locatelli 2013)) **'Tropical Forests and**	How sensitive are livelihoods to changes induced by climate?	Vulnerability of livestock- and forest-based livelihoods to climate variability and change in Lake Faguibine, northern Mali	Participatory approach: interviews, district workshops and community workshops.	Existing reports.	Outputs unclear. "This case study confirms the need for participatory and gender-sensitive vulnerability assessments across different scales and levels that consider the interaction between	Three researchers. Timeframe: not specified

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Climate Change Adaptation' (TroFCCA) project executed by CATIE (Centro Agronómico Tropical de Investigación y Enseñanza) and CIFOR and funded by the European Commission					socio-ecological systems and the dynamics and distribution of vulnerability across different social subsystems."	
Vulnerability Assessment of Central Coastal Senegal and the Gambia Marine Coast and Estuary to Climate Change Induced Effects (USAID 2012) **USAID/Ba Nafaa project**	What are the expected impacts of climate change on ecosystems, fisheries and communities? Which are the hotspots of climate change vulnerability?	Identify vulnerability "hotspots" and priority climate change adaptation measures that might be addressed within the scope of the USAID/BaNafaa Project (priority socioeconomic activities for mainstreaming of climate change adaptation measures) to support sustainable fisheries development in these contiguous coastal zones of bilateral and regional importance.	Baseline GIS data and mapping; local community vulnerability assessment; ecological assessments; stakeholder workshop.	Climatic analyses extracted from ICAM project hydrological study.	Recommends priority sites, priority socioeconomic activities for mainstreaming of climate change adaptation, four priority adaptation measures to be addressed within scope of project.	Experts in marine and wetland ecology and conservation, GIS, climate change, fisheries biology and community development. Timeframe: 5 months

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Village vulnerability assessment and climate change adaptation planning (V&A): Kitonga Village, Bagamoyo District Tanzania; Doc 3 (2012) **USAID Pwani Project**	What are the concerns and opportunities brought about by climate change? Which assets are at risk and what is the degree of impact for each one?	Village-level climate change vulnerability assessments and adaptation planning to help local leaders and government to assess climate change impacts and find ways to adapt to current and future climate change impacts in a strategic way using their own resources and knowledge (in coastal, rural villages).	Overlay local knowledge onto climate trends: focus group meetings and participatory rapid appraisal tools; large-scale climate change and online regional mapping tools and downscaling models.	Models and projections by IPCC, local perceptions.	Identification of climate change risks and potential impacts, root causes for weak adaptive capacity, brainstorming of adaptation measures.	Community engagement expert, facilitator, local leaders and government. Timeframe: 1–2 years
Village Vulnerability Assessment and Climate Change Adaptation Planning (V&A): Mlingotini Village, Bagamoyo District, Tanzania; Doc 4 (2011c) **USAID Pwani Project**	What are the concerns and opportunities brought about by climate change? Which assets are at risk and what is the degree of impact for each one?	Village-level climate change vulnerability assessments and adaptation planning to help local leaders and government to assess climate change impacts and find ways to adapt to current and future climate change impacts in a strategic way using their own resources and knowledge [in coastal, rural villages).	Overlay local knowledge onto climate trends: focus group meetings and participatory rapid appraisal tools; large-scale climate change and online regional mapping tools and downscaling models.	Models and projections by IPCC, local perceptions.	Identification of climate change risks and potential impacts, root causes for weak adaptive capacity, brainstorming of adaptation measures.	Community engagement expert, facilitator, local leaders and government. Timeframe: 1–2 years

