Operational Framework for Ecosystem-based Adaptation

Implementing and Mainstreaming Ecosystem-based Adaptation Responses in the Greater Mekong Sub-Region

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December 30, 2013

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Abbreviations

BAU	Business as usual
CBA	Community Based Adaptation
CBD	Convention on Biodiversity
CEA	Cost Effectiveness Analysis
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
FGD	Focus Group Discussions
GIS	Geographic Information System
GMS	Greater Mekong Sub-Region
GCF	Green Climate Fund
ILWIS	Integrated Land and Water Information System
InVEST	Integrated Valuation of Environmental Services and Tradeoffs
IWRM	Integrated Water Resource Management
IPCC	Intergovernmental Panel on Climate Change
M&E	Monitoring and Evaluation
MCA	Multi-Criteria Analysis
NAPA	National Adaptation Plans of Action
OECD	Organization for Economic Co-operation and Development
PRA	Participatory Rural Appraisal
PPCR	Pilot Program for Climate Resilience
RBM	Results Based Management
ROI	Return on Investment
SMCA	Scanning Mobility CCN Analysis
SMART	Simple, Measurable, Achievable, Realistic, Time bound
SES	Social-Ecological System
SCF	Strategic Climate Fund
SEA	Strategic Environmental Assessment
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WWF	World Wildlife Fund

Acknowledgements

The Framework to Implement and Mainstream Ecosystem-based Adaptation (EbA) response in the Greater Mekong Sub Region (GMS) was carried out through a partnership between the World Bank (WB) and the World Wildlife Fund (WWF). This analytical work was co-financed in the context of the World Bank-Netherland Partnership Program which the team acknowledge with gratitude.

The framework was written by the World Wildlife Fund, guided by the World Bank, and reviewed by expert groups with the support of consultations with governments from Lao PDR and Vietnam. The WWF team was co-led by Peter Cutter, Manager Landscape Conservation Program; Geoffrey Blate, technical advisor on climate change and Raji Dhital, Regional project manager for EbA and climate change specialist. The WWF team in Vietnam consisted of Viet Hoang, Climate Change and Freshwater Coordinator Tran Thi Mai Huong, Climate Change Programme Officer and; and in Lao PDR of Sidavone Chanthavong, National project coordinator, Martin Hollands, consultant. The World Bank team was led by Christophe Crepin, Sector Leader, and included Isao Endo, Environment Specialist, Sara Nielsen, Climate Change Specialist, and Thu Thu Thi Le Nguyen, Operations Officer.

The WWF team worked very closely with the Ministry of Natural resources and Environment (MONRE) in both the countries; in particular with the Department of Disaster Management and Climate Change (DDMCC) in Lao PDR and Institute of Strategies and Policies on Natural Resources (ISPONRE) in Vietnam. We acknowledge with gratitude the inputs provided by the governments of Lao PDR and Vietnam, and their support in developing and endorsing the customized EbA frameworks.

The report benefitted from substantial discussions with other national and sub-national stakeholders in Vietnam and Lao PDR. In Lao PDR, at the national level, the guidance was provided by the Climate Change Technical Committee. At the sub-national level, there was substantial engagement from Champasak Provincial Governor Office, Provincial of Natural Resource and Environment, Phathoumphone District Governor office, District of Natural Resource and Environment office, Champasak provincial Agriculture and Forestry Office, Phathumphone District Agriculture and Forestry Office, and Champasak University at sub-national level.

In Vietnam, from the Ministry of Natural Resources and Environment, we are grateful for the endorsement from Mr. Nguyen Minh Quang, Minister of Natural Resources and Environment. We also greatly appreciate the input and dedication from ISPONRE (Dr. Nguyen Van Tai, Ms. Kim Thi Thuy Ngoc, Ms. Le thi Le Quyen, Ms. Nguyen Thi Ngoc Anh, and Michael Parsons) and Ben Tre DONRE (Mr. Doan Van Phuc, Ms. Nguyen Thi Thuy, and Mr. Vo Van Ngoan).

This report benefitted from the contribution of the reviewers who provided comments to the first draft of this framework and helped to shape it—Mr. Alex Smajgi from CSIRO; Mr. Charles Rodgers from ADB Philippines; Mr. Colin McQuistan from Practical Action; Ms. Hanna Reid, from International Institute of Environment and Development; Mr. Mozaharul Alam from UNEP; Robert Mather from IUCN.

We would also like to thank continuous support developing and reviewing the framework from the Asian Development Bank (ADB)—Mr. Sanath Ranawana, project officer, Greater Mekong Sub-Region Core Environment Programme; from the ADB Environment

operations Center (EOC) Sumit Pokhrel, Deputy Technical Programme Head and Ornsaran (Pomme) Manuamorn, Climate Change Coordinator; from WWF-US, Mr. Shaun Martin, Senior Director, Climate Change Adaptation and Conservation Leadership and Ms. Anita Van Breda, Director, Disaster Reduction and Response, and from WWF International Cassandra Brookes, Head of Climate Adaptation.

From the World Bank, valuable comments were provided by Habiba Gitay, Iain Shuker, Jean-Michel G Pavy, Solvita Klapare, Stephane Hallegate, Anjali Acharya and Valerie Hickey.

A sincere thanks to the editing and design team led by Adam Broadfoot.

Foreword

Climate change poses significant challenges to sustainable economic growth and causes environmental instability worldwide. It will severely hinder progress on development in communities, in particular those reliant on natural resources for their livelihoods. The Greater Mekong Sub-Region (GMS) is projected to be one of the hardest hit regions in the world.

One major challenge that the GMS face today is to sustain the livelihoods of its residents and ensure continued economic growth. The long coastline and vast wetlands of the GMS support millions of people. The GMS is the rice bowl of East Asia, it holds one of the largest aquaculture and fisheries sectors in the world, and it is increasingly becoming a highly popular tourist destination. Its natural landscape also acts as a protective barrier to storms and floods, and the variety of ecosystems offers service that help increase the resilience of the GMS population. Many of these services are deteriorating, not only due to issues such as pollution and over-development, but they are also at risk to intensifying climate change. Increasing the resilience of these resources will adversely also increase the resilience of the populations that rely on them and could help communities adapt to climate change.

There exist several ways of adapting to the adverse impacts of climate change and reducing the vulnerability of communities and infrastructure. Ecosystem-based adaptation (EbA) provides nature-based solutions by building community resilience through effective and sustainable management of ecosystems. EbA takes a people-centric approach aimed at decreasing vulnerability of human systems by protecting the natural resource base and the services it provides. It is still a fairly new approach, but it is gaining increasing attention in the global development agenda as well as in international negotiations on climate change. As a result, several countries and other stakeholders worldwide are taking steps to ensure the applicability of EbA.

In the GMS, there is still a necessity to create a stronger enabling environment for implementing EbA, including developing technical tools and policy frameworks that provide guidance on designing, implementing and mainstreaming EbA solutions. In response to this need, the framework presented in this report has been developed as an effort to provide operational guidance to government planners and other practitioners on how to develop and mainstream EbA. The framework is guided by available literature, best practices, and the experiences of diverse development and adaptation practitioners. The framework provides stepwise guidance for analyzing vulnerability, selecting adaptation responses at the sub-national level, and for mainstreaming EbA into policies and planning processes.

Working closely with Governments and CSOs, the framework was field-tested in two locations to develop customized country frameworks. In Vietnam the framework was tested in the coastal districts of Ben Tre Province, and in the Lao PDR it was tested in Beung Kiat Ngong wetland in Champasak province. The sites were chosen based on their high vulnerability and high ecosystem services value to the communities that rely on those services. The Ben Tre coastal area is predicted to be one of the areas most impacted by sea level rise in the world. The Beung Kiat Ngong Wetland in Lao PDR is a 68,000 hectare catchment in Phathumpone District. The catchment is characterized by high biodiversity and supports a human population of 11,500 people. Field-testing in these two different social-ecological systems helped fine-tune and inform the further development of the framework and ensure that the two customized frameworks

were country-specific. The field-testing produced two case studies leading to two policy briefs, one for each country. These briefs will help guide further usage and implementation of the framework and mainstreaming of concepts and action.

The framework is intended as a starting point for designing and implementing EbA measures. While sufficient guidance on "what is needed to make a decision" and "how to get it" is provided here, it is expected that the users will modify and fine-tune it based on their particular objectives, context, needs, available time and budget. While this specific framework is focused on the GMS, the concepts and methodologies presented here will be applicable in other regions worldwide, especially regions with features similar to those in the GMS.

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Glossary of Key Terms Used

Adaptation: "Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected *climate change* effects" (IPCC 2007).

Adaptive Capacity: The whole of capabilities, resources, and institutions of a country or *region* to implement effective *adaptation* measures (IPCC 2007). Adaptive capacity of individuals and communities are shaped by their access and control to important resources and assets, such as access to land, access to water etc.

Climate Change: Changes in climate over a prolonged time. The IPCC (2011) defines climate change as a change caused by natural internal processes or external forcings, or by persistent anthropogenic changes in the composition of the atmosphere or land-use. This definition differs slightly from the UNFCCC definition, which only focuses on anthropogenic change, referring to climate change as a change of climate that is directly or indirectly caused by anthropogenic forces altering the composition of the atmosphere, *and* that occurs in addition to natural climate change. Climate changes include the observed and projected increases or decreases in regional and local temperatures, changes in timing, and amount of rainfall, sea level rise. etc.

Climate Impacts: The consequences of *climate change* or *climate hazards* on natural and human systems.

Ecosystem-based Adaptation (EbA): is "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change" (CBD 2009). Ecosystem-based Adaptation uses sustainable management, conservation, and restoration of ecosystems to build resilience and decrease the vulnerability of communities in the event of climate change.

Ecosystem services: Benefits that people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (Millennium Ecosystem Assessment 2005).

Exposure: The level at which a country/region experience the risks of climate change based on its geographic location. For example, coastal communities will have higher exposure to sea level rise and cyclones, while communities in semi-arid areas may be most exposed to drought.

Hazard: A hazard is defined as a harmful event that affects communities or ecosystems. A climate hazard is an event caused by climate changes with the potential to cause harm, such as heavy rainfall, drought, a storm, or long-term change in climate variables such as temperature and precipitation.

Multi-Criteria Analysis (MCA): A structured approach used to determine overall preferences among different alternative options, where the options accomplish several objectives that may not always complement one another (Department for communities and local government-London, 2009). In MCA, desired objectives are specified and corresponding attributes or indicators are identified. The measurement of these indicators is often based on a quantitative analysis (through scoring, ranking, and weighting) of a wide range of qualitative impact categories and criteria.

Risk: The likelihood of a hazard happening that will affect natural or human systems.

Scenario analysis: A method that describes the logical and internally consistent sequence of events to explore how the future might, could, or should evolve from the past and present (van der Sluijs et al.. 2004).

Sensitivity: The degree to which the community is affected by climate stresses. Communities dependent on rain-fed agriculture are much more sensitive to changes in rainfall patterns than ones where the main livelihood strategy is labor in a mining facility, for instance.

Spatial analysis: A set of methods whose results change when the locations of the objects being analyzed change (Longley et al.. 2005).

Spatial planning: A method used to influence the future distribution of activities in space (European Commission 1997). It goes beyond traditional land-use planning to integrate and bring together policies for the development of land-use, along with other policies and responses that influence the use of land (Office of Disaster Preparedness and Management, UK 2005). Spatial planning is critical for delivering economic, social, and environmental benefits by creating more stable and predictable conditions for investment and development, by securing community benefits from development, and by promoting prudent use of land and natural resources for development.

System dynamics: An aspect of systems theory used to understand the dynamic behavior of complex systems. The basis of the method is the recognition that the structure of any system—and the many circular, interlocking, sometimes time-delayed relationships among its components—is often just as important in determining the system's behavior as the individual components themselves.

Vulnerability: **"**The degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes" (IPCC 2007). Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. In EbA the ecosystems and their vulnerabilities are included in the analysis together with the vulnerability of communities.

Introduction

This document presents an Operational Framework for Ecosystem-based Adaptation (EbA) in the Greater Mekong Sub-region (GMS) that aims to provide robust and detailed guidance to decision makers involved in subnational decision making for the assessment and implementation of EbA measures. The EbA framework presented here reflects the complexity of climate change patterns and ecosystems, yet is accessible and systematic enough to be applied by a wide range of practitioners—including situations where resources and capacity may be limited.

The Framework is divided into two sections

Section I provides a brief explanation of EbA and the rationale for integrating it when assessing potential adaptation options and strategies worldwide. This section focuses on the need for an operational framework, its target users, and briefly explains the importance of considering social-ecological systems, vulnerability, and resilience in the EbA context. A brief discussion on the challenges and gaps prevalent in the existing EbA practices and frameworks is also presented.

Section II describes the design of the framework, and provides guidance for applying it to achieve better climate change adaptation outcomes. This section includes a conceptual design (ecosystem-development nexus), the use of robust analytical methodologies (scenario-analysis, spatial concepts, cost-effectiveness analysis, and participatory methods) and detailed guidance that is applicable at different scales to make EbA more relevant to development planners and policy makers. The framework consists of four steps.

- **Step 1:** Vulnerability assessment of Socio-Ecological Systems
- **Step 2:** Identification and Prioritization of EbA Responses
- **Step 3:** Implementation and Monitoring of EbA Responses
- **Step 4:** Mainstreaming EbA in National and Local Climate Change Planning

To operationalize the steps, users are provided with

- A checklist that summarizes the key actions needed for each step.
- A snapshot of steps 1 and 2, which captures the intermediate steps or sub-steps, objectives, outputs, and tools and methods available to complete each step.
- Detailed guidance in the form of the processes necessary and/or guiding questions for stakeholders for all steps. The guidance provided is primarily for sub-national level assessments, but the framework is flexible and some guidance is presented that allow the framework to be applied under different resources conditions and for up-scaling, so that it is suitable for:
- Local level planning with low- to medium-budget availability;
- Local level planning with high budget availability; and
- Up-scaling to national and/or bigger landscape level with corresponding resources.
- Links to additional resources that might be useful in accomplishing each step (for example including resources for carrying out vulnerability assessments, developing ecosystem-based indicators, etc.).

Additional Resources

Tools and resources to inform the identification of EbA responses

Annex 2 discusses recommended tools that can be used for the framework. The tools are a combination of community-based participatory tools for bottom-up analysis as well as top-down tools needed for the consideration of climate change and ecosystem services. The selection—and use—of these tools, processes, and guiding questions have been developed based on best practices (e.g. recommended in peer-reviewed literature and/or relevant field studies) as well as by the lessons learned from field-testing the present framework. However, users should keep in mind that these processes and tools are only one way of achieving the objectives and principles of EbA. They may change depending on the context in which the framework is applied, and new tools may emerge.

External resources

A series of external resources that can inform and help in EbA planning are also included in the annexes. In an attempt to capture existing and emerging good practices that can be useful for planners, these include—but are not limited to—links to external resources for climate risk screening and vulnerability assessments, ecosystem mapping, examples of adaptation options that take ecosystem services into consideration, and examples of indicators necessary in implementing EbA initiatives. Finally, if more background information is needed on EbA as a concept, a literature review with detailed explanation of EbA is accessible online together with case studies on the application of the EbA framework [www.panda.org/greatermekong/ebm, http://go.worldbank.org/152S84OJR0].

Target users

The framework is suitable for three main groups of users.

- *Sub-national and national governments* intending to adopt an integrated adaptation plan that includes EbA strategies. As such the guidance is useful not only for planners, technical personnel, and policymakers with an intention of implementing EbA measures, but also to those who want to compare different types of adaptation strategies available.
- *Adaptation practitioners* who are interested in integrated vulnerability assessments and identifying appropriate adaptation strategies including EbA.
- *Conservation practitioners* working with ecosystem management issues, interested in integrating climate change impacts and building community resilience.

Assumptions

The Framework assumes that the target users have a basic understanding of climate change adaptation and ecosystems. Basic concepts, though touched upon here, are not elaborated on any further. For more information on the concepts related to EbA, users can refer to the literature review.

The Framework also assumes that an area or system is defined prior to the implementation of the framework and a primary team established to lead the process of implementing the framework and developing adaptation responses, whether EbA or others.

Implementing the Framework

To receive the maximum value from this framework, users are advised to:

- Familiarize themselves with the central concepts (summarized in this document and expanded upon in the accompanying literature review).
- Read through the five steps and sub-steps before applying them, to understand the objectives and structure of each.
- Look at the processes/guiding questions, as well as tools, to understand how these conceptual steps can be operationalized and implemented on the ground.
- After understanding the objective of each step the users should reconsider their own experience as well as resources and expertise available to them; and make adjustments to the tools and processes as needed for their specific situation. Refer to additional resources in the annexes to get access to other guidance and frameworks.
- If possible plan and budget for necessary training and capacity building of the team that will be involved in assessing and implementing EbA.

1

Background and Rationale for the Implementation of Ecosystem-based Adaptation in the Greater Mekong Sub-Region

Climate Change in the Greater Mekong Sub-Region puts Pressure on Ecosystem Services and Communities

Climate change is a major sustainable development barrier, threatening to put significant pressure on human wellbeing and the natural systems that sustain it. Communities worldwide already experience more erratic, severe, and costly changes in natural patterns that undermine human development and put a strain on people's livelihoods. The poorest populations, which often rely on subsistence practices to sustain their livelihoods and have little access to essential assets and resources needed to cope with the impacts of climate change, are particularly affected. In Southeast Asia, there has been a remarkable increase in the frequency of climate related disasters such as floods, storms, and droughts. For example, for the decades of 1970–1979 and 2000–2009 the total number of floods per decade increased from seven to 118 (CRED, 2013).[1] During the past century, extreme weather events in the GMS have taken place more frequently and have increased in strength, resulting in loss of life and property. This includes very hot days, very cold days, or severe storms; changes in climate extremes, such as increase in the probability of intense rain and extended droughts; and sea level rise.[2]

The GMS is particularly vulnerable to climate impacts due to its geographic location, which increases exposure to weather-related hazards, along with a high socio-economic dependence on climate-sensitive sectors, widespread poverty, and low adaptive capacity. Despite recent and current economic growth, the region is still entrenched in poverty and food insecurity. Currently, 67 percent of the region's population lives in rural areas[3] that suffer from high incidences of poverty (GMS-EOC 2013). For example, in Vietnam 27 per-

In Cambodia a man employs two oxen to plow a rice field.

[1] Number of floods in different decades: 6 (1960–69), 7 (1970–79), 14 (1980–89), 68 (1990–1999), 118(2000–2009)

[2] CRED. 2013. *EM-DAT: Emergency Events Database*. Centre for Research on Epidemiology of Disasters. Available: www.emdat.be

[3] ADB GMS Statistics: http://www.gms-eoc.org/gms-statistics

Box 1 > Ecosystem-based Adaptation Definition

Ecosystem-based Adaptation is "the use of biodiversity and ecosystem services as part of an overall adaptation strategy, to help people and ecosystems to adapt to the adverse effects of climate change" (CBD, 2009). EbA analyzes linkages between ecosystems, communities, and climate change adaptation and can offer nature-based solutions adaptation solutions to reduce vulnerability of human beings.

cent of the rural population live below the national poverty line, versus six percent in urban areas. In Laos, these numbers are slightly higher, with 32 percent of the rural population below the national poverty line versus 17 percent of the urban population (World Bank 2008/2011). The rural poor in the region are highly dependent on natural resources for livelihood activities such as farming, fisheries, non-timber forest production, and livestock—all of which are highly sensitive to climate change and variability, thereby putting these communities at highest risk (GMS-EOC 2013).

Ecosystem-based Adaptation Offers New Opportunities to Build Resilience in Communities Reliant on Subsistence Livelihoods

Understanding Ecosystem-based Adaptation

Adaptation to climate change has emerged as a critical component to managing climate impacts worldwide and ensuring continued sustainable development. Planners and decision-makers have a range of adaptation pathways available to them that are generally divided into three or four categories: (1) *hard* or sometimes referred to as *grey* adaptation, (2) *soft* adaptation, (3) *green* or Ecosystem-based Adaptation (EbA), and (4) community-based adaptation (CBA) measures; although some literature considers green adaptation measures as a part of the soft adaptation measures. Hard approaches are characterized as capital-intensive, constructed-engineered solutions; soft approaches are characterized as being focused on institutions, behavioral, and policy approaches such as regulatory framework; and green approaches are characterized by an ecosystem-based/environmental management approach (The World Bank 2010b; EEA 2010).

Ecosystem-based Adaptation (EbA) analyzes linkages between ecosystems, communities, and climate change adaptation, and can offer nature-based adaptation solutions to reduce the vulnerability of human beings. Ecosystem-based Adaptation takes a people-centric approach as it uses biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change (CBD, 2013). The unique aspect of EbA is that it adds a social-ecological system (SES) dimension to the adaptation process. This indicates that the distinction between human and ecological systems is arbitrary, and the two should be viewed as being integral and interlinked (Berkes and Folkes 2003). If ecosystem services are relevant for a given community or sector—for example fisheries or farming—the adaptation strategies need to address the vulnerabilities of both natural and human systems at the same time, and consider the links between them (Locatelli et al. 2008).

Ecosystem-based adaptation is a relatively recent concept. However, strategies that utilize the services of healthy ecosystems have been implemented in various guises for some time. These include approaches to deal with episodic and/or long-term climate variability (particularly within the agricultural sector), and measures to reduce the consequences of natural disasters (UNFCCC 2011). Other practices, which were not originally conceived as climate variability, natural disaster, or climate change adaptation strategies, can often be very useful in increasing resilience to the expected impacts of climate change (Vignola et al. 2009). Much of the information about EbA is therefore not labeled as EbA, but often falls under categories such as ecosystem restoration, soil and water conservation, and disaster risk reduction (Munroe et al. 2011).