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Livelihoods, climate and non-climate threats and adaptation: Bagamoyo District Coastal Villages; Doc 7 (USAID 2013c) **USAID Pwani Project**	How has climate change affected crop yields? How have increasing temperatures affected fisheries? What are the existing adaptation options?	Understand the vulnerabilities specific to coastal communities in the district to provide guidance for planning directed at improving livelihood resilience and reducing vulnerability in communities to climate and non-climate stressors.	Transect walks, key informant interviews and focus group discussions.	GCMs sourced from World Bank Climate Portal.	Observations of climate change impacts on coastal agriculture, fisheries and tourism sectors.	Community engagement expert, facilitator, local leaders and government. Timeframe: 1–2 years
Informe Tecnico y Integracion SIG de Vulnerabilidad y Riesgo Climatico para la RPFM El Salado (2010) **USAID Sustainable Forests and Coasts Project**	Which sites are most vulnerable to increasing temperatures? Which sites are most vulnerable to non-climate stressors? What is the overall vulnerability of the region?	Vulnerability analysis to design pilot climate change adaptation measures for Reserva de Producción Faunística El Salado and Parque Nacional Machalilla (project target intervention areas).	Satellite imagery, historical weather data, water monitoring data, participatory workshops.	Historical data (30 years). Trends modeled with RClimDex. Salinity from peer-reviewed article (Boyer et al. 2005). Sea level rise from tide gauge.	Vulnerability maps.	Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Mozambique CCAP Explanatory Note of Vulnerability Mapping for Natural Disasters in the Municipalities of Quelmine and Pemba **(2015)** **USAID Coastal City Adaptation Project**		Vulnerability mapping in coastal cities is needed to identify areas with different risk levels to climate-related events and to other natural disasters, for cities to develop their detailed plans and prioritize adaptation activities for the most vulnerable areas.	Community participation; data collected then rasterized.	Existing datasets.	Vulnerability maps: may work as a baseline for monitoring progress of the current adaptation and mitigation work in Pemba and Quelimane, as well as influence future mitigation and adaption projects in the municipalities.	Experts in GIS and spatial analysis, community engagement, socioeconomic analysis, data collection and processing, rasterization and raster value extraction. Timeframe: not specified
Climate Change Vulnerability Assessment for Bungkotoko Village, Kendari District, Southeast Sulawesi (2013) **USAID Indonesia Marine and Climate Support Project**		For coastal community: to analyze whether or not season and weather pattern variability exists, whether these impacts of season and weather patterns affect livelihoods of people living in coastal villages or sub-villages (kelurahans), and to quantify to what degree people have the capacity to adapt to variability.	Adaptation Tool for Coastal Habitat (I-CATCH) approach: This approach includes questions for semi-structured interviews conducted in focus group discussions and plenary discussions, and uses tools typically used in the Participatory Rural Appraisal (PRA) approach.	Original data (not climate data).	Background for village adaptation plan, including exposure level, sensitivity and adaptive capacity.	Team of experts from IMACS and the MMAF Directorate General of Marine, Coastal and Small Islands.

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Vulnerability Assessment for Renda Village, Muna District, Southeast Sulawesi (2013) **USAID Indonesia Marine and Climate Support Project**		For coastal community: to analyze whether or not season and weather pattern variability exists, whether these impacts of season and weather patterns affect livelihoods of people living in coastal villages or sub-villages (kelurahans), and to quantify to what degree people have the capacity to adapt to variability.	Adaptation Tool for Coastal Habitat (I-CATCH) approach: This approach includes questions for semi-structured interviews conducted in focus group discussions and plenary discussions, and uses tools typically used in the Participatory Rural Appraisal (PRA) approach.	Original data (not climate data).	Background for adaptation plan, including conclusions on climate and weather changes, effect on livelihoods, adaptive capacity and vulnerability.	Team of experts from IMACS and the MMAF Directorate General of Marine, Coastal and Small Islands.

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
ACTIVITY DESIGN						
National Climate Vulnerability Assessment – Ukraine (2014) **Climate Forum East (project) and NGO Working Group on Climate Change**	What are the main adverse impacts of climate change on large cities? What factors affect vulnerability to climate change? What is the vulnerability of urban centers to heat stress, flooding and hydrometeorological events?	The risks posed by climate change and adaptation measures that can minimize their adverse effects on Ukrainian cities.	Government workshop to test cities against 7 indicator groups for urban vulnerability.	Peer-reviewed articles. Fifth National Communication.	1. Develop criteria for assessment of the vulnerability of Ukrainian cities to climate change. 2. Provide practical guidelines for the implementation of general adaptation measures that can be used in all or at least most of the cities. 3. Investigate the vulnerability of certain Ukrainian cities to climate change and develop specific recommendations of adaptation measures based on the findings of the investigation.	Climate scientist, expert on physical and geographical conditions and microclimatic features of cities, statistical analyst and working group of vulnerability experts. Timeframe: about 1 year