Because EbA often takes advantage of some conservation practices, EbA and conservation may often seem highly similar. For example, many conservation practices can be used to build resilience in communities against climate change as they increase ecosystem health and restore/maintain ecosystem services. The scope and objectives of the two practices differ, however. Conservation assumes static climate, and channels its focus on restoration or better management of damaged landscapes and preservation of landscapes. Ecosystem-based Adaptation, on the other hand, is designed to accommodate changes in a dynamic climate and reduce the vulnerability of people and ecosystems. The key factors that separate EbA measures from business as usual conservation are:

i. They are designed to address current and future impacts of climate change.
ii. They reduce the vulnerability of a social-ecological system that includes both people and ecosystems.

Ecosystem-based Adaptation can be implemented alone or in combination with other measures

Historically, there has been a bias for hard solutions at national (and some regional) planning levels (Parry et al. 2009), but soft and green solutions may offer new pathways that are safer and potentially less expensive. Hard solutions have especially been implemented in the water sector, where dams, dikes, and wells have been built or irrigation systems installed. Decades of experience in development and disaster risk reduction (DRR) has shown, however, that large-scale, hard infrastructure interventions are expensive and often only provide part of the solution to meeting people's livelihood needs (ELAN 2012). Though they have provided instant localized protection, they have in some instances also resulted in maladaptation and increased social vulnerability in the long run by disrupting and limiting ecological processes (CBD 2009). For example, infrastructure-based solutions often cause offsite problems for 'downstream' ecosystems and communities (Hirji and Davis 2009).

Compared to hard adaptation efforts, soft adaptation measures and EbA are generally considered to be more accessible to rural communities, lower in cost, and to offer co-benefits such as soil management, water regulation, carbon sequestration, and livelihood diversification opportunities. It deserves mentioning though that while some research shows that protecting biodiversity and ecosystems by using them sustainably is one of the most cost effective defenses against the adverse effects of climate change (TEEB 2010), a strong body of evidence for the overall effectiveness of EbA, including cost effectiveness, is still lacking. Some isolated cases of assessing the cost of ecosystem services have been undertaken, which can assist in communicating the value of such systems and thereby help assess the cost effectiveness. However, these are few in numbers, and more work is required.

Given the uncertainties associated with the climate change impacts, EbA is often a preferred strategy because it can be considered low- or no-regret; that is, it is not likely to result in maladaptation and yields multiple benefits even when accurate projections of climate change and their impacts are not available. Since ecosystems provide different types of services that increase human wellbeing, EbA serves the dual purpose of satisfying immediate needs and building safety nets and resilience for the future. Moreover, healthy ecosystems provide important services for DRR and can help reduce the gaps between DRR and adaptation efforts; for example, by serving as protective barriers against disasters and building local resilience by sustaining livelihoods and improving capacity to adapt to climate change.

EbA may not always be the optimal or only adaptation response necessary within a given system or area. A panel of solutions is often necessary to achieve the overall adaptation objective. This may require a combination of EbA and soft adaptation responses, CBA, or hard adaptation responses within the defined area or system (Box 2). For instance, protecting a coastline with a mangrove from floods may sometimes only work if complemented with some land-use planning and early warning, or a set of institutional solutions. Most EbA actions are highly dependent on institutions that may need strengthening. The challenge is to

Box 2 > Ecosystem-based Adaptation Combined with Hard-, Soft-, and CBA Measures

a. **Combining EbA with soft adaptation measures**: Should always be an objective. In practice, soft adaptation measures, which include changes in policies and behavior of individuals, societies, and institutions, are most always embedded in EbA, and provide excellent complements to EbA responses.

b. **Combining EbA with CBA measures:** Should always be an objective. There are many examples in available literature that elaborate on the similarities of EbA and CBA. At the local and site-specific level, they are almost always integrated, as participation and stakeholder engagement is crucial for EbA. Even at larger scale, such as national and landscape level, EbA should ideally always be complemented by CbA through local level pilots.

c. **Combining EbA with hard adaptation measures:** Should sometimes be an objective. While EbA is always complementary to soft and CBA measures; most of the time it contrasts with hard adaptation measures. Though very few examples in the available literature expand on "conditions" for integrating hard and EbA measures, EbA measures are generally combined with hard adaptation measures when the risk is too high and it is not known how EbA can perform against it; for example in coastal areas with a high risk of flood, where planting adequate hectares of mangroves may not be possible. However, it is necessary to remember that the decision needs to be made only after considering all possibilities and ensuring that the vulnerability analysis takes ecosystem vulnerability into account.

achieve the right balance between hard, soft, and EbA, under the right circumstances, in the right locations.

Ecosystem-based Adaptation builds upon a vast array of other disciplines, such as natural resource management, restoration ecology, sustainable development, and community-based conservation. Yet, there is still a need for additional work to be carried out to advance the practice. For example, as noted by the World Bank (2010) "robust information on specific benefits of EbA and the conditions under which those benefits are likely to be received is generally lacking." Decision makers must be convinced that green or EbA measures are capable of meeting their adaptation objectives. This will require a systematic consideration of the applicability, limitations, and risks of EbA options compared to traditional, often hard, infrastructure alternatives.

An Operational Framework for Ecosystem-based Adaptation Increases Resilience in the Greater Mekong Sub-region

For the GMS countries, EbA can provide adaptation solutions that are consistent with national development and adaptation goals, such as improving food security, strengthening coastal defense, and ensuring sustainable development. People's livelihoods and many key sectors in the GMS—such as investment in hydropower and tourism—are dependent on climate-sensitive natural resources, including forests, water resources, biodiversity, and other ecosystem services. EbA addresses the crucial links between climate change and these resources, considering natural resource management through a lens of enhancing community resilience. EbA also builds on existing capacities and efforts on natural resource management such as sustainable forestry, integrated water resource management (IWRM), and integrated coastal area management. In many cases EbA also offers solutions that are considered low- or no-regret; that is, activities which yield benefits such as improved forestry/watershed management (and others), regardless of whether expected climate changes occur.

The key needs in the GMS include (1) increasing awareness and capacity for adaptation including EbA;[4] (2) guidance on considering, assessing, and implementing EbA measures; and (3) building an evidence-base of how EbA contributes to reducing vulnerability.[5]

[4] Also identified in individual countries' National Adaptation Plans of Action (NAPA) and National Climate strategies in many countries.

[5] These needs were identified through stakeholder consultation carried out at project inception.

Coastal erosion in Bao Thuan commune, Ben Tre province. Vietnam.

The operational framework for EbA (also referred to as the framework or the EbA framework) proposed here provides technical guidance to GMS countries to help them assess and implement EbA measures, and integrate these approaches into their planning and policy systems. The framework enables users to consider EbA while formulating and prioritizing adaptation. *The framework acknowledges that EbA may not always be the most suitable adaptation option in all contexts and that the final decision on adaptation options depends on the different context and factors at play.*

The objective of the operational framework for EbA is to provide a user-friendly resource that offers guidance to the users and helps them:

1. Understand the interaction within an SES; that is a system comprising of both biophysical elements and socio-economic systems.
2. Assess current and future risks and vulnerability of the SES.
3. Design and prioritize adaptation measures.
4. Design and implement EbA projects.
5. Mainstream EbA in the national and sub national policy and planning processes.

An element of flexibility is built into the framework so that it can be applied in different conditions of resource availability and scales of decision-making. Since capacity is largely dependent on the available resources in the GMS, the guidance covers the following conditions for decision-making, for the first three steps:

a. *Low to medium budget availability and local scale*: Recognizing that most sub-national level decision makers face this challenge in the GMS, and taking the lessons learned from field-testing, unless otherwise specified the guidance is tailored for the decision

makers with lower resources for sub national and local scale.

b. *Medium to high budget availability and local scale*: In case of higher budget availability, the guidance recommends some spatial and geographic information system-based tools.

c. *Larger scale of decision-making*: Some guidance is provided for larger scale of decision-making, so that the users can upscale the framework and adjust it at national and landscape level.

A Framework for Ecosystem-based Adaptation will Cover Gaps and Add Value to Existing Processes

Ecosystem-based Adaptation remains a relatively new concept, but it is quickly gaining increasing attention in the global development dialogue as an effective mechanism for tackling climate change, with the added advantage of protecting biodiversity and helping to eradicate poverty. Since this task commenced, the EbA practice has gained prominence in the IPCC discussion as well as the Green Climate Fund (GCF) negotiations. The United Nations Framework Convention on Climate Change (UNFCCC) has begun discussions on incorporation in the climate system, and the concept will play a role in the nineteenth Conference of the Parties (COP) Meeting in Warsaw in November 2013. This makes the present framework highly relevant, since increased attention on EbA will call for the necessity of a framework that can guide policy makers on its implementation. However, this initial enthusiasm could fade—and critical policy support could fail to materialize—without more convincing evidence that it is an effective and efficient approach. Several gaps in existing practices, case studies, frameworks, and methodologies have been identified (Munroe et al, 2011). This framework makes attempts to address some of these gaps, such as:

- **More detailed comparisons between EbA and alternative adaptation strategies, taking into consideration the dynamics between social, environmental, and economic factors**. Although there are numerous frameworks and documents on vulnerability assessments and mainstreaming adaptation into development planning, detailed operational guidance on how to carry out EbA are very few. Available guidance on EbA does not necessarily adopt a social-ecological perspective with an emphasis on the context and vulnerability of communities as well as ecosystems. Understanding this dynamic is critical for identifying, selecting, designing and implementing appropriate EbA options or comparing against alternative options (such as hard solutions). This framework focuses a great deal of effort on the vulnerability analysis to compare differing options in each vulnerable setting considering the local economy, along with social and environmental factors.
- **More attention to the costs and benefits**: Past research on EbA tends to highlight its positive outcomes with comparatively little attention paid to the potential costs of EbA. This is not just in relation to economic costs (although this gap needs to be addressed more systematically and across a greater range of ecosystems), but also related to adverse actual and potential environmental and social effects. Cost effectiveness plays a big part in influencing policy makers and is a determinant in the success of an initiative. EbA measures are often cited as cost effective, and advocated for in part because of this attribute, without having adequate evidence of this. Most existing resources do not provide guidance on how to conduct a cost-effectiveness analysis. A field-tested methodology for cost-effectiveness analysis and examples of the field-testing is provided in this framework as a tool to compare various adaptation options, including hard adaptation measures, to support the evidence-base. Additional information on comparative cost-effectiveness analysis for adaptation measures is provided in the case studies that accompany this framework.
- **Greater consideration of the temporal and spatial aspects of EbA effectiveness**. In order to facilitate effective transfer of knowledge and increased capacity, more guidance on scenario analysis and spatial analysis is needed. These can be powerful tools in working with communities, infusing bottom-up and top-down knowledge, and examining various options and their implications.

Not all of the existing frameworks include guidance on scenario analysis and spatial planning, but both concepts are considered within this framework. The framework combines rigorous science, local knowledge, and participatory tools. Temporal and spatial analysis is integrated through the application of different tools such as InVEST[6] (Integrated Valuation of Environmental Services and Trade-offs) and other multi-criteria analysis tools.

- **More strategic Monitoring and Evaluation (M&E) of existing EbA projects**. Monitoring and evaluation of adaptation is an ongoing subject of discussion as it poses new challenges to carrying out M&E, specifically those related to the timeframe. Measuring results and the success of an adaptation project, policy, or program is difficult due to several issues including selecting indicators that can measure attribution, moving baselines over time, and the uncertainty surrounding climate change in general. That is, there is no certainty that an adaptation measure, including EbA, is successful unless the assumed climate change occurs. Monitoring and evaluation will need to be an integrated part of project implementation, but rethinking how it is done will require new methods including potential ex-post evaluations, and qualitative assessments. This framework proposes some indicators and methods for how EbA measures could integrate more systematic M&E, though this is one area where more work will need to be carried out.

Other gaps that generally exist in current frameworks include the lack of applicability at different scales. Most present guidance is limited to specific landscapes/ecosystems, have insufficient integration of EbA with CBA, and propose guidance that is too high-level in its form and not sufficiently operational for the target audience at the sub-national level. One of the major facets of the framework presented here is that it provides detailed operational guidance on how to conduct a vulnerability assessment of many areas, from the SES to sub-national governments. Adaptation planning and implementation at the sub-national level is crucial to address climate change adaptation due to its context specific nature; it cannot be successful without taking into consideration the local context, drivers of change, and vulnerability. As such, this body of work will contribute to a more substantial and concrete understanding of what is needed for adaptation of local SES. Though the framework in its current form is more suitable at the sub-national level, its architecture/conceptual model is multi-scalable. With some adjustments in the tools and activities, the framework can be up-scaled to any level.

Finally, the framework will help to generate more local level information on the application of EbA. Other gaps identified such as discussing tipping points and thresholds across a range of EbA measures, though highly important, has not been possible to address in the frameworks. These are important points, but need longer-term research.

This framework, while based on sound literature, has been applied to the rigors of the real world in two different landscapes. As a critical element of this, multi-stakeholder participation was incorporated in the design and field-testing of the framework, so the guidance provided is appropriate to the target audience. In order to create a user-friendly tool, a single document has been produced that users can utilize for clarification of key concepts and application in the field.

Practitioners Must Consider and Apply Essential Concepts Adopted from Related Development Fields

As mentioned, EbA builds on concepts from other related development fields. These are all essential to consider when developing and implementing EbA measures. Following is a brief summary of the concepts considered most important to EbA, along with an

[6] InVEST is based on ecological production functions and economic valuation methods. This tool is designed to address the principles of ecosystem-based management (EBM), bringing together credible, useful models based on ecological production functions and economic valuation methods, in order to bring biophysical and economic information about ecosystem services to bear on conservation and natural-resource decisions at an appropriate scale (Tallis and Polasky, 2009).

explanation of how those concepts "fit" in the EbA methodology.[7]

- **Social-ecological system:** It is important to understand human and biophysical interdependencies to establish human-centric adaptation solutions that are based on sustainable management of ecosystems. Social-ecological Systems (SES's) involve the interaction between humans and the biophysical world and are increasingly used as a mechanism for conceptualizing human-environment systems and how these systems can be managed to be sustainable and resilient (Berkes et al. 2003; Folkes 2006; Peterson 2010; Stokols et al. 2013).
- **Vulnerability over time and related components:** Vulnerability is "the degree to which an entity is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes" (IPCC 2007). It is generally described as being a function of three characteristics: exposure, sensitivity, and adaptive capacity (IPCC 2007; Gitay et al. 2002 in Bezuijen et al. 2011). An analysis of vulnerability for EbA includes an analysis of the threats over time, with the aim to either reduce current and future exposure and sensitivity or increase adaptive capacity by managing ecosystems.
- **Ecosystem services and vulnerability linkages:** The main principle of EbA is based on the close link between the health of ecosystems and the adaptive capacities of people within the coupled human-environment or social-ecological systems. It has long been recognized that healthy ecosystems have the capacity to better accommodate pressure and maintain resilience, and the adaptive capacities of human society are linked to the provision of ecosystem services (UNFCCC 2011). Put in another way, while human crises may not always result into environmental crises, environmental crises will nearly always result into human crises.
- **Resilience:** Resilience is described as a system's ability to bounce back to a reference state after a disturbance and the capacity of a system to maintain certain structures and functions despite disturbance. The concepts of adaptation, vulnerability, exposure, sensitivity, adaptive capacity, and resilience are interrelated and have significant overlap (Smit and Wandel 2006; Janssen 2007). Resilience is not simply the inverse of vulnerability, nor is it synonymous with adaptive capacity (Gallopin 2006). Rather, resilience can be looked at as a subset of adaptive capacity (with adaptive capacity considered broader); especially in a social setting regarding the ability to cope with impacts and take advantage of opportunities (Gallopin 2006). The EbA framework also looks at resilience as a subset of adaptive capacity.

The EbA framework presented here also considers resilience a subset or a part of the adaptive capacity of the SES, with special focus on communities and social systems. The ecological resilience factors such as connectivity, diversity, integrity, and so forth are not discussed in detail in the framework. While one reason for doing that is the scale (sub-national), another more substantial reason is because this framework aims to assist in formulating adaptation solutions that directly decrease a community's vulnerability.

While all or most of these concepts are essential for any kind of adaptation framework, for this EbA framework specifically, the articulation of these concepts depends on and must be interpreted in the context of:

i. *Adaptation of communities vs. ecosystems:* The primary objective of the framework is to support vulnerable communities to adapt to climate change with the recognition that their ability to adapt is interlinked with the ecosystems and ecosystem services. With that in mind, it is not the primary objective of the framework to increase ecological resilience, although the framework does touch upon concepts such as ecosystem resilience/vulnerability. The ecological resilience factors such as connectivity, diversity, integrity, and such are not discussed in detail in this framework. These factors/concepts pose a huge challenge especially for the target users at

[7] For further explanation of each concept, please refer to the accompanying literature review.

Box 3 > Guiding Principles for Implementing EbA

- Climate change adaptation must be integrated into broader sustainable development.
- The assessment of vulnerability and adaptation options should adopt a system perspective recognizing the connectivity between vulnerability of ecosystems and vulnerability of communities.
- Adaptation strategies must be custom-made and recognize the value of ecosystems services in building human resilience.
- Action must take place at the lowest appropriate level, with pilots at the local level.
- A two-way flow of knowledge transfer is necessary in identifying the risks and designing adaptation responses that includes recognition and transfer of a) local knowledge from communities and b) scientific data and tools for adaptation from practitioners, including climate change forecasts/projections/analyses, alternative future scenarios, long-term planning, and spatial analysis.
- Despite much uncertainty about the possible effects of climate change on local weather patterns and information gaps, build plausible scenarios on which to base decision-making and take a "no regret" approach.
- Support climate change adaptation from day one, but be precautionary.
- Take adaptive management approach and design flexible initiatives that allow for a diversity of answers to a single question, consideration of several adaptation strategies for the same goal, and a willingness to change focus and pathways mid-stream if needed (Andrade et al. 2011).

the sub-national level. Instead of focusing on these details, this framework takes a simpler approach and focuses on the factors that make an ecosystem vulnerable.

ii. *Ideal vs. Practical*: A comprehensive vulnerability analysis for EbA should ideally consider the totality of the system that constitutes communities, ecosystems, and all their inter-linkages. This ideal is however sometimes unrealistic in the real world where data, timeframes and other constraints necessitate a simpler and more practical tool. Hence the complexities of all the concepts discussed above (and in the literature review) are simplified as needed to make the framework applicable in a limited budget and in a relatively short time frame. Nevertheless, the framework provides guidance to consider for different components of a vulnerable system and their inter-linkages and offers ample opportunities for scaling up.

To design the framework, a set of guiding principles was used based on the literature and experiences of different organizations (Box 3). These provide the fundamental basis for the design of the EbA framework given the socio-economic development context and uncertainties surrounding the understanding of climate change impacts. These principles are expanded upon in Annex 1.

2

Operationalizing a Framework for Ecosystem-based Adaptation

The overarching objective of EbA responses should be to arrive at the solutions that will help decrease vulnerability and increase the resilience of communities and ecosystems by effectively utilize and manage natural resources such as forests, wetlands, and coastal ecosystems within a given area.

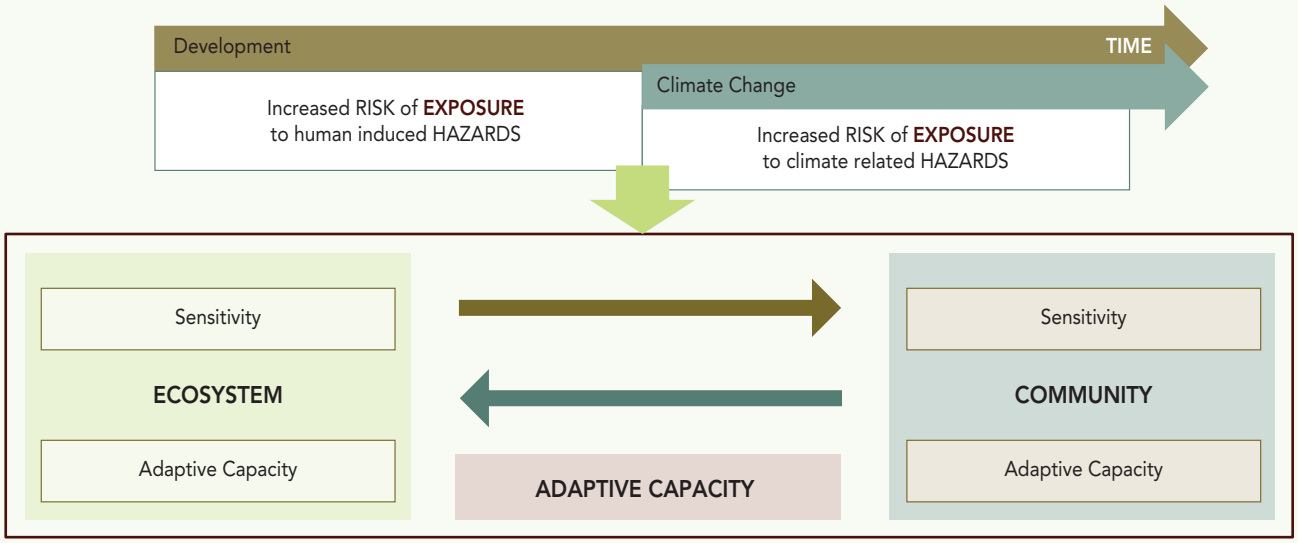
The basic conceptual architecture of the framework is presented in Figure 1. It consists of:

1. The context of different components of the SES, i.e. broader human (communities) and biophysical (ecosystem) conditions, including processes within the social and biophysical system;
2. Existing and future key drivers of change such as development activities and climate change; and;
3. Current and future vulnerability depending on exposure, sensitivity and adaptive capacity of the social ecological system.

The EbA framework builds on other vulnerability assessment frameworks, but applies an ecosystem and ecosystem services lens. The framework is structured to provide step-wise guidance to integrate ecosystem service considerations in each step of the assessment leading up to the design and implementation of adaptation responses including the consideration of EbA measures, and their subsequent integration in different planning processes. This operational framework provides detailed guidance on four steps.