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Climate Change Vulnerability Assessment for the Namakwa District Municipality (Bourne et al. 2012) **Conservation International**	How might biome climate envelopes change under climate change scenarios? Which sites are most important for supporting resilience to climate change? Which areas are ideal for ecosystem-based adaptation activities? Which are the most vulnerable groups?	Consolidate information on the vulnerability of the ecosystems, socioeconomic condition and institutional structures of Namakwa District Municipality (NDM). Identify the most vulnerable areas where an Ecosystem-based Adaptation (EbA) approach can have the greatest impact.	***Desktop review, stakeholder consultation.*** 1. Statistical approach was developed to generate climate change scenarios based on a wide range of GCM data on temperature and rainfall. 2. OneWorld's (2010) approach of assessing the distribution and quality of the relevant available socioeconomic, ecosystem and institutional resources to assess where greatest vulnerability exists. 3. Consultation with scientists and representatives of government and local communities.	Historical data and projections. Modeling based on three scenarios. Source not specified.	***Report, qualitative ranking, vulnerability index.*** 1. Addresses climate change risks and impacts in NDM. 2. Profiles the structural conditions that contribute to socioeconomic vulnerability in NDM 3. Assesses institutional vulnerability and local government capacity 4. Identifies priority areas for Ecosystem-based Adaptation (EbA) and conservation actions. 5. Makes recommendations for EbA actions (priority areas map and vulnerability index).	Four authors, including a leading international expert on global change, a regional expert on mapping the impacts of climate change on biome stability, and researchers. Timeframe: not specified
Durban's Municipal Climate Protection Programme: Climate Change Adaptation Planning for a Resilient City (2010–2011)	What are the expected impacts of climate change? What are some existing adaptation interventions?	As part of Ethekwini Municipality's Municipal Climate Protection Program, developed a headline adaptation strategy and more detailed municipal adaptation plans for the health, water and disaster management sectors	Multicriteria assessment.	Climate projections based on GCM data from the school of BEEH, University of KwaZulu-Natal. Peer-reviewed articles (Schulze et al. 2010, Mather 2007).	• Interventions prioritized using a multicriteria analysis. • Individuals responsible for enactment of the interventions; • Timeframes for implementation. • Alignment of the proposed interventions	One author, a climate protection scientist: Environmental Planning and Climate Protection Department; Timeframe: 15-month period (for all

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Environmental Planning and Climate Protection Department, Ethekwini Municipality		to assist sectors in adapting to the projected climate change impacts over the short, medium and long term.			with the Integrated Development Plan.	adaptation plans in series)
Kathmandu Valley, Nepal: Climate Change Vulnerability Assessment – Abridged Report (2015) **UN Habitat Cities and Climate Change Initiative (within UN-Habitat Asia-Pacific Strategy 2011–2015 / Cities and Climate Change Initiative abridged report)**	What are the potential impacts of floods, droughts and hazards that agriculture, water resources and energy, forests and biodiversity, public health, urban settlements and infrastructure are expected to face? Which are the hotspots in terms of vulnerability to climate change?	Objective of the study was to sensitize and strengthen the response and capacity of governments and stakeholders in the Kathmandu Valley to the impacts of climate change.	Analyzed through three main pillars: exposure, sensitivity and adaptive capacity to change. Working group, data collection, workshop, community consultations, visualization and mapping.	Historical data and projections. Peer-reviewed article (Shrestha et al. 1999) based on data from 49 weather stations. ICIMOD 2007 Projections by the Organisation for Economic Co-operation and Development (OECD) that used general circulation models and study from Nepal Climate Vulnerability Study Team. Local perceptions.	Initial output of Cities and Climate Change Initiative activities.	Experts in stakeholder and community engagement, data collection and research, visualization and mapping. Timeframe: 3 months (research study)