Step 1: Vulnerability assessment of Social-Ecological Systems

Figure 1 > Conceptual Architecture of the EbA Framework



Source: Adopted from UNFCCC, 2011 and Locatelli 2008.

Tending to rice paddies in China.

- **Step 2:** Identification and Prioritization of EbA Responses.
- **Step 3:** Implementation of EbA Responses
- **Step 4:** Mainstreaming EbA in National and Local Climate Change Planning

Step 1: Vulnerability Assessment of Social-Ecological Systems

Checklist for Key Activities in Step 1

- Identify the parameter and boundary for the social ecological system to be assessed.
- Identify vulnerable groups, sectors, and areas.
- Include poor and marginalized groups, such as groups of women, lowest income groups etc. in focus groups.
- Identify local resource people and/or champions.
- Consult key stakeholders and focus group.
- Identify key linkages between the socio-economic sectors (e.g., livelihoods of the communities) and ecosystem services.
- Identify and map major ecosystem services and ecosystem areas.
- Assess issues arising from climate change and non-climate change for each vulnerable group.
- Document spatial and temporal aspects, i.e. when (what time of the year) and where of past climate hazards.
- Assess past and current climate and non-climate risks to ecosystems.
- Assess future risks from climate hazards based on climate change projections.
- Assess future risks from non-climate pressures based on development plans and other factors.
- Assess the level of vulnerability for each vulnerable group/sector or area.
- Share and revalidate vulnerability assessment findings.

At the sub-national level, community participation is a key factor in the vulnerability assessment. Before starting Step 1, the users must have identified the parameters and boundaries of the area that will be studied:

- **Parameters** include biophysical parameters like wetlands and forests, as well as socio-economic parameters such as communities and livelihoods. Examples of SES's can be agricultural units comprised of farmers and the agricultural land and forests available; coastal stretch and the people dependent on coastal resources; and wetlands and communities surrounding such ecosystems among others.
- **Boundaries** should be based on their key role within the SES including all essential ecosystems, ecosystem services and surrounding communities and other socio-economic sectors. The boundaries can also be based on administrative boundaries (planning units), or on the geographical location of communities that uses the ecosystem services in the selected area. Ecosystem boundaries can also be considered depending on the objective. For example, if the ecosystem considered is big in scale, it can be disaggregated, such that a part of for example a watershed system, or a coastal stretch can be studied.

Carrying out a vulnerability assessment is a key step needed to set the context within which the respective adaptation actions will take place. It should include who and what components of the SES's are vulnerable and what are the risks or threats. This framework uses an ecosystem lens to provide an integrated understanding of vulnerability drivers and who is vulnerable to specific climate hazards. It gives guidance to analyze: (a) the context of the socio-ecological system (SES) i.e. understanding sectors/communities and the ecosystems; (b) present future drivers of change including climate and development pressures to both communities, socio-economic sectors and ecosystems; and (c) exposure, sensitivity and adaptive capacity of the SES.

The vulnerability assessment is one of the most important components in the framework as it helps the user understand the key dimensions of the problem and it will help define what adaptation responses are needed. Since the subsequent analysis will be based on the vulnerability assessment, it is important to allocate enough time for this task. The vulnerability assessment proposed here relies on:

1. The *climate hazards and impacts* identified by the scientists including models downscaled to be used at the local level where available (Annex 2, tool 1.1).
2. *Perceptions and past experiences* in the identified vulnerable communities. These can be gathered by using participatory rural appraisal (PRA) tools (Annex 2, tool 3).
3. The use of *expert judgment and available modeling, simulation and GIS based software* for development and analysis of future scenarios (Annex 2, tool 4).

The processes and products outlined below build on existing and proven-to-be effective tools for participatory stakeholder consultations, and provide one way for assessing vulnerability while taking into consideration ecosystems and ecosystem services. In addition, it makes use of a combination of spatial tools: for example, InVEST together with other modeling tools. The users of this framework should consider the data available, keeping in mind the context of the ecosystem and communities in the area, and should modify the steps and guiding questions provided below accordingly. In this process it is important to remember that:

- Assessing vulnerability is a process that should feed back into itself.
- A single methodology, approach, or set of tools for assessing vulnerability for all situations does not exist.
- Details on time, resources and capacity needed to conduct the steps are not included given that it is very context specific; in other words, depending on the context the funding necessary and time needed may differ. However, an indicative example is provided at the end of the step. The steps are designed in such a way that the main potential risks and potential options can be identified through

Table 1 Snapshot of Step 1 – Carrying Out A Vulnerability Assessment

Steps	Objective	Outputs	Tools
1. Vulnerability assessment of SES	**EbA lens: Current and Future risk and vulnerability of the Social-Ecological System**		
1.1. Understanding the context of SES (communities, their demographic, socio-economic conditions, key sources of livelihood and how they are supported by the ecosystem services).	To understand different groups within the communities and their current dependency on ecosystem services for their livelihood and other purposes.	i. A community profile of the study area. ii. List with ecosystem services ranked in accordance with their level of importance in the communities. iii. Groupings of key beneficiaries from the ecosystem services.	*Tool 1:* Secondary research and data collection. *Tool 3:* PRA *Tool 3.1:* Focus group discussion (FGD) *Tool 3.2:* Seasonal calendar *Tool 3.3* Community mapping
1.2. Understanding and mapping ecosystems and ecosystem services in the study area.	To identify major ecosystem services provided (including key species if relevant) to the communities and other socio-economic sectors in the study area.	i. A map of the community identifying ecosystems and ecosystem services. ii. A digital map of the study area showing key ecosystem services and their current distribution and amount.	*Tool 5:* Expert judgment *Tool 3:* PRA *Tool3.1:* FGD *Tool 3.3:* Community mapping
1.3. Understanding current threats or risks from climate change to the communities.	To understand climate characteristics in the study sites. To understand key concerns of the communities with regards to climate change and analyze the risks and impacts on different stakeholders/ groups within the communities.	i. Hazard map and hazard ranking. ii. Seasonal calendar with climate risks. iii. Past trend identifying climate hazards. iv. List of coping strategies.	*Tool 3:* PRA *Tool 3.1:* FGD *Tool 3.3:* Community mapping *Tool 2.2:* Historical timeline
1.4. Understanding threats and pressures from non-climate risks and different socio-economic dynamics including potential development plans to the communities.	To understand whether the existing socio-economic dynamics can increase or decrease the resilience of communities to cope with climate change. To understand how such change in socio-economic dynamics over time may push the community to be more (or less) resilient.	i. A list of socio-economic factors that make the community vulnerable. ii. Potential development plan and its projected impact.	*Tool 1:* Secondary research and data collection (Policy review) *Tool 3:* FGD/ Key informants interview
1.5. Understanding the threats from current climate and non-climate risks to the ecosystems and ecosystem services.	To assess the impacts of climate change and socio-economic dynamics to the ecosystem, in particular key ecosystem services and species. To assess how long ecosystems take to recover.	Current climate and non-climate risks and impacts identified.	*Tool 1:* Secondary research *Tool 3:* FGD *Tool 5:* Expert judgment
1.6. Creating future scenarios to identify future vulnerabilities to climate and non-climate change.	To identify potential risks and impacts from climate change and socio-economic dynamics in future based on climate change Projections. To identify how land-use will change (spatial analysis) under different scenarios in future.	Future risks and impacts from climate change and development pressures identified; different scenarios for the future developed.	*Tool 5:* Expert judgment *Tool 4:* Scenario analysis *Tool 4.1:* Modeling and simulation
1.7 Assessing exposure, sensitivity and adaptive capacity.	To assess and rank how vulnerable each sub-component/sector is.	Risk and Vulnerability Ranking	*Tool 3:* FGD *Tool 5:* Expert judgment
1.8 Summarizing the information and creating a vulnerability matrix.	To summarize and analyze the information collected	Vulnerability matrix	*Tool 3:* FGD *Tool 5:* Expert judgment

a simple analysis based on discussion with experts and stakeholders, and then the users can move to get more in-depth information on these potential risks and options – if resources allow.

- A multidisciplinary team is necessary to carry out the vulnerability analysis. The expertise needed include social science research methodology and data analysis, ecosystem and ecosystem services, familiarity with climate change issues and some mapping tools such as GIS. Efforts should be made to link with "bridging institutions" (i.e., the institutions that can provide for any gaps in capacity). Bridging institutions may be NGO's, INGO's, local academic institutions doing similar analysis, etc.

Step 1.1 Understanding the Context of the Social-Ecological System

Output/s: (i) Community profile; (ii) Ranked list of ecosystem services that are important to the communities; (iii) Groupings of key beneficiaries from the ecosystem services

Tools: Secondary research and data collection, PRA (Focus Group Discussions [FGDs], seasonal calendar, community mapping)

Process/Guiding questions:

i. Prepare questions/questionnaires and other participatory exercises such as a seasonal calendar. Examples of questions posed could include:
   a. What are the major "sectors/stakeholders" or "livelihood groups" within the study area?
   b. What provisions do these different groups collect from the natural resources such as forests/watershed etc.?
   c. In different months/seasons, what livelihood activities engage people? (Can also be addressed through a seasonal calendar.)
   d. What is the socio-economic value of priority ecosystem goods and services; e.g. what percentage of household income comes directly from the surrounding ecosystems; does it support their sustenance; or is it sold in the markets?

Box 4 > Integrating Gender in EbA

Why should gender be considered?

- Gender disparity and inequality increases the vulnerability of women and hence the whole community.
- Climate change may affect men and women differently. The adaptive capacity of people depend on various factors such as decisions on management of resources, mobility, skill-sets, access to information and knowledge, etc. These may vary for men and women
- Understanding the differences of men and women in interacting with resources, perceptions of what are the risks and what should be done, helps in adaptation decision-making.
- Men and women both play a role in maintaining healthy ecosystems for EbA.

Women take part in Vulnerability Assessment.

How is gender addressed within this framework?

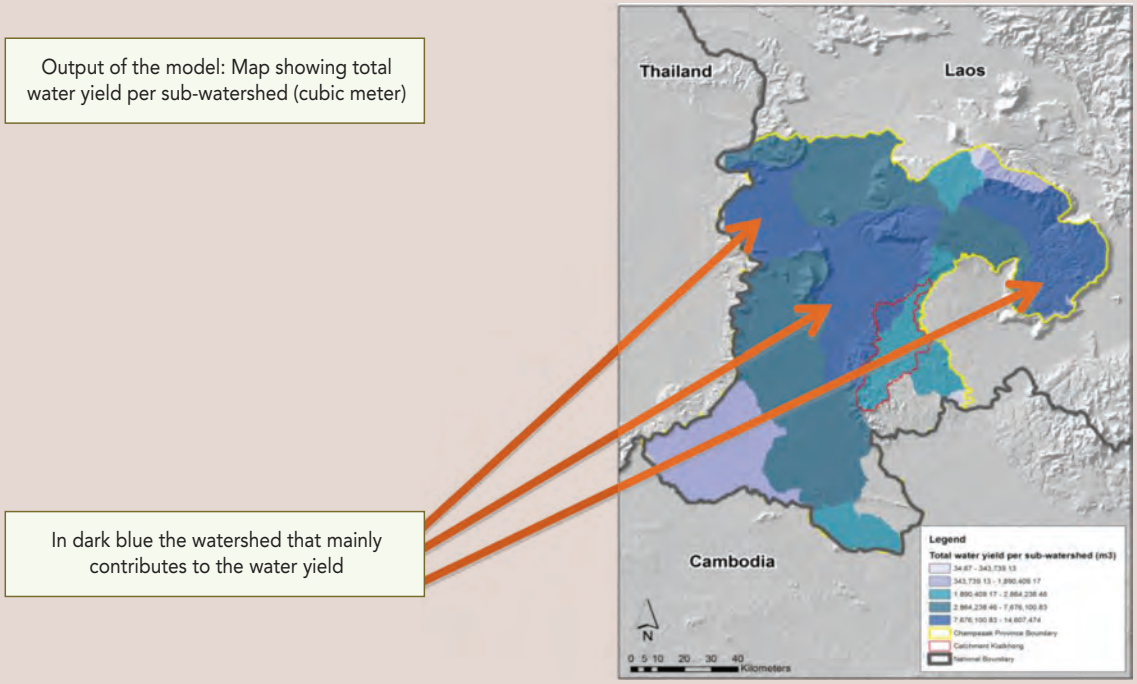
- The framework ensures that both men and women are represented in the multi-disciplinary teams that are responsible for undertaking EbA assessment.
- The framework ensures that women's perceptions and roles are included in stakeholder discussion, focus groups etc. and in the final analyses of the adaptation options.

Example 1 > Mapping of Ecosystem services using GIS-based software in Champasak, Lao

Model: Water Yield model (InVEST)

What it does: Determines the amount of water running as the precipitation minus the fraction of water that undergoes evapo-transpiration.

Objective: The objective of running this model is to determine which sub-watersheds are most important to total annual water yield. This helps to inform the decision on where the EbA actions should focus in order to increase water yield.



Source: WWF, 2013.

v. Rank different community groups based on how dependent they are on the ecosystem goods and services and identify the key beneficiaries.
vi. Rank (using qualitative measures) the ecosystem services in order of how important they are (economically, socially, and/or culturally) to the communities.
vii. Develop a community profile and a list of ecosystem goods and services that are important to the community.

For scaling up and/or for sub-national scale with sufficient budget

Outputs:

i. A profile of key socio-economic sectors and their dependence on ecosystem services.
ii. List of key ecosystem services for different ecosystems within a landscape, if possible, ranked according to importance.

Tools: Collection of secondary data and maps, inter-sectoral meetings and workshops to exchange knowledge.

Process:

i. Identify priority sectors for a given landscape/country based on their importance to development, for example: agriculture, hydropower, energy, transport, and so forth.

ii. Through secondary data and multiple consultations with different sectors identify and quantify direct consumption of natural resources by the different sectors.

Step 1.2 Understanding and Mapping Ecosystems and Ecosystem Services in the Study Area

Outputs: (i) A community-developed map of the ecosystem and ecosystem services; and/or (ii) A digital map of the study area showing key ecosystem services and their current distribution.

Tools: PRA (FGD, community mapping), expert judgment, consultation with stakeholders, community resource mapping.

Processes:

i. On a large map or aerial photo of the area, ask the focus groups/community representatives to identify (i) the major habitat of ecosystem type (for example forest types), and (ii) the location of livelihood assets. If the community has a prior existing map (for resources or disasters) the same map can be used.
ii. Identify and indicate on the map where priority ecosystem services are based on Step 1 and 2 for the detailed study and analyses.

For scaling up or for sub-national scale with sufficient resources

Outputs: A digital map of the study area showing key ecosystem services and their current distribution and amount.

Tools: GIS-based software

Process:

i. Identify and obtain the best source of existing data on historic and current vegetation/land cover classes to make a digital map.
ii. Collect any available contextual data, such as tenure, roads, settlements, rivers, terrain, catchment boundaries, and so forth should also be compiled at this stage.
iii. Conduct spatial and quantitative valuation of the ecosystem services using InVEST, or other appropriate methodologies and software for this type of spatial analysis.

Step 1.3 Understanding the Threats or Risks from Current Climate Change to the Communities

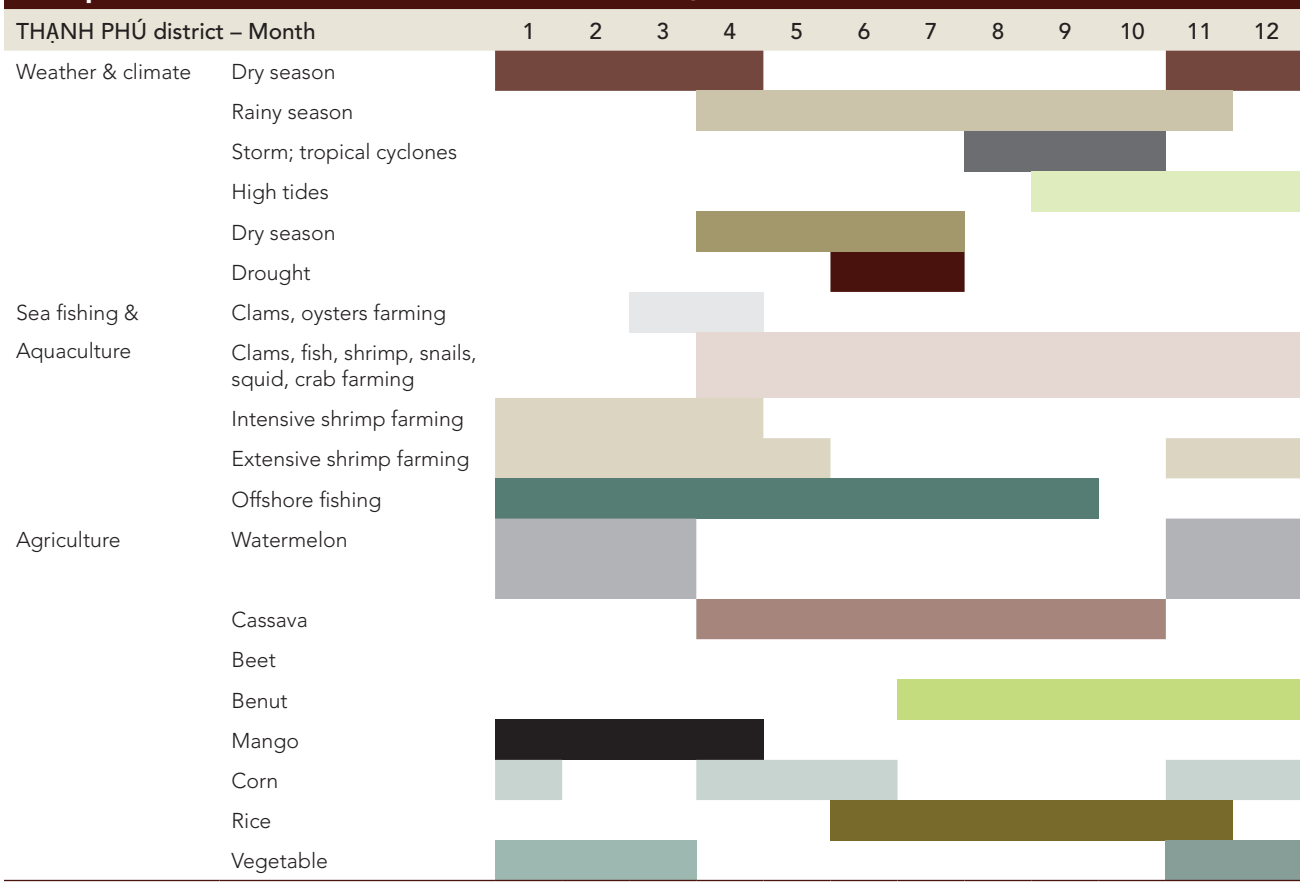
Outputs: (i) Hazard map and hazard ranking; (ii) Seasonal calendar with climate risks; (iii) Past trends identifying climate hazards; and (iv) List of coping strategies.

Tools: PRA (FGD, historic timeline, community mapping).

Process/Guiding questions:

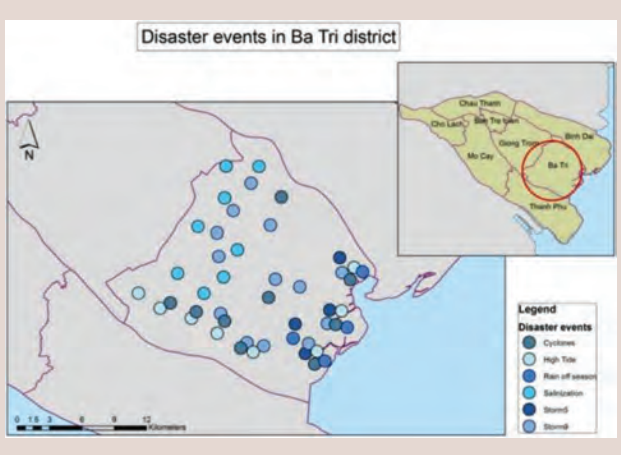
i. Collect information on available climate change projections at the local level and on predicted impacts from secondary data collection, or key informants' interviews.
ii. Explain the concept of climate hazards to the communities and, based on the community's perception, identify the common climate hazards in the area including intensity. Some discussions may be needed to conclude whether a particular hazard is caused by climate change, some other external factor, or a combination of both. The guiding questions should include:
    - What are the common climate hazards (such as floods, droughts, landslides, etc.) in the area based on community's perception?
    - What is the history of hazards in the area? And what was the intensity of these? This information should be included in a historical timeline.
    - Which locations (communities and ecosystems) are more prone and exposed to hazards?
    - What are the impacts from climate hazards? Which hazards are particularly harmful to the livelihood activities in the area? Which hazards are most likely to cause more damages? Can climate hazards be ranked based on their potential extent of impacts?
    - Which communities are most vulnerable to climate hazards? What are the factors that make them most vulnerable?

Example 2 > Seasonal Calendar in Thanh Phu District, Vietnam



Source: Field testing, WWF, 2013.

Example 3 > Participatory Hazard Mapping, Ben Tre, Vietnam



Source: Community mapping in Vietnam, WWF 2013.

- When are hazards, such as floods, droughts etc., most likely to occur in a year? How long do they last?

iii. Take the map from Step 2 and prepare a hazard map with participation from the communities to identify: (i) the locations that are prone to hazards; (ii) the types of hazards in different locations; and (iii) the communities most at risk from the hazards.

iv. Identify periods and seasonality of climate hazards and combine it with the seasonal event calendar for livelihood of different groups.

v. Based on the historical timeline, discuss the potential trend of climate change and likely impacts in future.

vi. Do a participatory hazard analysis and identify the hazards that are most likely to occur, hazards that are most likely to cause more damage and other hazard related information.

For scaling up and/or for subnational scale with sufficient resources

Outputs: Hazard map and hazard ranking

Tools/Methods: Secondary data collection and analysis, GIS-based software

Process:

i. Collect secondary data on past hazards, their intensity, location of origin and area affected by them.
ii. Take the map from Step 2.2 and prepare hazard maps that reflect (a) the locations that are prone to hazards; (b) the types of hazards in different locations; and (c) the communities/sectors and the "eco-zones" most at risk from the hazards.

Step 1.4 Understanding the Pressures on Communities from Different Socio-Economic Dynamics, Including Potential Development Plans

Outputs: (i) A list of socio-economic factors that make the community vulnerable; and (ii) a potential development plan and its potential impact.

Tools: Secondary research and data collection, PRA (FGD).

Processes/Guiding questions:

i. Identify and develop a list of non-climate drivers (such as development pressure, conflicts, or others) that have affected the communities in the past either positively or negatively.
ii. Identify the major resources of concern (natural and economical) and how they have changed over the years.
iii. Find out how resources are managed and whether there have been any conflicts over them.
iv. Find out how access to resources differs within the communities.
v. Collect information from the existing potential development plan and discuss with the communities about the positive and negative impacts of the proposed development.
vi. Initiate discussion on whether different sectoral plans complement or conflict with each other (for example, agricultural plans, forestry plans, land-use plans, conservation plans, and so forth).
vii. Identify communities that are likely to be most affected (either positively or negatively) from development plans and socio-economic dynamics, and list the reasons why.

Participatory mapping in Lao PDR.

For scaling up and/or for subnational scale with sufficient resources

Outputs: Same as for local level.

Tools: Secondary data collection and analysis.

Process:

i. Identify non-climate threats to different priority sectors, for example lack of sectoral collaboration, or economic instability.
ii. Analyze development plans for priority sectors to determine if they complement or conflict with each other (for example agricultural plan, forestry plan, land-use plan, conservation plan, and so forth).
iii. Identify communities that are likely to be most affected (either positively or negatively) from development plans and socio-economic dynamics, and list the reasons why.

Step 1.5 Understanding the Threats from Current Climate Change and Development Activities to the Ecosystems and Ecosystem Services

Output: Current climate and non-climate risks and impacts identified.

Tools: Secondary research and data collection, expert judgment, and PRA (FDG).

Processes/Guiding questions:

- Take each climate and non-climate hazard identified in Step 1.4 (above) and prepare questions/questionnaires and exercises to understand the following:
  - What are the positive/negative impacts of non-climate related activities including development activities on ecosystems?
  - How have ecosystems been affected by past hazards?
  - Are current natural resources in the area being overexploited? If yes, how can that be stopped?
  - What are the most important species to the communities? How do hazards affect these species?
  - Which ecosystems/ecosystem services are most vulnerable to the current development activities such as roads, tourism, and so forth?
  - What are the communities doing to protect ecosystem services?

For scaling up and/or for sub-national scale with sufficient resources

Outputs: Current climate and non-climate risks and impacts identified.

Tools: Secondary data collection and analysis.

Process:

i. Identify existing threats to natural habitats and ecosystem degradation.
ii. Analyze relevant sectoral plans to see whether they conflict with each other and especially biodiversity conservation plan.
iii. Analyze different sectoral plans to identify communities and landscapes most affected by the potential development.

Step 1.6 Creating Future Scenarios to Identify Future Vulnerabilities to Climate and Non-Climate Change

Output: (i) Future risks and impacts from climate change and development pressures identified; and (ii) different scenarios for future developed.

Tools: Expert judgment and scenario analysis (modeling and simulation).

Processes/Guiding questions:

Climate adaptation planning is a complex process, as practitioners must consider how decisions made in the present can influence an uncertain future; this practice is called scenario planning and analysis. There are a number of tools that can generate future scenarios to assess possible outcomes and help identify which outcomes look most attractive and which should be avoided. Scenario analysis as a tool is discussed at length in Section III. To carry out scenario analysis, users should:

i. Decide upon a planning horizon for the scenarios based on the context; for example 5 years, 10 years, 20 years, 50 years, or another timeframe. If the scenarios are based on government plans, the time horizon will be included based on the planning cycle. Ecosystem-based Adaptation may sometimes require a longer time horizon for planning and especially for full assessment of its impacts for M&E. Hence, to decide on the planning horizon there need to be some discussion on the objectives of intended EbA initiative.
ii. Discuss future development scenarios based on the past trends and the available socio-economic development plans (i.e., what is likely to change?). What infrastructure would be developed? What would it mean for natural resources? How does future land-use look under various alternative scenarios?
iii. Use stakeholders and experts to develop three or more alternative visions for the study area's future landscape. The scenarios normally include a business as usual (BAU) scenario; increased/decreased development pressures; increased climate risk.
iv. Determine future vulnerability (risks and impacts) from climate change and development pressures to the social-ecological system in each scenario.

Example 4 > Use of InVEST Model in Scenario Analysis in the Mekong Delta, Vietnam

Model: Near Shore Waves Erosion Protection Model (InVEST)

What it does: The model simulates wave transmission based on the information from tide and storm information integrated with seabed topology, habitat distribution, and biology. "It quantifies the protective services provided by natural habitats of near shore environments in terms of avoided erosion and flood mitigation. [This] informs land management decisions by highlighting the relative contributions of different coastal habitats in reducing erosion and attenuating near shore wave heights and energy levels" (Natural Capital Project 2013).

Objective: The objective of this model is to help planners; landowners and other stakeholders understand the coastal protection services provided by near shore habitats and also to compare what happens if there are no habitats.

In the case of Vietnam, it is easier for planners to understand the effectiveness of "hard" measures such as dikes in reducing the wave height, but this model, calculates the reduction of wave heights under different scenarios, including conservation scenario, where mangroves are planted to reduce the wave heights. In the Mekong Delta in Vietnam, where the EbA framework was field tested, three scenarios were developed based on (I) the Government's plans for 2020 and (II) experts' knowledge. The assumptions for each scenario are described below.

I) *Business as Usual (BAU) Scenario based on the Land-use Plan*

- The economic development growth rate is the same as the previous period (2000–2010);
- The provincial land-use plan towards 2020 is fully implemented.

II) *Development scenarios based on the Agricultural and Rural Infrastructure Development Plan*

- Agriculture and aquaculture areas are expanded;
- Rice and shrimp farming systems are intensified;
- All the planned infrastructure is constructed including dikes;
- Newly proposed urban and industrial areas are developed.

III) *Conservation Scenario*

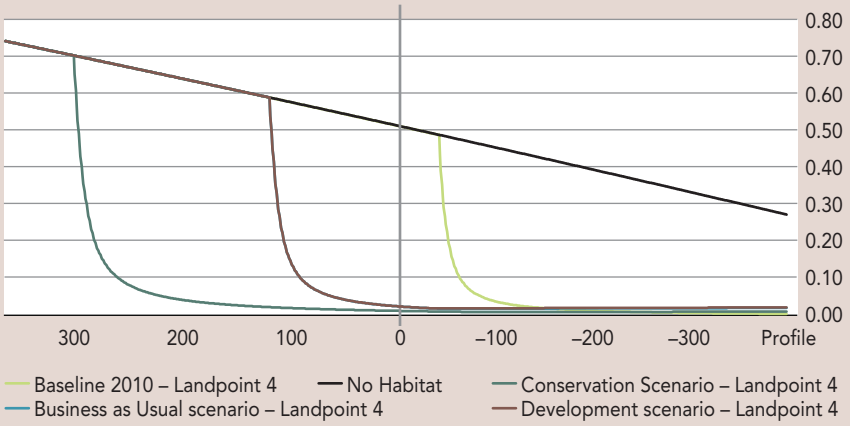
- More conservation areas (i.e.,Vam Ho bird sanctuary, clam breeding areas, fish conservation zones) are established and well managed; and
- Mangroves cover all the planned forestry area

The figure below shows the percentage of wave height and energy changes at one specified land point under different scenarios (seven land points were modeled overall).

Output of the model:
Percentage of wave heights reduced

No Habitats (mangroves/sand dunes): the wave will surge further to 300–400m to inland.

Plantation/Protection of habitat: Waves of about 0.7m reduced to 0.1m at 300 meters from the coastline



The black line (no-habitat) means if there are no mangroves and sand dunes, the wave surge will be 300–400m inland. The current mangrove belt and sand dunes (baseline) have reduced the wave height from 0.4m to 0.1m when it reached 100m inland. In the BAU and development scenarios, the wave height reduced from 0.6m to 0.1m at 100m from the coastline to the sea. In the conservation scenarios, the wave height reduced from 0.7 m to 0.1m at 300m from the coastline thanks to mangroves expansion and plantation of the dunes.

Example 4 > Example of Risk Ranking Matrix

A. Risk Ranking Matrix

Exposure (likelihood)						
	High (5)	M	MH	MH	H	H
	Moderate-High (4)	LM	M	MH	MH	H
	Moderate (3)	LM	LM	M	MH	MH
	Low-Moderate (2)	L	LM	LM	M	MH
	Low (1)	L	L	LM	LM	M
		Low (1)	Low-Mod (2)	Moderate (3)	Mod – High (4)	High (5)
Sensitivity (consequence)						

B. Socio-Economic Vulnerability (Risk Ranking) Matrix

Exposure and Sensitivity						
	High (5)	M	MH	MH	H	H
	Moderate-High (4)	LM	M	MH	MH	H
	Moderate (3)	LM	LM	M	MH	MH
	Low-Moderate (2)	L	LM	LM	M	MH
	Low (1)	L	L	LM	LM	M
		High (1)	Mod – High (2)	Moderate (3)	Mod – Low (4)	Low (5)
Adaptive Capacity						

Source: ICEM climate change adaptation and mitigation methodology (CAM).

For scaling up and/or for subnational scale with sufficient resources

Products: Maps showing the change in the amount and in the distribution of ecosystem services due to climate pressures within the study areas for both the scenarios.

i. If there is sufficient budget and capacity, a scenario analysis can be done using different GIS-based tools. The land cover change analyses can be developed using either development plans, land change modeling tools, or simply by consulting stakeholders on how to assess what change in land cover they foresee based on the future scenarios identified. This step should be made using a methodology that will allow converting this information into GIS-data.
ii. All the new land cover maps will be used as input data in the ecosystem services models to assess how they will change under the alternative scenarios. In possible ecosystem services models the combination of land cover change and climate change can be included in the analyses.
iii. To identify the effect of the combination of climate and non-climate changes to the ecosystem services an InVEST model can be run. This model uses the land cover maps coming from the land change modeling scenarios, and the different climate variables as inputs to assess the effects of both climate and non-climate change (Example 4).

Step 1.7 Calculating and Ranking Exposure, Sensitivity and Adaptive Capacity for Hazards

Output: Risk and Vulnerability Ranking.

Tools: PRA (FGD), Expert judgment.

Processes/Guiding Questions:

i. Identify sub-units within the socio-ecological system, for example different groups of communities

Example 5 > Indicators for exposure, sensitivity and adaptive capacity for social ecological systems

There are four important factors to consider when assessing vulnerability of an SES:

Exposure is the degree of climate stress on a particular system. Indicators could be based on:

- Geographic location
- Magnitude, severity and frequency of extreme events

Sensitivity is the degree to which a species or system will be affected by or responsive to climate change exposure. Indicators could be based on:

- Level of dependence on natural resources
- Condition of natural resources
- Demography of the community groups

Impact (or level of risk) is a function of the level of exposure to climate change-induced threats, and the sensitivity of the target assets or system to that exposure.

Adaptive capacity is understood in terms of the ability to prepare for a future threat and in the process increase resilience and the ability to recover from the impact. Indicators could be based on:

For natural systems

- Species diversity and integrity.
- Species and habitat tolerance levels.
- Availability of alternative habitat.
- Ability to regenerate or spatially shift.
- For individual species: dispersal range and life strategy.

For communities

- Current livelihood and income diversity of household.
- Perceived alternative and supplemental livelihoods.
- Awareness of household vulnerability to climate hazards.
- Access and use of climate-related knowledge.
- Formal and informal social networks.
- Ability of community to reorganize.
- Leadership and governance.
- Equitable access to resources.
- Insurance and financial resources.
- Access to external services (medical, finance, markets, disaster response etc.).
- Access to alternative products and services.

For infrastructure

- Availability of physical resources (e.g., materials and equipment).
- Backup systems (e.g., a Plan B).

Crosscutting factors

- The range of available adaptation technologies, planning, and management tools.
- Availability and distribution of financial resources.
- Availability of relevant skills and knowledge.
- Management, maintenance, and response systems including policies, structures, and technical.
- Staff and budgets.
- Political will and policy commitment

Source: Developed/Adapted from ICEM (2013).
Note: It is not always easy to determine and measure indicators for vulnerability, especially for the natural systems. In the field-testing, some indicators were used, but not all.

Table 2 > Example of Vulnerability Matrix

	Current Hazards	Future Climate and non-Climate hazards	Exposure	Sensitivity	Risk Ranking	Adaptive Capacity	Vulnerability
Community group/Sector 1	Description		Low -High	L-H	L-H	L-H	L-H
Community group/ Sector 2							
Community group/ Sector 3							
Ecosystem component/ hotspot 1							
Ecosystem Component/ hotspot 2							

and different ecosystem units or services (such as mangroves, sand dunes etc.)

ii. This process can be done for both ecological systems and community/socio-economic systems. For ecosystems, make note of the severity of impacts during past extreme events to calculate the sensitivity of a particular ecosystem.

iii. For each threat (or a selection of the most important threats if there are too many threats) evaluate the risks and vulnerabilities within each sub-unit. This evaluation is best done by an expert or a series of experts. Each sub-unit will be given a score between 1 and 5 for *exposure* (likelihood) and *sensitivity* (consequence).

iv. The exposure and sensitivity ratings are then related to each other to determine the *risk ranking* of that particular threat, to that particular sub-unit. See Example 4 below.

v. Take the cumulated rank of the risk in the above matrix and plot it against the adaptive capacity to gain an overall picture of vulnerability of the communities and/or socio-economic systems.

vi. Unless adaptive capacity of the ecosystem can be calculated in a meaningful way, do this step for the socio-economic system only.

Step 1.8 Summarizing the Information and Creating a Vulnerability Matrix

Outputs: Vulnerability matrix

Tools: PRA (FGD); Expert judgment

Process/Guiding Questions:

i. Creating a vulnerability matrix (Table 2) is one way to present the vulnerability analysis, but as long as the analysis is complete and presented in a way that makes sense to the users, this step may not be necessary.

ii. Calculate and rank exposure, sensitivity, and adaptive capacity of each identified hazard.

iii. Rank vulnerability of communities and ecosystems based on the climate and non-climate risk, exposure sensitivity and adaptive capacity from the previous step. Depending on the context, the user may either:

iv. Assess exposure, sensitivity and adaptive capacity, and rank vulnerability as a combined function of these from low to high. The indicators to assess exposure sensitivity and adaptive capacity are developed together by the focus group discussion and expert's judgment.

v. If it is not feasible to assess exposure and/or sensitivity and/or adaptive capacity, analyze the information collected above instead and rank the vulnerability based on risks and impacts. This may in particular be necessary for ecosystems.

The vulnerability assessment is one of the most crucial and one of the most challenging steps necessary to identify appropriate EbA responses. To assist the users, Annex 2 presents various resources for climate risk screening tools, links to resources for assessing impacts of different drivers on ecosystems, and a list of resources to help map and valuate ecosystem services.

Table 3 > Snapshot of Step 2 – Identifying and Prioritizing Adaptation Strategies

Steps	Objective and EbA lens	Outputs	Tools
2. Developing adaptation strategies	*EbA lens:* Consideration of ecosystem services while designing adaptation options		
2.1. Identifying existing coping strategies and strategies for adaptation	To develop a list of hard adaptation and EbA measures and strategies to address existing and future vulnerabilities	(i) A list of coping strategies (ii) A list of adaptation strategies	*Tool 3:* PRA *Tool 3.1:* FGD/ Key informants' interviews
2.2. Suitability and prioritization of adaptation options	To compare how different adaptation strategies perform to achieve the adaptation target/objective	A criteria for screening adaptation strategies	*Tool 7:* MCA
2.3 Cost effectiveness	To compare cost effectiveness of different adaptation strategies	Cost effectiveness of each adaptation option identified	*Tool 1:* Secondary research and data collection *Tool 5:* Expert judgment

Step 2. Identifying and Prioritizing Different Adaptation Reponses

The purpose of Step 2 is to identify a broad range of potential alternatives including hard and soft adaptation measures. For each hazard, a range of alternatives should be identified, which include EbA responses and other solutions (hard, soft, or CBA). These approaches are then evaluated based on different criteria to select the optimum adaptation strategies. Based on the nature of the adaptation criteria, the framework will provide a methodology for both Cost Effectiveness Analysis (CEA) and MCA.

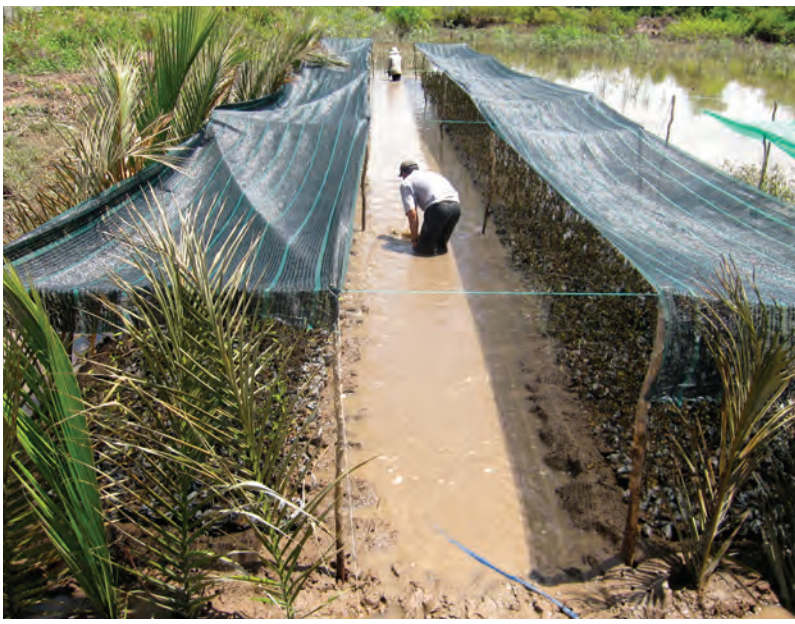
Checklist for Step 2

- Identify coping strategies of different vulnerable groups and sectors identified in consultation with the stakeholders.
- Consult expert groups to formulate appropriate adaptation strategies for communities and ecosystems.
- Identify the preferred future with adaptation strategies implemented.
- Assess specific problems and priorities of the vulnerable groups, sectors, and ecosystems.
- Identify the adaptation strategies that meet the adaptation objectives.
- Develop and rank multiple criteria for prioritization of adaptation strategies.
- Include cost effectiveness as criteria.
- Prioritize and short-list adaptation strategies based on the agreed criteria.
- Identify and discuss the adaptation responses with the local stakeholders to get their input.

Step 2.1 Identifying Existing Coping Strategies and Responses to Climate Change

Outputs: (i) A list of coping strategies; and (ii) a list of adaptation strategies.

Tools: PRA (FGD).



Mangrove nursery built in An Thuy commune to provide enough, healthy, and diversify mangrove seedlings for restoration, Ben Tre province, Vietnam.

Example 5 > Potential Ecosystem-based Adaptation Strategies

Coastal Ecosystems and Coastal communities

- *Maintenance and/or restoration of coastal vegetation* (such as mangroves) to provide coastal defense and reduce coastal erosion. The vegetation reduces the strength of waves before they reach the shore and therefore reduces the intensity of coastal inundation and erosion (Munroe et al. 2011). This would enhance ecosystem services in the community such as erosion control, nutrient recycling, production of atmospheric oxygen, and other benefits, as well as potentially expand fish stocks with the increase in spawning and feeding grounds for fish.
- *Brush mattressing* involves placing a layer of branches on a dune/shoreline or stream bank designed to protect against small-scale erosion from waves and wind (UNEP 2012). It addresses erosion control and nutrient recycling.
- *Floating gardens or floating agriculture* for areas which are seasonally flooded or waterlogged for long times (IUCN 2011; UNEP 2012) to enhance provisional services.

Forested Catchments and Communities reliant on agriculture and fisheries

- *Conservation and restoration of forests and natural vegetation* to stabilize hillside/mountainside slopes and regulate water flows, preventing flash flooding and landslides as rainfall levels and intensity increases (Munroe et al. 2011).
- *Introduction of community fisheries* to help preserve fish stocks and the establishment of community forests to ensure sustainable supplies of timber, non-timber forest products, and forests foods. This example addresses provisional ecosystems services such as food, timber etc.
- *Establishment of healthy and diverse agroforestry systems* (the integration of food production into forests) to cope with changed climate conditions (Munroe et al. 2011)
- *Conservation of agro-biodiversity* to provide specific gene pools for crop and livestock adaptation to climate change (UNFCCC 2011).
- *Managing the spread of invasive alien species* that are linked to land degradation and that threaten food security and water supplies (UNFCCC 2011).
- *Integrated nutrient management* to integrate the natural and man-made soil nutrients to increase crop productivity and preserve soil fertility for future.

To ensure successful impacts from the EbA options, it may be necessary to couple EbA approaches with soft adaptation measures including targeted education, awareness raising, and capacity building. It is also important to ensure that the EbA options contribute to social cohesion and team building and do not create conflicts.

Links to different resources that would be helpful in identifying and analyzing adaptation options are given in Annex 2.