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate Change Vulnerability Assessment: Hoi An, Viet Nam – Abridged Report (2014) **UN Habitat Cities and Climate Change Initiative**	What are the main climate hazards the city is exposed to? What is the expected severity of the impacts? What is the sensitivity and adaptive capacity of the city's assets and livelihoods to the impacts of climate change? Which areas are most exposed to climate hazards?	Specific objective not clearly stated.	Section on assessment framework: utilizes UN-Habitat's Cities and Climate Change Initiative in Asia-Pacific framework, follows IPCC framework (exposure, sensitivity, and adaptive capacity). Used a mix of quantitative and qualitative methods, including climate models and scenarios, GIS data and mapping, community consultations through focus groups and key informant interviews with local government officials.	Climate projections by Vietnam Ministry of Natural Resource and Environment, proceedings of a workshop to develop scenarios.	With four categories, solutions for improving capacity of Hoi An to adapt to climate change: 1. policy, institutional and coordination 2. finance and investment 3. human resources and information 4. technology and infrastructure.	10 principal or contributing authors, experts in climate models and scenarios, GIS data and mapping, community consultations through focus groups and key informant interviews with local government officials. Timeframe: not specified
Climate Change Vulnerability Assessment: Honiara, Solomon Islands – Abridged Report (2014) **UN Habitat Cities and Climate Change Initiative**	Which sites and assets are exposed to flooding? Which wards and ecosystems are most vulnerable to climate change? What are some ongoing adaptation interventions?	To provide national and local government decision makers and community leaders with information relevant to defining their adaptation priorities and plans, with the view of eventually integrating this into their regular programs and budgets. Part of process to implement key recommendations of the Solomon Islands	Desktop review, field observations, and community consultations. Exposure, sensitivity and adaptive capacity were analyzed.	Tide gauge records, satellite sea level records, riverine flood risk maps, census data, downscaled climate models from the Pacific Climate Change Science Programme	Proposes the key sectors for climate change adaptation and mitigation measures in Honiara; recommends specific measures for updating and improving the City Council local planning scheme and City Council corporate plan.	Three authors. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
		National Development Strategy (2011–2020) and the National Climate Change Policy (2012–2017).				
Climate Change Vulnerability Assessment: Lami Town, Fiji – Abridged Report (UN Habitat 2013) **UN Habitat Cities and Climate Change Initiative**	What is the level of exposure, sensitivity and adaptive capacity of ecosystems, communities and institutions? Which are the vulnerability hotspots?	To provide national and local government decision makers and community leaders with information relevant to defining their adaptation priorities and plans, with the view of eventually integrating this into their regular programs and budgets.	Desktop review, field observations, and community consultations. Exposure, sensitivity and adaptive capacity were analyzed	Climate Change 2007. Synthesis Report. Kellogg, Brown and Root 2011. Climate Change Vulnerability and Adaptation Assessment for Fiji.	No report-specific objective or outputs outside of findings and recommendations; however, follow-up actions from the publishing of the full report (2011) are included as an annex.	Summarized from other reports, multiple authorship. Timeframe: not specified
Climate Change Vulnerability Assessment: Port Moresby, Papua New Guinea – Abridged Report (UN Habitat 2014) **UN Habitat Cities and Climate Change Initiative**	What are the potential economic impacts of drought? What are the implications of cyclones on communities and infrastructure? What is the level of sensitivity of ecosystems and infrastructure? What is the existing local adaptive capacity?	To provide national and local government decision makers and community leaders with information relevant to defining their adaptation priorities and plans, with the view of eventually integrating this into their regular programs and budgets.	Desktop review, field observations, and community consultations. Exposure, sensitivity and adaptive capacity were analyzed	General sea level rise for Papua New Guinea (no local data available). Data from the Australian Bureau of Meteorology and CSIRO (Commonwealth Scientific and Industrial Research Organization). Climate Change in the Pacific Scientific Assessment and New Research.	No report-specific objective or outputs outside of findings and recommendations.	Four authors. Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Climate, Forest Cover and Water Resources Vulnerability, Wami/Ruvu Basin, Tanzania (2014) **USAID Global Water for Sustainability Program**	How are water resources vulnerable to climate change?	Assess vulnerability of water resources to climate/forest cover change at Wami/Ruvu Basin level (however, does not appear that project will manage implementation of adaptation measures).	Historical data and climate projections. Projections from IPCC, peer-reviewed articles (Ngana et al 2010, Jack 2010, Shemsanga et al. 2010). Climate Wizard Wami/RUBU Basin Water Office.	Existing datasets.	Implications of climate change and forest cover change on water resources in the Basin from both availability and demand perspectives. Identifies sector-specific areas of adaptation. Report "tries to contribute" to aim of each sector drawing up its own adaptive management plan.	Water resource management experts, hydrologists, climate forecasting/ projection modelers and forestry experts. Timeframe: program initiated in 2010, report published in 2014
Climate and Landscape-related vulnerability of water resources in Mkindo catchment, Wami River Basin, Tanzania (2014) **USAID Global Water for Sustainability Program**	How are water resources vulnerable to climate change?	Information on climate and landscape factors that affect water availability and quality in the Mkindo River Catchment and suggestion of focal adaptation strategy development for water resources management and monitoring by the stakeholders in the catchment (however, does not appear that project will manage implementation of adaptation measures).	Current climate and climate projections. Sources: World Weather Online, Wami/RUBU Basin Water Office, Climate Wizard.	Existing datasets.	Description of the major factors affecting water availability and water use in the Mkindo River catchment. Informational meetings to discuss and develop adaptation strategies.	Two principal authors. Support from school teachers, villagers, community development officer, water supply officer, farm manager's input on water use, hydrologists, forestry expert and workshop facilitator. Timeframe: work carried out between January and August 2013