Process/Guiding Questions:

a. Review the list of hazards identified in Step 1 and identify how ecosystem services have helped communities cope with climate hazards in the past.
b. Identify coping strategies of vulnerable communities, and whether they are viable for future climate hazards.
c. Establish insight on what else can be done to adapt to current and future hazards and what support is needed from existing institutions.
d. Identify which are the priority ecosystem services in the area to inform the selection of potentially applicable adaptation options.
e. Review existing examples of adaptation options including EbA and hard adaptation solutions for similar ecosystems if available and consult with different stakeholders and expert. See below example and Annex 3 for examples of some appropriate adaptation options for various areas.
f. Develop a range of adaptation strategies that would address each of the identified hazards. Adaptation strategies can be both EbA and hard adaptation measures. This should be done in (i) consultation with the communities keeping their current coping strategies in mind and (ii) in consultation with experts to bring in solutions based on good science and experiences from other similar areas.

g. Explain how implementing this adaptation strategy would mitigate the threat, avoid or reduce the risk, and/or build adaptive capacity or resilience. This should include an explanation of how to prevent maladaptation.
h. Outline who would be the lead agency/people responsible for implementing the strategy, when it would need to be implemented by, and any sequencing requirements.

Guidance for identifying EbA options

Establishing awareness of climate risks and of vulnerable areas/sectors including vulnerable communities, as done in Step 1, is a key step in helping to identify adaptation options. Understanding the linkages between the wellbeing of people and socio-economic sectors and ecosystem services can help identify context-appropriate hard and ecosystem-based interventions.

As mentioned earlier, the users should also be aware that there might be situations where EbA measures may not be the only, or the most appropriate option for the identified risks and vulnerabilities. For example, EbA may not be the most appropriate solutions for some high-risk urban areas where land-use change is not possible. Here EbA solutions alone may not be able to withstand the high intensity risks such as floods or sea level rise; in highly impoverished areas, EbA solutions may need to be integrated with other solutions. It is also important to note that EbA must be accompanied by a set of institutional solutions such as providing early warning, building capacities, policy support, and so on. In such cases, EbA should be considered with other solutions. However, ecosystem perspectives need to be at the heart of the planning process from the beginning, including the time during which adaptation goals are set and when attempts are made to understand risks and vulnerabilities. In this way, even if hard infrastructure solutions are chosen to minimize the climate risks they should not degrade the ecosystems.

To identify the appropriate adaptation options it is helpful to review past literature and case studies, as well as consult with appropriate experts. Links for different

Example 6 > Potential Criteria for MCA

- **Efficiency:** Are the outputs achieved optimal relative to the resources allocated?
- **Effectiveness:** Will the option meet the objectives?
- **Equity:** Will the option benefit vulnerable groups and communities?
- **Maintenance of Ecosystem services:** Will the option ensure maintenance of crucial ecosystem services?
- **Capacity:** Is there enough capacity to implement the adaptation option?
- **Urgency:** How soon does the option need to be implemented?
- **Flexibility:** Is the option flexible, and will it allow for adjustments and incremental implementation and reiteration depending on the level and degree of climate change?
- **Robustness:** Is the option robust under a range of future climate projections?
- **Practicality:** Can the option be implemented on relevant timescales?
- **Legitimacy:** Is the option politically, culturally, and socially acceptable?
- **Synergy/Coherence with other strategic objectives:** Does the option offer co-benefits (for example, improving agricultural land management practices could lead to reduced erosion/siltation and carbon sequestration).
- **Institutional feasibility:** Is the strategy acceptable to the public? Can it be implemented with existing institutions under existing laws?
- **Unique or Critical Resources:** Would the strategy decrease the risk of losing unique environmental or cultural resources?
- **Health and Safety:** Would the proposed strategy increase or decrease the risk of disease or injury?

Source: Modified from UNFCCC 2010 "Adaptation Assessment: Planning and Practice".
It should be noted that it is not necessary to use all the criteria listed above for a MCA. In discussion with the stakeholders, depending upon the time available, four or five most relevant criteria for assessment can be chosen.

resources available to identify and analyze adaptation options are provided in Annex 2.3 and 2.5. The EbA options identified should take into account:

- Which ecosystems are they applicable for?
- Which ecosystem service do they target?
- What are the likely benefits?
- Do they contribute to the adaptation objective identified?
- What are the costs associated in terms of financial and human resources?

The examples above may be of some use in identifying adaptation options for Step 2. More examples compiled by United Nations Environment Programme (UNEP) are provided in Annex 3 with information on which ecosystem services are targeted, a rough assessment of the capacity needed and benefits associated with the chosen adaptation strategy. The list from UNEP can serve as an excellent starting point to prepare a long list of adaptation options and to start discussions with a different range of stakeholders and experts.

Step 2.2 Identification and Prioritization of EbA Responses

Outputs: A criteria for screening adaptation strategies.

Tools: MCA.

Process/guiding questions:

i. Collectively agree on the main categories of the impacts of the selected adaptation strategies: environmental, social, economic, or other categories.
ii. Identify the criteria/indicators to be used to measure those effects (see Example 6). An example of an MCA used to evaluate adaptation options is provided in Annex 2.
iii. Assign 'weight' to different criteria to denote the relevance.

Based on the collectively agreed criteria, rank the identified adaptation options.

For all scales with sufficient budget

If there is enough resource and capacity, some modeling tools such as the land-use change modeler, Integrated Land and Water Information System (ILWIS), can also assess the change in the spatial indicators due to the adaptation. This step will produce maps, which will be used in the Scanning Mobility CCN Analysis (SMCA) software (e.g. Marxan with Zones).

Step 2.3 Assessing the Cost Effectiveness of EbA Responses

The 'economic" aspects of adaptation options are an important part of decision making. A CEA is one type of economic decision-making tool that can be used for comparing different adaptation options. This analysis compares two or more options for achieving the same (or similar) outcome, the benefits of which are not easily measured in monetary terms. A classic CEA starts by stating a specific goal (such as reducing the incidence of a disease in a town by 50 percent in four years), presents data on the expected cost of two or more methods of achieving this goal, and then selects the least-cost alternative (World Bank 2010).

An important aspect of CEA is that the main benefits of projects and interventions are not evaluated in monetary terms. These benefits are presented in non-monetary measures of effectiveness, such as the number of lives saved, or years without major flooding. By comparing the ratio of costs to the measure of effectiveness, options for interventions can be ranked. Avoiding having to estimate a monetary value for an aspect of project benefit is a key attraction of CEA.

Cost Effectiveness Analysis is most commonly used in health economics to compare the cost of health interventions. This is primarily due to the difficulties in monetizing benefits such as lives saved or years of life extended. Given the difficulties in monetizing many benefits of environmental and development projects, CEA is highly appealing in these fields and is widely used.

In some situations the cost effectiveness may be identified as the most important criteria for evaluating options at a planning level, to the extent that it is decided to use CEA instead of a broader multi-criteria analysis. Alternatively, as efforts are made to move from subjective to objective analysis within MCA CEA can

Fishermen at work: Fish is one of the major protein and income sources for populations along the river in Ben Tre province, Vietnam

be used to significantly tighten the "cost effectiveness" scoring within the MCA.

Different levels of complexities are possible within CEA. In some cases, it may be enough to simply say that option A is 10 times more expensive that option B, and in some cases a multiple analysis with different discount rates may be needed. The potential opportunity costs and tradeoffs of all the adaptation options including EbA responses may need to be analyzed under certain situations; the framework acknowledges this complexity. Considering there is still a lack of clarity in available data about costs and benefits, the approach below suggests a relatively simple approach.

Outputs: Cost effectiveness of each adaptation option identified

Tools: Secondary research and data collection, and expert judgment

Process/Guiding Questions:
As earlier mentioned, measuring the cost-effectiveness of EbA remains a gap. The present framework carried out CEA in the two locations where the framework was field-tested. This was done using five steps:

i. Identification of adaptation options for the analysis;
ii. Defining the measure of effectiveness;
iii. Choosing a discount rate;
iv. Assessing costs; and
v. Establishing a cost-effectiveness ratio and interpreting results.

i. *Identification of adaptation options for the analysis*

Based on a discussion with stakeholders and following a preliminary MCA, the user should identify the key priority adaptation strategies for a CEA analysis. Some parameters in selecting adaptation options for this may include:

- *The objective of the project being analyzed*: Does the adaptation option identified meet the outcome envisioned by the project?
- *Intervention options:* What specific adaptation interventions are under consideration? What data is available for those options?
- *Are the indirect and direct costs* of the interventions measurable?

ii. *Defining the measure of effectiveness*

The choice of the effectiveness criteria depends on the main objective of the intervention. If the objective is broadly defined, then a detailed discussion of the objectives of a climate change adaptation intervention should be established. This will be a very important consideration for a comparative analysis of adaptation options since the objective of EbA is not always cost related. While it would be extremely difficult to quantify the value of ecosystem services in building resilience, ecosystem services and the associated value should be included to the extent possible, as part of the effectiveness to ensure that the comparative analysis takes into consideration the environmental value of ecosystems. Some example of effectiveness may include (but are not limited to):

- Increased food security;
- Reduced property damages;
- Reduced wave height; and
- Diversified livelihood skills.

iii. *Choosing a discount rate*

Discounting is an important part of any economic analysis. Discounting acknowledges the opportunity cost of spending money on one activity instead of another. People usually have a time preference for money; that is they prefer to have money now than wait until sometime in the future. Similarly, most people would prefer to incur costs in the future instead of today. Serious consideration should be given to the discount rate, although some lenders and development organizations may sometimes have established protocols that analysts may be required to follow. Such protocols may call for using the government's long-term bond rate, local lending rates, or a social discount rate for the discount rate. Others argue that discount rates in developing countries should be higher due to stronger time preference for money.

A detailed discussion of discounting is beyond the scope of this guidance, but in line with standard recommendations, it is suggested that the CEA analysts use a range of discount rates to reflect different assumptions about the return on investment (ROI) of the intervention over time, perhaps even including a declining discount rate to environmental benefits that will continue far into the future. Using more than one discount rate increases robustness, but it adds an added layer of complexity to the analysis.

As a general rule, the discount rate will typically have a bigger impact when the timing of costs and benefits is not synchronous. Use of zero or a low discount rate implies that future benefits are valued as if they were received today. The use of higher discount rates (anything above five percent) suggests that the future benefits are less valuable than if they were received today, but that does not indicate that a high discount rate should not be used. The danger is if a zero discount rate was used for social projects, then society may end up allocating too many resources to achieving just these objectives and not enough to other valuable objectives.

iv. *Assessing costs*

Only direct costs are considered in the financial cost calculations for a CEA. Particular elements of these direct costs to be incorporated into the analysis are:

- *Categories of direct costs,* such as maintenance and operating costs in the future, may be significant and should be considered by decision makers.
  - Direct costs can be defined as costs that can be accurately traced to a cost object with little effort. The cost object may be, for instance, a product, a department, or a project. For example, the costs of gravel, sand, cement, and wages incurred on production of concrete.
- *Categories of indirect costs* including insurance.
  - Costs that cannot be accurately attributed to specific cost objects are called indirect costs. These typically benefit multiple cost objects and it is impracticable to accurately trace them to indi-

Example 7 > Cost Effectiveness Analysis in Vietnam

During the field-testing of the present framework, a cost effectiveness analysis was carried out in Vietnam. The parameters of the analysis were:

- *Adaptation Measures:* (1) Cost effectiveness of building sea dikes for coastal flooding was compared with (2) the cost effectiveness of planting mangroves.
- *Effectiveness Indicator:* The expected number of people protected from the negative impacts of sea level rise, as a result of the implementation of the adaptation measure.
- *Discount rate:* 10 percent
- *Scenarios:* (1) low risk and (2) high risk.

CEA of the short-term adaptation option (Low CC scenario)

With the low climate change risk scenario, the cost effectiveness ratios were computed for a short-term period of 10 years. The table below summarizes the financial and economic cost-effectiveness of the short-term adaptation measures to climate change risk in three coastal districts, namely Thanh Phu, Ba Tri, and Binh Di, and in the whole Ben Tre province.

Results from the CEA showed very high financial cost ratios for all hard-adaptation measures with the construction of sea dikes in three coastal districts. On average, the cost for a person in the expected flooded area being protected with sea dike systems in the Ben Tre province from climate change risk is about 138.8 Mill VND/person. The cost is much lower for the EbA with coastal forest ecosystems, which is about 1.7 Mill VND/person.

When the benefits of the environmental services of the costal forest ecosystems is considered, the total economic cost effectiveness ratio becomes negative for the EbA option implying that the economic benefits of the option is higher than its financial cost. The cost for protecting a person from the negative impact of climate change risk using the EbA option has a cost saving of more than 100 percent compared to that of the hard or engineering adaptation option with sea dike construction.

Table 4 > Cost effectiveness analysis for low climate change risk with short-term adaptation options (year 2020).

District	Adaptation options	Effectiveness measure	Financial costs	Financial cost effective-ness ratio (Mill VND /person)	Other economic net benefits/ costs	Total costs	Total economic cost effective-ness ratio (Mill VND /person)
Thanh Phu	Sea dike	14,806	2390.5	161.5		2390.5	161.5
	EbA with mangroves	14,806	21.3	1.4	62.7	–41.4	–2.8
Ba Tri	Sea dike	10,070	190.3	18.9		190.3	18.9
	EbA with mangroves	10,070	10.5	1.0	57.8	–47.3	–4.7
Binh Dai	Sea dike	4,714	1526.6	323.8		1526.6	323.8
	EbA with mangroves	4,714	19.0	4.0	121.5	–102.5	–21.8
Ben Tre province	Sea dike	29,590	4107.3	138.8		4107.3	138.8
	EbA with mangroves	29,590	50.8	1.7	242.0	–191.2	–6.5

(*continued on next page*)

Example 7 > Cost Effectiveness Analysis in Vietnam *(continued)*

High climate change risk and long-term CEA

For the high climate change risk scenario, the long-term adaptation responses with sea dike system alone (hard solution), and a combined hard and EbA solution with integrated sea dike systems and coastal forest ecosystems (EbA) were considered.

Similar analysis, under the high risk scenario showed that the cost for protecting a person from the negative impact of climate change risk by using the combined hard and soft adaptation options have a cost saving as compared to the hard adaptation option alone of about 55 percent, 17 percent, and 5 percent for Ba Tri, Binh Dai and Thanh Phu district, respectively. Combining the EbA solution (coastal forest ecosystem) with the sea dike system not only helps reduce the cost per unit of benefit but also increase the security of the dike system.

Source: From Vietnam Case Study produced in association with this framework. wwf.panda.org/ebm

vidual products, activities, or departments. Examples include: the cost of depreciation, insurance, power, and salaries of supervisors with multiple responsibilities.

- *Categories of other costs* like the opportunity costs.
  - An additional level of complexity within cost calculations is required when other important costs are generated by the project's implementation. For example, cost calculations can include the loss of earnings and benefits due to the fact that public financing has been attributed to a specific objective (this is called the loss opportunity cost). Lost ecosystem services can be valued and incorporated here.
- Magnitude of direct costs.
- *Timing of costs*; that is, in what time period will they be incurred.
  - Timing matters to ensure discounting is done correctly. It is also important to consider taking into account future costs in the decision on which interventions to apply.
- Who incurs these costs?
  - Economic efficiency measures do not typically consider who bears the costs. But from a social dimension perspective it is an important consideration.

v. *Establishing a cost-effectiveness ratio and interpreting results*

- Define cost-effectiveness ratio.
- Give a template summary table for how interventions can be compared easily.

Step 3. Implementation of Ecosystem-based Adaptation Responses

Checklists for Key Activities in Step 3

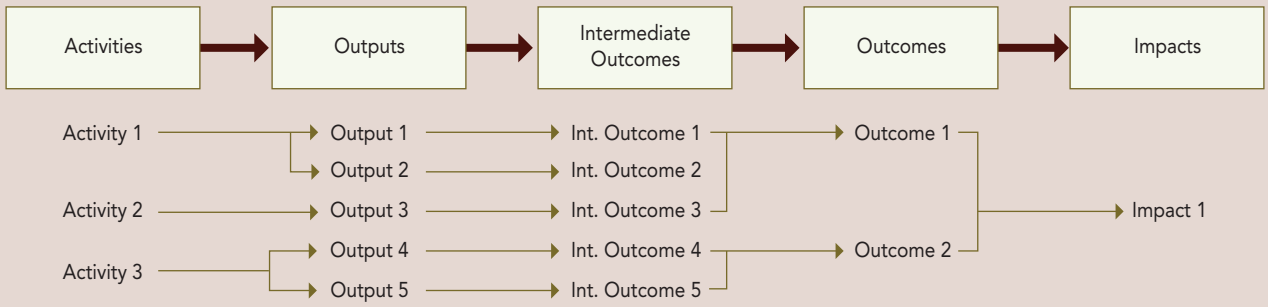
Implementation of EbA initiatives

- Identify outcomes of the initiative that are associated with the maintenance or improvement of delivery of key ecosystem services that can contribute to the adaptive capacity of communities in consultation with the stakeholders.
- Design EbA activities with explicit recognition of available local resources.
- Establish a Theory of Change for EbA.
- Identify risks and assumptions for each outcome/output.
- Consider: (i) system-wide vulnerabilities; (ii) costs and benefits; and (iii) avoidance of maladaptation.
- Develop strategies to mitigate identified risks.
- Identify cost of selected outcomes and outputs.
- Establish a funding plan and corresponding budget.
- Establish linkages between the initiative concept and national, sub-national, and/or local development plans, strategies, and policies.
- Assess the sustainability of outcomes and outputs.

Monitoring and Evaluation (M&E)

- Identify and budget for M&E requirements.
- Establish a Logical Framework Analysis
- Identify indicators and baselines.
- Assure that indicators are SMART Indicators (Simple, Measurable, Achievable, Realistic, Time bound)

Example 8 > Results Chain showing contributions of EbA activities to the outcome



Source: UNEP 2012.

- Identify outputs that can contribute to the EbA outcome.
- Identify criteria for an "effective" EbA initiative that includes reducing risks and enhancing overall adaptive capacity.
- Identify targets, milestones, sources of data, frequency, and responsibilities.
- Identify and assess how evidence can be collected and documented.
- Establish a reporting line for M&E and identify appropriate agencies/people to authorize changes to the initiative if necessary.
- Document reflection, evaluation of the project, adaptive learning, and adjustments made to different aspects of the initiative along the way.

Once the adaptation options have been identified and shortlisted, and a particular strategy is selected, the chosen strategy and accompanying options need to be implemented. Implementation consists of several steps including: (1) design, (2) deployment of the strategy, and (3) consistent M&E. The iterative feedback process is of particular importance so that actions can be adjusted as new information is obtained.

Step 3.1 Design an Outcome-Based or Results Based Management (RBM) Framework

Building a suitable project management design is a crucial step in the process to ensure the consistent and timely delivery of results and assess potential adjustments needed in the project design over time (UNEP 2012). The aim of the design should be to clearly specify the activities required to achieve the intended adaptation objectives and outcomes.

Linking activities, outputs, and outcomes

Based on the identified adaptation strategies it is important that the expected outcomes from the initiative are clearly articulated, and relevant indicators are identified to monitor the ongoing progress and various outcomes. Important considerations for this include:

i. Make any adjustments necessary to the adaptation outcome/s identified in Step 1 based on the findings from the vulnerability analysis.
ii. Formulate the anticipated 'impacts' from the outcomes. The overarching impact from the outcomes may be much broader, longer-term, and in line with the national and sub-national priorities to which the action may contribute. The outcomes must be within the scope of your initiative.
iii. For EbA actions, the principal outcome should be to reduce vulnerability in the targeted community (or other socioeconomic system). Interim or related outcomes should include maintenance, or improved conditions of key ecosystem services that contribute to the adaptive capacity of communities, increases resilience, and reduces vulnerability.

There are many ways to create an RBM framework (e.g., log-frame, results based matrix, and theory of change). They all require a clear articulation of how activities contribute to outputs, outcomes, and possible long-term impacts. Ecosystem-based Adaptation

Ride and elephant: Ecotourism in BKN wetland, Lao PDR

options may consist of a number of adaptive actions, from active management measures (such as planting mangroves in a coastal area, or diversifying community livelihoods based on different ecosystems) to capacity building actions (for example, training on climate-resilient policy formulation). It is imperative to have clarity on which activities contribute to which outputs and intended outcomes; in other words, it should be clear what links the activities and impacts together. See Example 8.

Specify the assumptions made in the logical chain and identify barriers or risks to implementation

Project implementers will need to specify the key assumptions made in relation to the implementation of the EbA options and the intended results. Assumptions can be process related or related to human behaviors. If there is an assumption that climate change will affect socio-economic systems and ecosystems in certain ways, the chain of events will need to clearly articulate how that will happen.

Once the outcomes have been identified, it is also important to identify critical barriers along with ways in which those barriers can be mitigated. Barriers can be a combination of information constraints, institutional failures, capacity constraints, economic constraints, and political factors (UNDP, 2010). They are specific to the national, sub-national, and local level conditions. A comprehensive analysis of barriers helps determine: (a) the feasibility of what the identified EbA initiative specifically seeks to achieve; (ii) how it is dependent on, or linked to, other ongoing strategies and interventions as well as their successes and failures (UNDP 2010); and (iii) what barriers and challenges remain. A single initiative will be able to resolve some, but not all, barriers (see Annex 1 for more information on barriers). The key barriers can be identified through:

- Focus group discussions with relevant stakeholders.
- A thorough analysis of the context including policies, institutions, capacities and so forth.
- One-on-one interviews with key informants; for example, national and sub-national governments.