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Cubango-Okavango River Basin Climate Change Vulnerability Assessment (USAID 2013a) **USAID Southern Africa Regional Environmental Program**	What specific areas are most vulnerable to climate change? Which livelihoods are most vulnerable to climate change? What is the existing and needed adaptive capacity at the local, national and regional levels?	For specific areas vulnerable to climate change, discuss vulnerabilities of different livelihoods and assess existing and needed capacity.	2-day workshop results with practitioners, policy makers, government representatives and scientists.	Previous reports (OKACOM 2010, Wolski 2009, and Chemonics International 2012).	"Hopefully these insights can inform some of the climate change adaptation discussions in the Okavango Basin" – not intended as a complete vulnerability assessment.	Practitioners, policy makers, government representatives and scientists knowledgeable about relevant aspects of the Okavango Basin (workshop participants). Ministry of Environment, Tourism, Agriculture, and Water, academic institutions, conservation organizations and an environmental consultant. Timeframe: report based mainly on a 2-day workshop
Assessing Climate Change Vulnerability in East Africa (2009–2010) (CARE 2011) **Global Water Initiative, CARE, Action Against Hunger, Catholic Relief**	Which climate hazards are likely to affect local livelihoods? What are the potential impacts of said hazards? Which groups are most vulnerable to climate change?	Analyzing vulnerability and capacity to adapt to climate change at the community level, incorporating issues at regional and national levels in an effort to foster an enabling environment for community-based adaptation.	Community consultations, data analysis using community-based risk screening tool for adaptation and livelihoods (CRISTAL) tool.	Historical data and climate projections from previous reports. Local perceptions.		Staff not specified. Timeframe: between 2009 and 2010

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Services, IUCN, Oxfam America						

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
OTHER						
Assessing Climate Change Vulnerability in Fisheries and Aquaculture: Available methodologies and their relevance for the sector (2015) **FAO**	How are national economies vulnerable to potential climate change impacts stemming from changes in their fisheries? How is the fish-based food security of nine Pacific island countries and territories (PICTs) vulnerable to climate change? What is the social-ecological vulnerability of coral reef fisheries to climate change? What are the socio-ecological vulnerabilities of fisheries-dependent communities in relation to climate change and environmental variability, including impacts of other sector activities that may exacerbate vulnerability? How are Lower Mekong Basin	An overview of vulnerability assessment concepts and methodologies, with six case studies in the context of fisheries and aquaculture.	Methodology varies by case study.	Hadley Center for Climate Prediction and Research (HadCM3).	Outputs vary by case study.	One principal author with input from eight contributors (expertise or skills not specified). Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
	fisheries and aquaculture species and production systems vulnerable to predicted climate change impacts? Which species have life histories and exposures that may leave them vulnerable to large changes in abundance or productivity?					
A Risk Analysis and Screening Approach for Climate Change Mitigation and Adaptation Options: A Tool for Climate Action Planning. (2014) **Advisory Service Agreement between the Ministry of Environment and Climate Change and the International**	What are the types of risks associated with a specific measure/option? How important (qualitatively) are the expected benefits of the proposed measures/options?	Risk analysis and screening approach for climate change mitigation and adaptation options based on benefits, costs, and risks, prepared for Romania's Climate Change Action Plan.	1. Screening for "no regrets" measures. 2. Use more in-depth analysis (multi-criteria analysis, cost-benefit analysis, cost-effective analysis or modeling) for higher-risk measures.	N/A.	Summary of screening approaches. Does not actually conduct the screening.	Timeframe: not specified

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Bank of Reconstruction and Development / World Bank						
Assessing Climate Change Adaptation in Indonesia: A review of climate vulnerability assessments conducted by USAID/ Indonesia partners (2014) **USAID E3 Analytics and Evaluation Project**	How have the various approaches to vulnerability assessment been similar or different across projects? How have the various approaches linked disaster risk reduction and climate change adaptation? What methods led to greatest local ownership and understanding? Where have existing vulnerability assessments stimulated changes or the mainstreaming of climate and local disaster risk management at the local level? What are the lessons learned, success factors and opportunities that should be	Review USAID-supported, community-level processes for assessing climate change vulnerabilities and fostering adaptive practices – lessons learned, success factors and opportunities (forestry, marine, WASH, disaster risk reduction)	Desktop review and field visits to CVA sites – see Annex J for interesting list of barriers to CVA process.	N/A.	Recommendations for USAID/Indonesia and implementing partners.	Forestry, marine, water and sanitation, and disaster risk reduction experts. Timeframe: 4 months

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
	considered in the next round of USAID programming for climate change adaptation?					

Title and Implementers	Questions	Purpose	Methods	Climate Data and Information	Outputs	Expertise and Timeframe
Coastal Vulnerability to Climate Change and Sea Level Rise, Northeast Graham Island, Haida Gwaii (Queen Charlotte Islands), British Columbia (2007) **University of Victoria, University of Guelph**	What are the environmental and social impacts of climatic change and accelerated sea level rise on sensitive coastal regions?	Investigate the environmental and social impacts of climatic change and accelerated sea level rise on one of Canada's most sensitive coastal regions – the northeastern coast of Graham Island, Haida Gwaii (Queen Charlotte Islands).	Combines scientific findings on climatic and environmental changes with an assessment of community-based and locally relevant examples of adaptive capacity to climate change. Comprehensive literature review, examination of modern climatic variability and change trends and oceanic responses, assessment of prehistoric climatic changes reconstruction of prehistorical coastal geomorphic responses to past sea level changes, study of modern coastal erosion and change trends using measurement and mapping of recent morphological changes, assessment of plausible future climate change scenarios, community workshop and mapping exercise, door-to-door survey of community perceptions and experiences of climate risks, discussion of developing short- and long-term adaptation strategies.	IPCC reports, national climate trends published by Environment Canada, peer-reviewed articles (Taylor and Taylor 1997, Walker and Sydneysmith 2007).	Adaptive capacity building to reduce vulnerability to climate change, short-term responses and adaptive capacity building and long-term adaptation strategies.	Four principal scientists: Research scientist (natural resources), research analyst (agriculture and food), coastal geoscientist and geography expert. Input from experts in: culture, GIS specialist for sea level rise analysis, nearshore dynamics, C dating, Foraminifera analysis, community map cartography, LIDAR image processing, water level data and interpretation, and climate data. Timeframe: 3 years

APPENDIX B: CLIMATE DATA SOURCES

Data Source	Description	Organization
GENERAL		
Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)	Historical (30+ years; 1981 to near present) global rainfall dataset available to support drought early warning and environmental monitoring. Data are a combination of satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.	US Geological Survey (USGS); Famine Early Warning Systems Network, USAID; Earth Resources Observation Science Center, National Aeronautics and Space Administration (NASA); National Oceanic and Atmospheric Administration (NOAA)
Climate Impacts: Global and Regional Adaptation Support Platform	Web-based climate information service to support decision makers in developing and emerging countries to prioritize adaptation needs; service provides sound knowledge on current and projected climate stimuli, climate impacts and adaptation options at the national, subnational and regional levels.	GIZ
Climate Research Unit TS Google Earth Interface	Temperature and precipitation data covering the period 1901–2015 and all land areas; data allow half-degree cells to be examined.	Climate Research Unit, University of East Anglia
Climate Research Unit Updated	Center for past climate history and its impacts on humanity, the course and causes of climate change during instrumental period.	Climate Research Unit, University of East Anglia
Climate Risk and Adaptation Country Profiles	Platform to guide access, synthesis and analysis of relevant country data and information for disaster risk reduction and adaptation to climate change.	World Bank
Climate Wizard	Global historical temperature and rainfall maps. Global state-of-the-art predictions of temperature and rainfall.	The Nature Conservancy, University of Washington, University of Southern Mississippi
Data Distribution Center	Compilation of data sources by IPCC. Contains datasets from multiple data centers around the world, including China, Norway, Canada, France, the United States, Korea and Japan.	IPCC
Global Climate Data	Historical data derived from three quality-controlled sources. Future projections based on data derived from downscaled GCMs under two scenarios that describe future economic growth and energy use.	World Bank
Global Circulation Models	GCMs represent physical processes in the atmosphere, ocean, cryosphere and land surface and are the most advanced tools currently available for simulating the response of global climate system to increasing greenhouse gas concentrations.	IPCC