Collectively identify key indicators and establish baselines and targets to monitor each outcome and output[8]

This step may be one of the trickiest parts in implementation. The ability to deal with uncertainty and the dynamics of the changing environment is a key component of the M&E process for strategies focused on reducing long-term climate risks. The idea of M&E for adaptation using indicators and baselines is complicated due to several factors:

- *Uncertainty:* Most effects of the EbA options may only be measurable if climate change happens. For example, in the event of planting mangroves, the effectiveness of these in relation to climate change will only be measurable should an identified climate event occur such as actual sea level rise.
- *Timeframe:* The timeline for when climate change may happen is often uncertain, and thus the impact of the EbA activity may not be successfully measured within the duration of project implementa-

[8] Or alternatively, develop an adaptation theory of change. See Travers et al. 2012 for more information

Example 9 > Snapshot of Potential Indicators adapted from PPCR

Outcomes	Indicators
Increased resilience of households, communities, businesses, sectors and society to climate variability and climate change	Change in percentage of households (in areas at risk) whose livelihoods have improved (acquisition of productive assets, food security during sensitive periods of the year) Change in damage/losses ($) from extreme climate events in areas at risks Percentage of people with year-round access to reliable water supply (domestic, agricultural, industrial) Maintenance/protection of surrounding ecosystems (ha. of forests/mangroves restored/sustainable managed) to support sustainable use and provision of essential services (water, food
Strengthened climate responsive development planning	Degree of integration of climate change in national planning with recognition of ecosystem-based approaches e.g., national communications to UNFCCC, national strategies, PRSPs, core sector strategies, annual development plans and budgets, and NAPs Changes in budget allocations of all levels of government to take into account effects of climate change and climate vulnerability Ecosystem-based approaches considered and prioritized as solutions to climate change where appropriate

tion. As a result, this may call for the consideration of ex-post evaluations years after project implementation. In other words, a final evaluation at the closure of implementation may not be sufficient to assess the success of an EbA activity.

- *Moving Baselines:* EbA will take place in the context of changing climate hazards, changing status of ecosystems (not necessarily climate-related), and dynamic socio-economic systems. These considerations must be included when developing baseline information.
- *Attribution:* Closely related to the timeframe and the moving baselines is the capacity to attribute success to the actual EbA measures. Using the example of implementing mangroves: over time, certain fish populations may increase near the mangroves. This could be attributed to the implementation of the mangroves, or potentially new legislation on agricultural pollution, which results in reduced runoff creating more suitable condition for fish as well.

As a result of these challenges, EbA M&E systems must be developed taking into consideration changing climate and socio-economic profiles, and indicators and targets should be set within a framework that considers change over time (UNEP 2012).

Setting Indicators and establishing baselines

Indicators, baselines, and targets should be selected in consultation with a range of stakeholders including ecosystem management experts, local community members, and local, sectoral and national governments stakeholders (among others) depending on the context. Preliminary research, data collection, and analysis may also be required to establish baselines.[9] The information collected by participatory methods throughout steps 1 and 2 can generate good indicators to create a baseline and can be used later for performance evaluation. For example, the current climate risks and perceived impacts, coping strategies, and so forth can be used as a baseline.

[9] For detailed guidance on creating baseline and step-wise guidance to create monitoring framework please refer to Spearman and Mc. Gray 2011. Available online at http://pdf.wri.org/making_adaptation_count.pdf.

Choosing appropriate indicators for adaptation requires rooting the goal of adaptation intervention to its specific scale, climate change, and development context. It should also be recognized that adaptation might not be a final outcome, but "a diverse suite of ongoing processes (including social, institutional, technical, and environmental processes) that enable the achievement of the development objectives" (UNDP 2007). For EbA, indicators can be developed either to facilitate monitoring of the progress in developing and implementing adaptation measures in particular (so-called process-based indicators), or to measure the effectiveness of such adaptation measures (so-called outcome-based indicators) (UNFCCC 2011). A suite of process and outcome based indicators are provided in Annex 3.

The Pilot Program for Climate Resilience (PPCR) under the multi-donor funded Strategic Climate fund (SCF) has also suggested some core indicators for climate resilience. These indicators, accepted by multiple donors, can also be included and expanded[10] for use in EbA. Example 9 below reflects some indicators from PPCR, with some addition of indicators that may be relevant for EbA.

It should be noted here that the indicators and the whole M&E process could be qualitative as well as quantitative. Some goals and indicators are hard to quantify and measure; users should consider some qualitative indicators as applicable. While indicators may be attractive for their objectiveness, transparency, reproducibility and measurability (Pringle 2011), users should take caution in their use as they may have unintended negative side effects, especially when direct measures are not possible and proxy indicators are used to measure effect (Pringle 2011). Room to measure the unintended and unexpected should also be provided.

In addition to indicators, it is also necessary to establish baselines, or the current situation of natural and socio-economic systems. For baselines, it is necessary to:

i. Review and synthesize existing information on current vulnerability, climate risk, and current adaptation responses based on primary data, previous studies, expert opinion, and policy context. (These should be available from Steps 1 to 3).
ii. Describe EbA-related policies and measures in place that influence the ability to successfully cope with climate variability.
iii. Develop baseline indicators of vulnerability and adaptive capacity that take into account the underlying historical trends in the indicator value over time. Note whether there is a trend upward or downward over the last five or ten years that can be drawn from existing records or statistics.

Baselines may be established using existing secondary data sources or may require a primary data collection effort. Information collected throughout Steps 1–3 of this framework can serve as baseline data:

- *Historical/baseline data:* current vulnerabilities (historical trend, ecosystem mapping, vulnerability profile) and current adaptation measures (consultations, field interviews, literature review).
- *Scenarios:* future impacts and vulnerabilities adaptation to future affects (using such approaches as multi-criteria analysis, cost–benefit analysis, and consultations).

Prepare a work plan including a plan for participatory M&E

The logical framework needs to be translated into a time-bound work-plan that clearly identifies: (1) the timeframe, (2) key milestones for the initiative, (3) who is responsible for the activities, and (4) how frequently EbA actions will be monitored.

Project interventions, in general, are often short term and M&E within a project intervention cannot possibly determine EbA success within that timeframe. As mentioned above the impacts of EbA strategies are only apparent in the long-term. Therefore, it is nec-

[10] For full list of PPCR please see https://climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/REVISED_PPCR_results_framework_for_PPCR_Sub_Committee_08162012.pdf

essary to develop M&E systems that can outlive project timeframes and include indicators that can be measured by communities and/or local institutions rather than project staff. The M&E plan should also include criteria for assessing sustainability against climate change, replicability, and cost effectiveness, in addition to measuring progress against the established baselines and targets. It should also identify who will implement the actions, who will be involved in participatory M&E, and how often the data will need to be collected for M&E. If any change is recommended from M&E, identify who should be consulted to implement the change and how the transparency can be ensured in the process.

Questions to Consider for the work plan:

- How will the EbA initiatives fit into existing activities?
- Who is responsible for what aspects of the plan?
- What resources are available?
- What is the timeframe for implementation?
- Which partners need to be involved?

Questions to consider for the Monitoring Plan:

- What questions do you want to answer to get an accurate idea of the progress?
- What data will be used to answer those questions?
- Who will collect the data and when?
- Who will analyze the data and report the results?

Step 3.2 Adaptive Implementation through Monitoring and Evaluation (M&E)

Allocate resources and assemble a team for implementation

Ensure that there are sufficient financial and human resources for the outlined activities including M&E and support for learning-by-doing.

Mangroves rehabilitated along the river in Ben Tre, Virtnam.

Implement the EbA activities and continuously monitor the progress

Ensuring that the actions identified are implemented on time and within the specified budget is one important aspect of monitoring. Monitoring will also require additional collection of data that will then be compared with the baseline to check whether the individual EbA activities are contributing to the intended results and whether the assumptions made in the beginning are correct or not. For qualitative indicators, it is a good idea to have a discussion with the same set of focus groups/individuals that helped to establish the guidelines.

Reflect and Adapt

Review and reflect on the outputs of M&E and assess whether the initiative is progressing as intended. If the progress is as desired, review whether any adjustments can further help in increasing effectiveness and efficiency; if the progress is not as intended, identify what changes can be made at what level. For example, would changing individual EbA actions yield different results, or are some adjustments in outputs and outcomes necessary? Identify what are the barriers to progress and how they can be removed. Identify which assumptions need to be adjusted. These reflections should be done in a participatory manner in discussion with the relevant stakeholders and experts. Once the changes have been identified, alter the program inputs and adjust the work-plan accordingly.

Questions to consider:

- What has been done without delay?
- What were the challenges?
- What worked? How and why did it work?
- What did not work and why?
- What would you do differently if you had the chance to do it again?

Documentation and collecting evidence

The outcomes of M&E can often provide valuable lessons not only for the identified initiative, but also for other ongoing and future initiatives. In addition, they can help to demonstrate the effectiveness of the initiative, and offer useful evidence to be presented to decision makers for further investments to potentially upscale or expand initiatives. Hence, it is important to carefully document the lessons learned from the initiative both during implementation and during project management (i.e., what worked, what did not work, and what evidence of effectiveness exist).

Step 4. Mainstreaming EbA strategies in Policy and Planning

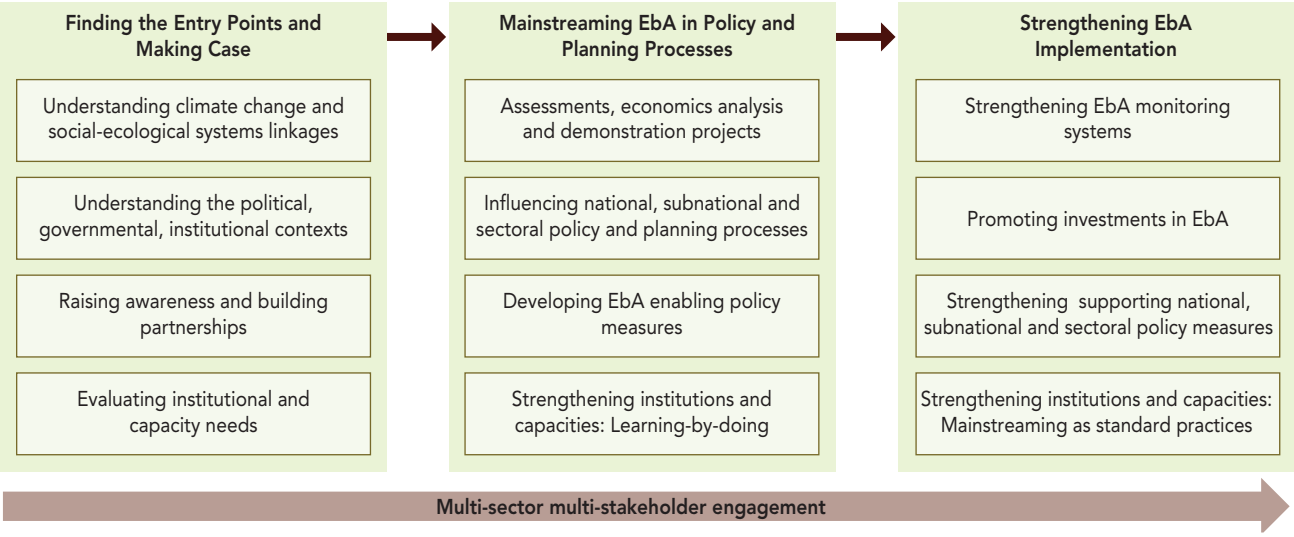
Mainstreaming, or integrating, EbA into policies and planning processes is an important step for governments to achieve sustainable and climate resilient development. Mainstreaming is also important for all other EbA practitioners and individual projects/initiatives in a country, or even within a region, as their long-term aim is to ensure that countries follow the path for sustainable and climate resilient development.

As most governments, including those in the GMS, are still in the process of mainstreaming climate change in national and sectoral plans as well as developing overall climate change and green growth plans and strategies, this is an optimal time to include EbA considerations in the process. The responses identified through implementation of the framework in ecosystems within a country, could in particular inform action plans.

Step 4.1 Mainstreaming EbA in National and Sub-National Policies and Plans

Mainstreaming climate change raises several questions among scientists, policy makers, and stakeholders. One overarching question is the determination of how climate protection can be integrated in a cross-sectoral policy approach (UNDP-UNEP, 2011; Kaphenngst, 2012). Since EbA tackles adaptation from an ecosystem perspective, and sometimes addresses mitigation, EbA has the potential to contribute substantially to climate mainstreaming and, at the same time, protect or enhance biodiversity (Kaphengst, 2012). From the economic point of view, integrating EbA concepts and other adaptation strategies into socio-economic development planning increases the effectiveness and efficiency of investments, as the co-benefits from enhancing the flow of ecological services from relevant

Figure 2 > Framework for Mainstreaming EbA into Development Planning



Source: Adopted from UNDP-UNEP framework for mainstreaming adaptation into development planning.

natural capital support multiple agendas (Vignola et al. 2009; TEEB, 2010). This process would also help address issues of leakage and additionality (TEEB, 2010).

Increasingly, countries are realizing that, in the long-term, climate change adaptation needs to be supported by an integrated, cross-cutting policy approach—in other words, mainstreamed into national development planning (UNDP-UNEP, 2011). At present, there are numerous initiatives and different financing mechanisms aimed at assisting countries with climate change adaptation. Efforts concentrate on developing specific adaptation measures, with a focus on those that correspond to countries' "most urgent and immediate needs," as detailed in various National Adaptation Plans of Action (NAPAs). As part of mainstreaming climate change adaptation into development planning, steps taken in mainstreaming ecosystem services—considering the value they provide in economies (green economy), also provide encouraging entry points for mainstreaming EbA.

Mainstreaming EbA is a multi-level process that requires vertical and horizontal coordination among different ministries and agencies including cross-sectoral engagement. Planning at the national level provides the overall framework within which sectoral and other sub-national levels operate. The national level is where the policy goals from long-term visions and national development strategies are translated into action plans and budgets. Key planning interventions including integrating EbA in sectoral plans and initiating new programs to enable adaptation which may, for example, reallocate funds to more vulnerable sectors or regions requires engagement at both national and sub-national levels (Lebel et al. 2012).

Basic principles and conceptual framework for mainstreaming EbA initiatives understandably do not differ much from the available frameworks for mainstreaming climate change adaptation.[11] However, it is import-

[11] There is not much literature on mainstreaming EbA; there is, however, available literature on mainstreaming either climate change (both mitigation and adaptation) and climate change adaptation into development planning and processes such as UNDP-UNEP's Guide for practitioners for "Mainstreaming climate change adaptation into development Planning" or the Organization of Economic Cooperation and Development (OECD)'s "integrating climate change into development planning etc."

ant to recognize that EbA is a subset of an adaptation process and needs mainstreaming in both "adaptation plans" as well as development plans. In many countries, EbA responses such as sustainable management of forests, water, coastal areas etc. may already be part of the development plans and planning processes. What mainstreaming EbA will need to do, is add a climate change lens to these considerations.

Based on the guidelines provided by different literature including Organization for Economic Co-operation and Development (OECD) and UNDP, and past experience, the following steps for mainstreaming EbA are recommended:

Preliminary assessment: Biophysical, Social, and Valuation Assessment to understand the linkages between climate change resilience, ecosystem services and development

The assessment is a structured process that provides knowledge that is useful for policies, strategies, and management. Preliminary assessments seek to answer questions regarding the needs of vulnerable people and sectors, identify ways in which ecosystem services can build resilience, identify the existing attempts to address them, and identify the existing gaps in meeting them.

Process:

i. Assess the climate change risks and vulnerability at the appropriate scale of interventions (climate risk and vulnerability assessments).
ii. Identify ecosystem services, its beneficiaries (by sector or by groups of people) and how they can increase the resilience of the vulnerable sectors and communities (ecosystem-based assessments).
iii. Get an understanding of the links between current and future climate change, and national development priorities and how EbA can contribute to development priorities.
iv. Identify priority areas for EbA, based on the climate risk assessment and development priorities.
v. With the priority areas in mind, carefully assess the governmental, political and institutional settings that includes (UNDP-UNEP 2010):
    - Existing policies and regulations at national and sub-national levels.
    - Planning processes at national and sub-national level and their timing.
    - Responsible institutions and key actors.
    - Mandates of the different institutions and decision-making processes involved.
    - Governance and political situation.

Analysis of policies and planning processes to identify and agree upon policy and institutional entry points for mainstreaming

This analysis needs a continuous engagement with the policymakers and sets the stage for mainstreaming.

Process:

i. From the existing policies and planning processes, identify possible entry points in development as well as adaptation planning and processes. Possible entry points for mainstreaming EbA are presented in Example 10.
ii. Identify responsible institutions for relevant policy and planning processes at national and sub-national level.
iii. Initiate dialogues with relevant actors at different government institutions and build partnerships.
iv. Identify and agree on the entry points for mainstreaming, such as which policy/planning process, which institutions, and which stakeholders. This identification must be done together with the government, development and adaptation practitioners, and where possible engage other experts and non-governmental agencies. It is necessary to understand the mandate of each institution. Normally, it is the line ministry at the national level that decides which institution should take the lead for which activities.

Raise awareness, capacity and build partnership

Once the relevant institutions and stakeholders are identified, this process aims at building required technical and functional capacity to enable uptake of EbA measures.

Process:

i. Assess the capacity gaps of the relevant institutions and organize awareness-raising and capacity-build-

Example 10 > Possible Entry Points for Mainstreaming EbA

At national level

- National development plans.
- National target for adaptation.
- National biodiversity conservation plans.
- National plans for disaster risk reduction.
- Poverty reduction strategy paper.
- National budget allocation process or review.
- National priority list for adaptation projects for NAPA.
- Strategic Environmental Assessments (SEA).

At sectoral level

- Sectoral strategies, plans and polices, for example land-use plan, agriculture plan, infrastructure development plan.
- Preparation of sectoral budget and budget allocation.

At subnational level

- Provincial and district level development plans.
- Provincial and district level polices/action plans for climate change adaptation, if available.
- Preparation of Sub National Budgets.

Example of Possible Entry Points for Mainstreaming Identified in the Case of Vietnam

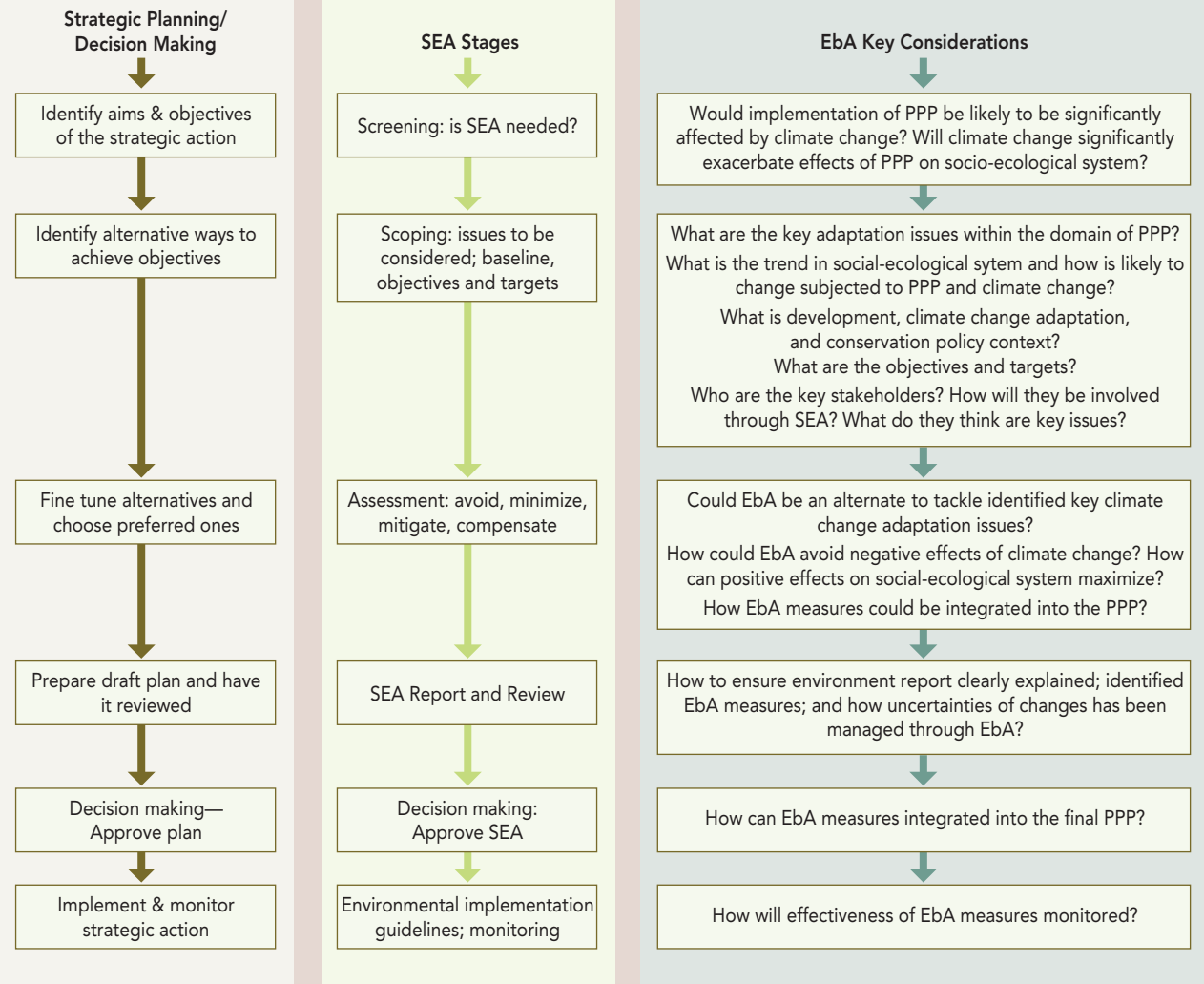
Relevant Sectors	Relevant Policies	Relevant Agencies
Natural resource and environment management	Provincial Climate change Action Plan	Department of Natural resources and Environment (DONRE)
Biodiversity Conservation	Provincial Biodiversity Conservation planning	DONRE
Land Use	Provincial Land use plan	DONRE
Planning and Investment	Provincial Socioeconomic Development Plan	Department of Planning and Investment (DPI)
Agriculture	Climate change action plan for agriculture sector	Department of Agriculture and Rural Development (DARD)
	Aquaculture and fishery development plan	DARD
	Forestry development plan	DARD
	Irrigation development plan	DARD

National Level:

- The national focal points working on climate change action plan development and coordination: the National Target Program to Response to CC (NTP-RCC) and the Supporting Program to response to CC (SP-RCC).
- Planners and decision makers at national levels, who are developing and approving socio-economic development plan (Ministry of Planning and Investment (MPI), land-use plan (MONRE); and sectoral plans (e.g. Ministry of Agriculture and Rural Development, Ministry of Transport).
- The technical government and non-government institutions and organizations working in technical support for policy planning and climate change adaptation and mitigation in Vietnam.