Data Source	Description	Organization
Global Historical Climatology Network	Integrated database of climate summaries from land surface stations across the globe obtained from more than 20 sources.	NOAA
HURSAT	Provides tropical cyclone-centric satellite data.	NOAA
International Best Track Archive for Climate Stewardship	Provides tropical cyclone data in a centralized location to aid understanding of the distribution, frequency and intensity of tropical cyclones worldwide.	NOAA
International Satellite Cloud Climatology Project	Collection of weather satellite radiance measurements to infer global distribution of clouds, their properties and variations. Datasets are used to study the role of clouds in climate.	NASA
Optimum Interpolation Sea Surface Temperature (OISST)	Global sea surface temperature constructed by combining observations from satellites, ships and buoys on a regular global grid.	NOAA
Tropical Rainfall Measuring Mission	Data from a research satellite to improve understanding of the distribution and variability of precipitation within the tropics, as well as the interactions between water vapor, clouds and precipitation that regulate Earth's climate.	NASA
SECTOR- OR REGION-SPECIFIC		
Climate Change, Agriculture and Food Security – Climate data portal	Global and regional future high-resolution climate datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agricultural and livestock production, and ecosystem services and hydrology.	Centre for Tropical Agriculture, Consultative Group on International Agricultural Research (CGIAR)
Famine Early Warning Systems Network	Provides access to geospatial data, satellite image products and derived data products in support of FEWS NET drought monitoring efforts throughout the world.	USGS, USAID
Global Assessment Report on Disaster Risk Reduction	Summary of trends of disasters and expected future losses.	UN International Strategy for Disaster Risk Reduction
International Disaster Database	Contains essential core data on the occurrence and effects of over 22,000 mass disasters in the world from 1990 to the present day. Compiled from various sources (UN agencies, NGOs, insurance companies, research institutes and press agencies.	Center for Research on the Epidemiology of Disasters
Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation	Provides an assessment of scientific literature on issues that range from the relationship between climate change and extreme weather and climate events to the implications of these events for society and sustainable development.	IPCC
Sistema Regional de Visualización y Monitoreo de Mesoamérica (SERVIR)	Regional monitoring and visualization system for Mesoamerica that relies on satellite imagery.	Centro del Agua del Trópico Húmedo para América Latina y el Caribe (CATHALAC)

APPENDIX C: SOURCES OF INDICATOR DATA[5]

Data/Tool	Description	Source
Millennium Development Goals	Eight goals for meeting the needs of the world's poorest people. Country- and sector-specific indicators are provided.	UNDP
International Human Development Indicators Profiles	Country-specific social vulnerability based on the Human Development Index (HDI) of the UNDP. The HDI combines indicators of life expectancy, educational attainment and income.	UNDP
Climate Change Knowledge Portal	A web-based tool that provides country-specific indicators of sensitivity, including information on water access, sanitation, land use, wealth, age and agriculture.	World Bank Group
Open Data	A data catalog that provides access to a number of indicators that can be used to assess sensitivity.	World Bank Group
Demographic and Health Survey	A 30+-year record for most developing countries of demographic and health survey information.	USAID
Least Developed Countries Factsheets	Country-specific development statistics for least developed countries that can be used to assess sensitivity.	United Nations Development Policy and Analysis Division
Government statistics databases	National and local government websites provide information on development indicators.	Various local governments
Adaptation Learning Mechanism	Web-based information platform that includes case studies of adaptation.	UNDP

5 The source for Appendix C is USAID 2016a.