Source: Adapted from UNDP-UNEP, 2011 and example from field testing the framework.

Example 11 > Mainstreaming EbA into development policies and plans through SEA



Source: Adopted from EU's guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment.

ing activities in accordance with these gaps. Institutional reviews may have already been commissioned by a different agency, so assessing what is available in a particular country before embarking on a new institutional capacity analysis is important (World Bank 2010). Lack of awareness, capacity, and resources can be a big impediment for mainstreaming EbA. It is necessary to have multiple dialogues and provide enabling support to the government institutions where needed. The World Bank suggests focusing on technical capacities (for overall climate change adaptation, ecosystem management, disaster risk reduction, and so forth).

ii. Have a continuous dialogue and build partnerships with relevant government institutions at various levels. Identify key individuals and actors within the institutions who can act as agents for change.

iii. Ensure that there is horizontal and vertical coordination between the different institutions involved.

Influencing the policy and planning processes

This crucial step builds on the outcome of the previous step, and the amount of interest and credibility generated by the EbA initiatives.

Fisheries in Cambodia.

Process:

i. Collect sufficient information at different levels of intervention related to climate risks, impacts and scope for EbA: i.e., country specific, province specific, or district specific. The aim is not to generate perfect information on complex issues (such as adaptive capacity of ecosystems), but generate sufficient information to inform possible policy reforms and measures (OECD 2009). The information should factor in uncertainty.

ii. Analyze prior experience on mainstreaming different EbA approaches and climate change adaptation and build on those experiences and lessons learned.

iii. Incorporate spatial analysis and economic analysis to help policymakers make informed decisions.

iv. Design and implement demonstration projects to show the relevance and effectiveness of adaptation responses. The demonstration projects and lessons learned on enabling conditions can make the difference in convincing policymakers to act (UNDP-UNEP, 2011). The demonstration projects must take into account local capacities and needs, and additionally be designed for eventual scale-up and replication.

v. Recommend concrete steps for policy amendments or ways to develop new policies to support EbA and send to appropriate authorities for approval.

Influencing current and pipeline investments for development and conservation

Mainstreaming EbA or at least finding a way to integrate these in current and pipeline investment is as necessary as mainstreaming them in policies. In practice, implementation on the ground is clearly influenced by the investments.

Process:

i. Identify the potential to integrate EbA approaches in existing and pipeline investments allocated for development and conservation activities.

ii. Engage the project proponents in the EbA assessment.
iii. Target communication materials to project proponents.
iv. Identify activities in an existing/pipeline that can integrate EbA approaches.
v. Demonstrate cost effectiveness and recommend allocation of investments for EbA activities.

Step 4.2 Use the Strategic Environment Assessment as an Instrument to Mainstream EbA

As a legally required and specifically defined process, Strategic Environment Assessments (SEAs) are an opportunity to systematically integrate EbA using a standardized approach into policies and plans. Countries are increasingly adopting SEAs and making the application of SEA mandatory to policies, plans, and programs. Under national regulatory requirements, the development policies and plans are subject to an environmental assessment during their preparation, and before their adoption. This includes the drafting of an SEA report, which should analyze alternate development pathways based on environmental considerations. An SEA directive requires the process to go through extensive multi-sectoral and multi-stakeholder participatory process. The SEA report and the results of the consultations are taken into account before adoption of the proposed plans and policies. SEA directives also require monitoring of significant environmental effects of the policies and plan in order to identify unforeseen adverse effects at an early stage of implementation (EU 2013). See Example 11 for an illustration on how EbA could be implemented using SEA. In general, the following should be in order to mainstream EbA in development policies and plans through SEA:

- Build EbA considerations into the SEA and subsequently plan and policy from the earliest stage and follow them throughout—start at the screening and scoping stages to build these issues into the mindset of all the key stakeholders. The SEA can be used as a creative process to support learning among all these parties.
- The EbA must be tailored to the specific policy and planning context. It is not simply a checklist of issues to tick off. Potentially, each SEA can be different.
- When consulting stakeholders, avoid drawing out the SEA procedure and leave enough time to properly assess complex information drawing EbA linkages to environmental sustainability and sustainability of policies and plans at large.
- Use the SEA as an opportunity to explore alternate adaptation options (e.g. EbA vs. Infrastructure). At this time, many options are still open and you can flag potentially problematic projects to be thoroughly investigated during project design subjected to Environmental Impact Assessment (EIA).

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Annex 1: Essential Principles and Barriers to Consider in an EbA Framework

Guiding Principles for the Framework

Integrate climate change adaptation into broader sustainable development

First and foremost, any adaptation effort should be a part of a broad sustainable development pathway. Climate change hazards can create significant impediments and jeopardize the sustainable development pathway and place the lives and livelihoods of many at risk. Consequently, it becomes important to integrate adaptation strategies into broader development policies, plans, and targets. In addition, good climate change adaptation adheres to the same principles as good development. Maintaining a balance of people, the environment, and the economy is more likely to be sustainable.

Adopt a social-ecological perspective

From the onset, adaptation efforts should adopt a social-ecological perspective in order to create a framework that best enables capturing the dynamics between the social, economic and ecological. Ecosystems are complex and they interact with social and economic systems across a range of scales. Hence the design of adaptation strategies and understanding of vulnerability needs to include the range of drivers that affect the delivery of ecosystem services and cause the communities to be more vulnerable. An effective adaptation strategy is possible only through understanding and reducing not only specific vulnerabilities to climate variability and extreme events, but also other underlying causes of vulnerability (such as poverty, governance, etc.).

Adaptation strategies must be custom-made

Adaptation is context specific. The impacts of climate change will not be the same throughout the region, and the capacity to act will differ in different sites. For this reason, appropriate strategies for communities to adapt to climate change will depend on local conditions including location, topography, weather, natural systems, surrounding influences and drivers, knowledge and institutional arrangements. While it is good to learn from other experiences, it is not possible to directly copy solutions across the region. Therefore, adaptation responses have to be suited to a particular site and need to consider human, community, environment, and economic dimensions.

Pilot at the lowest appropriate level

Action should take place at the lowest appropriate level, with pilots at the local level. It is necessary to realize that "reducing vulnerabilities and increasing resilience starts with local, community-based adaptation initiatives that engage multiple stakeholders at various levels to design and pilot risk reduction measures" (UNDP 2011). Though the challenge of climate change is global, adaptation is local and it is necessary to think of longer-term solutions that address specific and local problems. Initiatives designed with the local piloting in mind should also include opportunities for replication and scaling up.

Two-way flow of knowledge transfer

Continuous participation of different stakeholders in identifying the risks and response is crucial for strong ownership and sustained adaptation responses (UNDP 2011). Adaptation strategies that are not congruent with the existing local knowledge and resources have little chance of succeeding. Similarly, it is also important to create a meaningful dialogue, increase capacity and raise awareness of communities. This can be accomplished through the use of multiple, coupled methodologies, including climate change forecasts/projections/analyses, alternative future scenarios, long-term planning, and spatial analysis. This will help facilitate the difference in climate risks even for the areas that geographically appear to be close (Andrade et al. eds. 2010). Linked with the principle of community

participatory approaches, EbA initiatives should be designed with an inherent understanding of local perceptions on capabilities and risk related to a changing climate (Villanueva 2011 cited in UNEP 2012). Core to the design and monitoring and evaluation of the initiative should be people's perceptions of ecosystem contribution to livelihoods, risk and capacity.

Take "No Regret" action despite uncertainty

Studies indicate that despite much uncertainty about the possible effects of global warming on local weather patterns and information gaps, society knows enough to build plausible scenarios on which to base decision-making. This is true even in developing countries, where historical longitudinal climate data may be limited. Using such scenarios helps decision-makers identify "no regret" beneficial adaptation measures that would be useful against a range of climate change outcomes (UNDP 2011).

Support climate change adaptation from day one, but be precautionary

Climate change predictions are uncertain and impacts of climate change in specific sites are still largely unknown. However, uncertainly must not be confused with ignorance. We have sound evidence that climate change will bring drastic changes, and the lack of detailed information on how these changes will unfold is not a reason to do nothing about adaptation. The sooner actions are taken, the more effective they will be. It is important therefore that we do not delay adaptation actions in the wait for better climate change models.

However, in the face of uncertainty it is wise to take a cautious approach. This means acting in a way that minimizes losses. Adaptation actions should not close off options for future generations.

Adaptive management approach

In times of high uncertainty, management approaches must be flexible and receptive to new findings. Project design and implementation should reflect a flexible and adaptive management approach. EbA and other adaptation activities should adopt approaches that can be tailored to changing circumstances. This can only be achieved if the design allows for a diversity of answers to a single question, consideration of several adaptation strategies for the same goal, and a willingness to change focus and pathways mid-stream if needed (Andrade et al. 2011).

Overcoming Barriers

Barriers can be a combination of information constraints, institutional failures, capacity and behavioral constraints, technological and financial challenges. UNEP, (2012) suggests the following for removing barriers:

Support to key sectoral governance entities to develop and strengthen policies, institutions, and knowledge for integrated ecosystem-based approaches to climate change adaptation based on:

- Development, dissemination, and application of improved climate change risk information relevant to a broad range of end users;
- Strengthened institutions across sectors and at different levels, in conjunction with harmonized institutional mandates to coordinate and jointly formulate and implement climate change policy;
- Establishment of policy development and review mechanisms to iteratively integrate ecosystem-based approaches to manage climate change risk into relevant policies, strategies and plans;
- Mainstreaming ecosystem-based adaptation according to broader development frameworks and sectoral strategies;
- Increased knowledge and understanding of climate variability and change-induced threat, at the country level and in vulnerable areas;
- Strengthened awareness and ownership of adaptation and climate risk reduction processes at the local level; and
- Enhancement of enabling environment, and successful demonstration and deployment of relevant adaptation technologies to facilitate technology transfer.

Use of the full range of public and private financing mechanisms by ministries of finance and nation-

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Thai woman working in the rice fields.

al and subnational planning bodies to support ecosystem-based approaches to adaptation that includes:

- Pro-poor public sector budgeting, adjusted to incorporate climate change risk and adaptation; and
- Design and application of climate change risk finance mechanisms.

Implementation of incentive structures by ministries of finance and national and subnational planning bodies designed to effect behavioral adjustments by the public and private sectors. Examples include:

- Regulatory and fiscal incentive structures adjusted/expanded in relevant institutions, including key sectoral ministries and subnational governing bodies, to stimulate climate change risk reduction by the private sector and households.

Annex 2: Tools and Resources used to Identify EbA Responses

Annex 2.1. Tools to Help Assess EbA Responses

This section contains a brief description and applicability of different tools suggested and largely tested within the framework. Choice and application of tools and methods play a central role when deciding on field-level activities. For example, when conducting a stakeholder discussion, it may make sense to address the issue of past hazards (step 1) and coping strategy (step 2).

To ensure that the framework is built on past experiences and is suitable to the local reality, most of the tools used in the framework are taken from those commonly used in any participatory planning arena, including land-use planning. To deal with specific elements of climate change and ecosystem services, some relatively new tools are also suggested that may require a new type of thinking, as well as new data and analysis. The tools described below are not a comprehensive list of tools for assessment and planning of EbA. Rather, these tools help communities focus on specific objectives and outputs, and get started in planning for climate change.

The tools suggested here, though mostly apt for sub-national level analysis and the corresponding budget and resources availability, can be scaled up to any level. The framework also gives examples of tools that can be used at larger geographic scales. It is up to the users to evaluate and select tools appropriate to their context and capacities. It is important to mention that the tools presented here may change over time, new tools may develop, and some tools may become outdated.

Tool 1. Secondary research and data collection

Before starting work in communities, it is important to know the bigger picture and collect any secondary data available at both national and sub-national level. Any secondary data available concerning scientific information on climate change, types of ecosystems in the study area (such as forest type, information on topography, geography etc.), and past disasters would be useful. Similarly, demographic and socioeconomic data on communities such as male/female ratio, or major sources of livelihoods in the area (among others) should be collected beforehand. Finally, because EbA falls within the wider climate change and development planning process, users must thoroughly consult with all secondary resources available to collect as much information as possible before consultations with stakeholders commence. Possible sources for secondary resources are:

- *Climate change related reports* that identify existing climate change problems in the countries: e.g. National Communications to the United Nations Framework Convention on Climate Change (UNFCCC), and United Nations Convention on Biological Diversity (CBD); and the Intergovernmental Panel on Climate Change (IPCC) Reports;
- *Policy documents* such as national and sub-national policies on climate change adaptation: e.g. National Adaptation Programmes of Action, climate change action plans at the provincial level, existing policies, regulations and/or action plans for protection of ecosystems such as forests, wetlands, coastal areas, poverty reduction strategies, development plans, and so forth;
- *Statistics and data*: meteorological data on current climate trends, seasonal forecasts for specific area, climate change forecasts, national census, and poverty data;
- *Maps* showing topography, agro-ecological regions, and infrastructure;
- *Assessment reports from NGOs or UN organizations* on any related programs and initiatives;

- *Evaluations* of past disaster response operations;
- *Environmental screening reports* for the target area; and
- *Consultation* with agencies (governmental and non-governmental) working in the target area.

Tool 2: Stakeholder Consultation

Stakeholder consultation processes for EbA include identifying and engaging key people and organizations that can either impact or are impacted by any part of EbA assessment. It is necessary to do a preliminary stakeholder assessment to identify key stakeholders that can help in initiating the discussion about the adaptation objective. At a sub-national level, it may involve:

- National and subnational governmental agencies, such as ministry of natural resources and their provincial and district level offices, ministry of planning and investment and their subnational offices, sectoral ministries such as agriculture, forestry, water, land-use, and their subnational offices;
- Technical experts in climate change and different sectors;
- Non-governmental agencies that are engaged in climate change and adaptation related activities; and
- Community representatives.

Once the stakeholders are identified, decide on a suitable engagement processes such as meetings, workshops, and one-on-one communication if needed.

Tool 3: Participatory Rural Appraisal (PRA) tools

Tool 3.1. Focus Group Discussion (FGD)

Focus group discussion is one of the most commonly used participatory methods to understand concerns and perceptions of the communities. A focus group is a small group of six to ten people, led through an open discussion by a moderator. The moderator/researcher has to establish a focus group based on some shared characteristics, so that the group is more or less homogenous, everyone feels equal, and no member feels inhibited to speak. Focus group can be formed based on gender, age, livelihood groups, or other characteristics to facilitate the discussion on common and individual concerns and perceptions.

A predetermined questionnaire is necessary to conduct a Focus group discussion, but the discussion has to be open-ended and semi-structured. The questionnaires should not be too long and the discussion should ideally be under two hours. To make analysis easier, the same questionnaire should be used with different focus groups where possible.

Key informant interviews can be used in addition to the FGD to fill in the gaps, discuss and elaborate on the issues that are sensitive to discuss in a group, or to get insights from people who have specific knowledge about relevant issues, for example history of extreme events, or the current status of a specific policy implementation. Key informants can be selected from the government agencies at national, provincial, and village level, as well as from individuals who are recognized by the local community to have specific knowledge or authority.

Tool 3.2. Seasonal Calendar

The purpose of generating a seasonal calendar is to identify the seasonality of community's livelihood activities, resource use, and resource abundance. Communities identify different activities (agriculture, seasonal migration) that occur throughout a year and the guided discussion will seek to identify how the climate change will affect overall activities, and whether it will alter the seasonality of the community's livelihood activities. The discussion will also seek to understand historical changes in seasonality that the community has already experienced, and the social mechanisms that the community has employed to mitigate their effects.

Tool 3.3. Historic Climate Trend analysis

Understanding the history of past extreme events, and a community's reaction to these events, can serve as very important information for adaptation plans. The historical trend analysis will give an insight into past climate hazards, their trends, intensity, and impacts to ecosystem services and communities. For EbA, it is important to talk about the impact on ecosystems and ecosystem services, such as impact on abundance and quality of water, food, fodder etc. The guided discussion should also include community reactions, coping strategies, and any institutional support involved.

The trend analysis should also take into account major political and socioeconomic development that has affected the communities in the past.

The trend analysis can be done either just through discussion, or by using a piece of long thread or string that is stretched across the meeting area to mark the passage of time. Starting with the earliest hazard, a timeline of 30 to 50 years is developed to identify hazards, their impacts, and coping strategies. Paper can be put along the length of the thread and details recorded in different colors.

Tool 3.4. Participatory Hazard and Resource Mapping

Ecosystem services and hazard mapping is done to identify the key ecosystems, ecosystem services, and their location in the study area, and to map the local climate hazards.

Climate hazard and resource mapping can be done either on a piece of paper or on actual maps of the study area, if they are available. Communities outline the boundary of the area, identify key ecosystems, ecosystem services and physical features (examples: rivers, wetlands, forests, location to collect water, food, fodder, and physical features such as schools, health centers, and financial institutions). Communities also identify major ecosystems and ecosystem services in the area. Then major hazards and hazard prone locations are then identified and mapped.

Guided discussion can cover direct, visible, and indirect impacts of climate change on livelihoods and ecosystem services. Mapping is a time consuming but important exercise. If there is a time constraint, it can be combined with the focus group discussion or other group discussions. The information from participatory hazard maps can be used to produce high-resolution maps through GIS.

Tool 4. Scenario Analysis

Scenario analysis is a process of analyzing possible future events by considering alternative possible outcomes or alternate future developments. For EbA and other adaptation planning, scenario analysis can provide a useful insight on the future risks and vulnerability to both societies and ecosystems. Scenarios are developed based on certain criteria or assumptions about the future (for example, level of infrastructure development, with or without climate change pressures and so on). These criteria can either be collectively agreed upon or taken from existing and future development plans/policies. Scenario analysis can be done with or without using any modeling in a stakeholder consultation.

Climate adaptation planning is a complex process as it involves consideration of how something that is uncertain can be influenced. A number of "tools" can help in structuring thinking about the future to see the different ways it might go, which of these would be preferable and which not, and what choices can lead to those preferred futures. This process is called "scenario planning" as it identifies the different possible future scenarios and what would influence them.

A common way of doing this is to consider how current drivers of change would influence the SES over an agreed time horizon (e.g. 5, 10, 20 years). This is called the "Business as usual" scenario. The other scenarios could be what if the developmental pressures increased (i.e. unregulated development, and what if conservation increased and development was sustainable—a conservation scenario). Consideration of these different scenarios helps people think about which of the future options they would prefer to live in, and therefore what decisions to take. Based on the secondary data available, climate projections such as sea level rise, and the future development plans, such scenarios can be developed and discussed in a participatory way. The outcome can show the ways in which different actions will impact the vulnerability of social-ecological system in future.

Scenario analysis can be done with or without modeling tools and software.

Tool 4.1. Scenario Analysis with Experts and Stakeholders

Participatory stakeholder analysis is used to identify the effects of alternative responses or actions

to emerging challenges, to determine how different groups of stakeholders view the range of possible management options available to them, and to identify appropriate management option.

Tool 4.2. Scenario analysis using modeling tools

The vulnerability assessment of certain ecosystem services in the study area can be made using InVEST (Integrated Valuation of Environmental Services and Trade-offs), a tool based on ecological production functions and economic valuation methods. It was developed by the Natural Capital Project- a joint venture among Stanford University's Woods Institute for the Environment, University of Minnesota's Institute on the Environment, The Nature Conservancy, and the World Wildlife Fund (http://www.naturalcapitalproject.org/). This tool is designed to address the principles of ecosystem-based management, bringing together credible, useful models based on ecological production functions and economic valuation methods in order to bring biophysical and economic information about ecosystem services to bear on conservation and natural-resource decisions at an appropriate scale (Tallis and Polasky 2009).

Although InVEST is built not to take climate change into account, some models in InVEST can be useful in assessing future vulnerability through creation of different scenarios. For example, InVEST's **coastal vulnerability model (Tier 0)** does not evaluate any environmental service, but gives a qualitative index of coastal exposure to erosion and inundation, highlighting the relative role of natural habitat in reducing such exposure to coastal population. This model can be used to analyze coastal vulnerability under different scenarios.

InVEST's **erosion protection model (Tier** 1) quantifies the protective benefits that natural habitats provide against erosion and inundation (flooding) in near shore environments, in terms of total water level at the shore, the amount of shoreline erosion, and the amount of avoided damages due to erosion (in local currency) from a given habitat. This model shows the level of erosion protection under different scenarios.

Tool 5: Expert Judgment

Expert judgment is an approach for soliciting inputs from individuals with particular expertise on concepts related to EbA. Considering the complexity involved in EbA, especially with regards to uncertainties and the impact of climate change in ecosystem, expert judgment can be used for rapid assessment and analysis of different aspects of vulnerability and adaptation prioritization of adaptation options. Expert judgment can be used in a variety of ways, including panel format for aggregating opinions, meetings, and workshops. It is important to realize that specific expertise may be necessary at different phases. Expert consultation may be needed in designing the project, deciding the data to be included, and for analyzing the data rigorously in order to come to science- and experience-based conclusions.

The experts needed may include climate change and adaptation specialists, hydrologists, ecologists (foresters, marine biologists, etc.), species specialists for particular species, sociologists, socio economic specialists, economists, and others.

Tool 6: Vulnerability Matrix

Creating a vulnerability matrix is one way of presenting the vulnerability analysis. The ultimate objective of the user should be to understand current and future risks and impacts from climate and non-climate risks, in order to come up with effective adaptation strategies.

It is good to keep in mind that the *vulnerability of a system* is best understood by looking at not only individual pressures and impacts but also the altered interactions within the system—in this case, interactions between ecosystem and communities. The vulnerability matrix includes columns for the exposure, sensitivity, adaptive capacity, and cumulative vulnerability and rows for different livelihood groups or sectors and ecosystem services under analysis.

Tool 7: Multi-Criteria Analysis

Multi-criteria Analysis (MCA) is a decision-making tool for complex problems, where multiple criteria are involved. Since many social, economic, and environmental criteria are important and should be consid-

ered in selecting the final adaptation measure, MCA can be used to compare and make a decision on the best possible adaptation measure. The multi criteria decision support system will help in structuring the available information in a clear and concise way, so as to support the identification of the most suitable alternative. With this approach the choices made will be participatory, explicit and justified. Multi Criteria analysis can be done with or without the use of any software/computer based tools. In both cases, stakeholder participation is extremely important to define the criteria used in analysis.

As both socio-economic development and adaptation planning will be complex, different stakeholders may have differing views about the relative importance of different direct objectives. The first stage of multi-criteria analysis should be a participatory process to agree on the relative importance of different possible objectives, if the objectives were not preagreed. Then different criteria are developed to evaluate the adaptation options. These criteria can be given different weights depending upon their importance. The minimum process for conducting the MCA would be through an "Experts Workshop", where each of the options would be discussed and subjectively scored (e.g. on a scale of 1–5), against each of the criteria; the scoring is then adjusted according to the weighting, and the weighted scores are used to rank the adaptation options.

This basic approach to conducting a MCA of the options can be improved depending on capacity, resources, and information. One of the advantages of the approach is that individual components of the scoring can be upgraded to (or toward) objective scoring as information becomes available on the effectiveness of that approach in different situations.

Resources for Multi-criteria analysis

Resource	Description	Link
Multi Criteria Analysis Tool	Web resource which gives an overview of the multi-criteria analysis tool DEFINITE	*http://www.ivm.vu.nl/en/projects/Projects/spatial-analysis/DEFINITE/index.asp*
Spatial Decision Support Software	Gives an overview of the software and has link to many publications related to the use of the software. These are generic and open-source tool for multi-objective planning	*http://www.uq.edu.au/marxan/*
European Commission (1997). Compendium of European planning systems. Regional Development Studies Report 28. Office for Official Publications of the European Communities, Luxembourg.	Study report that provides an authoritative and comparable reference on spatial planning systems and policies throughout the European Union	*http://commin.org/upload/Glossaries/European_Glossary/EU_compendium_No_28_of_1997.pdf*
Structure Decision Making	Conceptual framework. It highlights concepts and ideas about the Structured Decision Making (SDM) approach. In the "tools" section there is an inventory of some of the tools and techniques available to make the application of SDM to real-world situations a little easier.	*http://www.structureddecisionmaking.org/index.htm*

Annex 2.2 Resources to Help Valuate and Determine EbA Responses

Climate Risk Screening
(Adopted from Traerup and Lewoff, 2011)

Climate risk screening tools	Description	Available at
Adaptation Wizard	Provides a 5-step process to assess vulnerability to climate change and identify and options to address key climate risks. The "getting started section" is helpful for Step1: Designing adaptation Outcome. (UK Climate Impacts Program)	*www.ukcip.org.uk/*
Assessment and Design for Adaptation to climate change – A Prototype Tool (ADAPT)	Carries out risk analysis at the planning and design stage, through a five level flag classification and proposes options to minimize risks + guides project designers to appropriate resources. The focus thus far is on agriculture, irrigation and bio-diversity. (World Bank)	*http://sdwebx.worldbank.org/ climateportal/*
Climate change adaptation through integrated risk assessment (CCAIRR)	The approach constitutes of five main components: Capacity assessment and strengthening, review of knowledge data and tools, Rapid Risk Assessment, mainstreaming, and monitoring and evaluation. (Asian Development Bank)	*http://www.adb.org/ Documents/ Reports/Climate- Proofing/chap8. pdf*
The Community-based Risk Screening tool- Adaptation and Livelihoods (CRiSTAL)	User-friendly conceptual framework aimed at raising awareness on climate change adaptation and facilitates the identification and organization of an adaptation strategy. IUCN, SEI-US, IISD, Inter-cooperation	*http://www.cristaltool.org/*
Climate Vulnerability and Capacity Analysis (CVCA)	The methodology provides a framework for analyzing vulnerability and capacity to adapt to climate change at the community level. CARE	*www.careclimatechange.org/cvca/ CARE_CVCAHandbook.pdf*
climate change and Environmental Degradation Risk and Assessment (CEDRA)	The too assists in prioritizing which environmental hazards may pose a risk in existing locations and support the decision to adapt existing projects or start a new one (Tearfund)	*http://tilz.tearfund.org/Topics/ Environmental+Sustainability/ CEDRA.htm*
Designing climate change Adaptation Initiatives: A Toolkit for Practitioners	The toolkit aims to provide support for developing countries to move to low emission climate resilience growth paths while mobilizing financial resources to scale-up good practices with sufficient speed and where most needed. UNDP	*http://www.undp-adaptation. org/projects/websites/docs/ KM/PublicationsResMaterials/ UNDP_Adaptation_Toolkit_ FINAL_5–28–2010.pdf*
Disaster Risk Reduction Tools	ProVention Consortium	*http://www. proventionconsortium. org/?pageid=32&projectid*
NAPAssess	NAPAssess is an interactive decision-support tool designed to facilitate a transparent and participatory NAPA formulation process in Sudan. The use of multi- criteria analysis is also relevant in the context of climate screening	*http://www.sei-us.org/ napassess/*
Opportunities and Risks from climate change and Disasters (ORCHID)	Basic framework including a 4 steps generic approach to portfolio screening for climate risks. Institute of Development Studies (IDS) and Department for International Development (DFID)	*http://www.ids.ac.uk/go/ research-teams/vulnerability- team/research-themes/climate- change/projects/ orchid*
Screening Matrix	Simple climate change screening matrix or checklist to establish sector program support sensitivity. Testing on sector programs in 17 countries and some results are available. (DANIDA)	*http://www.danidadevforum. um.dk/ en/menu/ Topics/ClimateChange/ ClimateAndDevelopment/ ToolsAndReferences/ ClimateChangeScreening*
Temporal and Spatial Analogues	Involves the construction of temporal or spatial analogues using historic climate data. The data used as temporal and spatial analogues is either from the past or from another location.	*http://content.undp. org/ go/cms- service/download/p ublication/?version= live&id=3259633*

Annex 2.3. Resources to Assess Impacts on Ecosystems and Identifying Ecosystem-based Adaptation Options

Resources	Description	Link
Step-by-Step Guide for Considering Potential climate change Effects on Coastal and Estuarine Land Conservation Projects.	This draft step-by-step guide was developed to assist in the consideration of how climate change may affect proposed conservation projects. The guide is based on the assumption that it is prudent to evaluate how the targets of conservation projects might be affected by changing climate conditions. These evaluations may help to determine how the resilience of a project may be increased and/or how a project may contribute to the wider system's (e.g., watershed, coastal ecosystem) resilience. (Office of Coastal and Ocean Resource Management and NOAA (2011))	*http://coastalmanag ement.noaa.gov/ land/media/celphowtoapp.pdf*
Ecosystem Services Review for Impact Assessment	The Ecosystem Services Review for Impact Assessment (ESR for IA) provides practical instructions on how to incorporate ecosystem services throughout environmental and social impact assessment. WRI (2011)	*http://www.wri.org/p ublication/ ecosyste m-services-review- for-impact- assessment*
An introductory guide to valuing ecosystem services.	This guide looks at how the framework for the valuation of the natural environment could be improved by offering an approach that ensures that ecosystems and the services they provide are taken into account. It builds on traditional valuation approaches. In particular, Chapter 3 provides an overview of the steps to be taken in valuing the impacts on ecosystem services which includes identifying policy options and the current baseline; assessing the impact of policy options on the provision of ecosystem services, and valuing the changes in ecosystem services. DEFRA (2007)	*http://archive.defra.gov.uk/ environment/policy/natural- environ/ documents/ eco-valuing.pdf*
Biodiversity In Impact Assessment; Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment.	Provides an overview of the minimum knowledge required to address biodiversity in impact assessment and presents guidelines for biodiversity inclusive impact assessment. CBD (2006)	*http://www.cbd.int/d oc/publications/ cbd- ts-26-en.pdf*
Biodiversity in Impact Assessment.	Outlines principles to promote "biodiversity-inclusive" impact assessment (IA), including Environmental Impact Assessment (EIA) for projects, and strategic environmental assessment (SEA) for policies, plans and programs. Guiding principles and *operating* principles are presented. The operating principles provide high-level guidance on how to incorporate biodiversity in impact assessments. IAIA (2005)	*http://www.iaia.org/publicdocuments/ special- publications/SP3*
Ecosystem-based Adaptation Tools	An online database for tools and projects for innovative interdisciplinary coastal-marine spatial planning and ecosystem-based management.	
Ecosystem-based approaches to climate change adaptation and mitigation in Europe"	Study to address current knowledge gaps regarding the uptake and implementation of ecosystem-based approaches and thereby gain a better understanding of their role and potential in climate change adaptation and mitigation in Europe."	*http://ec.europa.eu/environment/ nature/climatechange/pdf/EbA_EBM_ CC_FinalReport.pdf*

Annex 2.4. Resources for Mapping and Valuation of Ecosystem Services

Resources	Description	Link
Ecosystem Services Evaluation using InVEST	Information about the Natural Capital Project, the InVEST tools and its applications. Many links to publications about ecosystem services valuation can be found here.	*http://www.naturalcapitalproject.org/*
Heart of Borneo: Investing in Nature for a Green Economy	Case study in Borneo where InVEST and the Land Change Modeling tool have been used to valuate the natural capital and to develop different scenarios for the future	*http://www.hobgreeneconomy.org/en/home*
A Green Vision for Sumatra: Using ecosystem services information to make recommendations for sustainable land use planning at the province and district level.	Publication describing the outcomes from a study conducted in Sumatra by WWF Indonesia, in which InVEST has been used for the assessment of the ecosystem services	*http://www.naturalcapitalproject.org/indonesia.html*
Integrating ecosystem-service tradeoffs into land-use decisions. Proceedings of the National Academy of Sciences of the United States of America	InVEST has been used to evaluate the environmental and financial implication of seven planning scenarios encompassing contrasting land use combinations in the North Shore of O`ahu (Hawaii)	*http://www.naturalcapitalproject.org/pubs/tradeoffs-2012.pdf*
Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning. International Journal of Biodiversity Science, Ecosystem Services & Management.	Description of the InVEST marine models and the results from an application to the West Coast of Vancouver Island, British Columbia (Canada)	*http://www.princeton.edu/~pinsky/Home_files/Guerry%20et%20al%202012%20IJBSESM.pdf*
Mapping and Valuing Ecosystem Services as an Approach for Conservation and Natural-Resource Management.	Key features of the InVEST models are discussed in this paper including the ability to visualize relationships among multiple ecosystem services and biodiversity.	
Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. Front Ecol Environ, 7(1): 4–11.	This paper demonstrates how InVEST can quantify ecosystem services in a spatially explicit matter and analyzes tradeoffs between them in order to make natural resource decisions more effective, efficient and defensible.	*https://groups.nceas.ucsb.edu/sustainability-science/weekly-sessions/session-5–2013–10.11.2010-the-environmental-services-that-flow-from-natural-capital/supplemental-readings-from-univ-of-minnesota-students/Nelson%20et%20al%202009.pdf/view*

Annex 2.5. Resources for Analysis of Adaptation Options

(*Adopted from UNEP 2012*)

Resource	Year	Description	Link
USAID Adapting to Climate Variability and Change: A Guidance Manual for Development Planning	2007	This adaptation guidance manual designed to assist planners and stakeholders in the identification and analysis of adaptation options through a stepwise approach drawing on relevant case studies	pdf.usaid.gov/pdf_docs/PNADJ990.pdf
Georgetown Climate Center Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use	2011	This adaptation tool kit provides a concise overview of a range of planning, regulatory and spending tools to assist adaptation decision-making	http://www.georgetownclimate.org/sites/default/files/Adaptation_Tool_Kit_SLR.pdf
GIZ Climate Proofing for Development	2010	This document presents a methodology for climate proofing in development planning. Of particular relevance is Step 3 "Options for Action" which provides a methodology for evaluating and prioritizing adaptation actions	www.undp.org.cu/crmi/docs/gtz-climateproofing-td-2010-en.pdf
World Bank Climate Impacts on Energy Systems: Chapter 4 Emerging Adaptation Practices	2011	This chapter describes the different considerations in delivering adaptation actions in the energy sector.	http://elibrary.worldbank.org/content/book/9780821386972
USAID Adapting to Coastal Climate Change: A Guidebook for Development Planners	2009	This guidebook provides a details treatment of climate concerns in coastal areas. The user is guided through the stages of adaptation planning, implementation and integration	pdf.usaid.gov/pdf_docs/PNADO614.pdf
UNFCCC Assessing the Costs and Benefits of Adaptation Options: An Overview of Approaches	2011	This publication provides an Introduction to a range of different assessment approaches and methodologies to assessing the costs and benefits of climate change adaptation options and shares best practices and lessons learned.	http://unfccc.int/files/adaptation/nair_obl_work_programme/knowledge_resources_and_publications/application/pdf/2011_nwp_costs_benefits_adaptation.pdf
World Bank Economics of Coastal Adaptation to Climate Change	2010	This report provides a global level overview of the costs of adaptation to sea level rise required from 2010 until 2050	http://www-wds.worldbank.org/external/default/ WDSContent-Server/WDSP/IB/2010/10/27/000333038_20101027000904/Rendered/PDF/574750Revised-01stal0Zone0Adaptation.pdf

Annex 3: Resources to Assist with Implementation of EbA Responses

A small village near BKN wetland, Lao PDR.

Examples of different Adaptation Options including aligned to impact area and ecosystem services
(Compiled by UNEP 2012)

Impact area	Adaptation technology	Description	EbA/Soft/Hard	Ecosystem services addressed	Benefits	Capacity requirements	Further Information
Coastal zone: Erosion Control	Beach nourishment	Beach nourishment is primarily used in response to shoreline erosion, although flood reduction benefits may also occur. The approach involves the artificial addition of sediment of suitable quality to a beach area that has a sediment deficit to maintain beach width and provide storm protection.	EbA Soft	Storm protection Erosion control Recreation and aesthetic values	Reduces impacts of erosion Provides storm buffer Increases beach amenity Potential ecological benefits i.e. enhanced nesting sites Low visual /aesthetic impact	Medium	*http://pdf.usaid.gov/pdf_docs/PNADO 614.pdf*
	Artificial Sand Dunes and Rehabilitation	Dune rehabilitation refers to the restoration of natural or artificial dunes from a more impaired, to a less impaired state of overall function, in order to gain the greatest coastal protection benefits. Artificial dune construction and dune rehabilitation are aimed at reducing both coastal erosion and flooding in adjacent lowlands.	EbA Soft	Storm protection Erosion control Recreation and aesthetic values	Buffer against coastal inundation and flooding Reduces impacts of erosion Provides coastal habitats for many plants and animals Are natural elements of the beach system	Low to Medium	*http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf*
	Seawalls	Seawalls are hard engineered structures designed to prevent further erosion of a shoreline. Sea walls vary significantly in form and materials depending on the physical setting.	Hard	Storm protection Erosion control	Provides high degree of protection against coastal flooding and erosion Seawalls generally have a low space requirement compared to other technologies	High Expert input required High capital and maintenance cost	*http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf*

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Examples of different Adaptation Options including aligned to impact area and ecosystem services *(continued)*
(Compiled by UNEP 2012)

Impact area	Adaptation technology	Description	EbA/Soft/Hard	Ecosystem services addressed	Benefits	Capacity requirements	Further Information
Coastal zone: Erosion Control *(continued)*	Brush mattressing	A brush mattress is a layer of branches placed on a dune/ shoreline or stream bank designed to protect against small scale erosion from waves and wind.	EbA Soft	Erosion control Nutrient cycling	Provides erosion control in low energy environments Provides a potential habitat for a range of species Recycles exists organic matter (dead branches etc.)	Low to Medium	*el.erdc.usace.army.mil/elpubs/pdf/sr23.pdf*
	Re-vegetation	Re-vegetation is used in the coastal zone to prevent/ reduce erosion, to improve riverbank ecosystem structure/ function and to improve water quality	EbA Soft	Erosion control Recreation and aesthetic values Production of atmospheric oxygen	Re-established local native flora Increases dune stability by reducing Aeolian (wind-blow) erosion Reduces turbidity Habitat creation Economically attractive	Low	*http://pdf.usaid.gov/pdf_docs/PNADO614.pdf*
	Mangrove forestation and conservation	Mangrove forestation and conservation aims to provide a natural buffer against coastal erosion and inundation, mangrove forests can also significantly contribute to habitat values	EbA Soft	Nutrient cycling Production of atmospheric oxygen Storm protection Erosion control	Reduction of income wave and tidal energy Able to cope with high levels and types of stress Habitat creation Water quality and regulation Potential source of fuel and fiber	Low	*http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf*

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Examples of different Adaptation Options including aligned to impact area and ecosystem services *(continued)*
(Compiled by UNEP 2012)

Impact area	Adaptation technology	Description	EbA/Soft/Hard	Ecosystem services addressed	Benefits	Capacity requirements	Further Information
Agriculture: Soil conservation and management	Slow-forming Terraces	Slow-forming terraces are constructed from a combination of infiltration ditches, hedgerows and earth of stone-walls. The terraces decrease surface water runoff, and increase water infiltration, they are used to improve the conditions for agricultural production, decrease erosion and increase soil moisture	Soft EbA	Erosion control Food, fiber and fuel Soil formation and retention Nutrient cycling Water cycling	Capture surface water runoff and increase infiltration Increase soil moisture Reduce soil erosion from surface water runoff	Low/Medium USD$350/ha capital costs USD$86/ha annual maintenance	http://ncsp.undp.org/sites/default/files/TNA_Guidebook_AdaptationAgriculture.pdf
	Integrated Nutrient Management	The aim of Integrated Nutrient Management (INM) is to integrate the use of natural and man-made soil nutrients to increase crop productivity and preserve soil productivity for future generations	EbA	Food, fiber and fuel Nutrient cycling Soil formation and retention	INM enables the adaptation of plant nutrition and soil fertility management in farming systems to site characteristics	Low/Medium Costs associated with INM relates to the purchase and distribution of inorganic fertilizers	*http://ncsp.undp.org/sites/default/files/TNA_Guidebook_AdaptationAgriculture.pdf*
Agriculture: Sustainable Crop Management & Agro biodiversity Conservation	Crop Diversification	Crop diversification through the introduction of new cultivated species and improved varieties if aimed at enhancing plant productivity, quality, health and nutritional value and build resilience to pests, diseases and climate change	EbA	Food, fiber and fuel Pest and disease control Genetic resources Seed dispersal Pollination Invasion resistance	Improved drought resilience Improved yields Increased resilience to pest and diseases Increased food security	Low Costs related to the purchase of new seed varieties and farming techniques	*http://ncsp.undp.org/sites/default/files/TNA_Guidebook_AdaptationAgriculture.pdf*
	Ecological Pest Management	Ecological Pest Management (EPM) is an approach to increasing the strengths of natural systems to reinforce the natural processes of pest regulation and improve agricultural production.	EbA	Food, fiber and fuel Pest and disease control	Farmers can avoid the need and cost of pesticides Promotes self regulating systems Increases resilience to stresses such as drought, soil compaction and pest invasions	Low to Medium	*http://ncsp.undp.org/sites/default/files/TNA_Guidebook_AdaptationAgriculture.pdf*

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Examples of different Adaptation Options including aligned to impact area and ecosystem services *(continued)*
(Compiled by UNEP 2012)

Impact area	Adaptation technology	Description	EbA/Soft/Hard	Ecosystem services addressed	Benefits	Capacity requirements	Further Information
Agriculture: Sustainable Farming Systems	Mixed Farming	Mixed farming is an agricultural system in which a farmer conducts different agricultural practices together, such as cash crops and livestock. The aim is to increase productivity and to complement land and labor demands across the year in varying conditions	EbA	Food, fiber and fuel Genetic resources Nutrient cycling Seed dispersal	Increased food security Maintains soil fertility Maintains soil biodiversity Conserves water Increased nutrient cycling	Low	http://ncsp.undp.org/sites/default/files/TNA_Guidebook_AdaptationAgriculture.pdf
	Agro-forestry	Agro-forestry is an integrated approach to the production of trees and of non-tree crops or animals on the same piece of land. Agro-forestry can improve the resilience of agricultural production to current climate variability as well as long-term climate change through the use of trees for intensification, diversification and buffering of farming systems	EbA	Food, fiber and fuel Genetic resources Soil formation and retention Production of atmospheric oxygen Water cycling Climate regulation	Increases productivity of the land Protection and improvement of soils Livelihoods diversification	Low to Medium	*http://ncsp.undp.org/sites/default/files/TNA_Guidebook_AdaptationAgriculture.pdf*
Water Resources:	Rainwater Collection from Ground Surfaces – Small Reservoirs and Micro-catchments	This practice consists of collecting rainfall from ground surfaces using micro-catchments to divert or slow runoff so that it can be stored before it can evaporate. The second part consists of collecting flows from a river, storm or other natural watercourse (sometimes called floodwater harvesting) which can be stored and used to improve soil moisture for agriculture	EbA	Freshwater Water cycling Soil formation and retention	Can contribute to increased groundwater recharge Improve soil conditions Reduce erosion from surface water runoff	Medium to High	*http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationWater.pdf*

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Examples of different Adaptation Options including aligned to impact area and ecosystem services *(continued)*
(Compiled by UNEP 2012)

Impact area	Adaptation technology	Description	EbA/Soft/Hard	Ecosystem services addressed	Benefits	Capacity requirements	Further Information
	Catchment Thinning	Catchment thinning involves the planned removal of vegetation (trees) in densely forested areas that are suffering from drought to increase the amount of surface water runoff and increase stream flows. The technique is currently in its infancy	EbA	Food, fiber and fuel Water cycling	Increase steam flow and available water for human use Provide a source of fuel and fiber	Medium to High	*http://www.water-corporation.com.au/W/wungong_index.cfm*
	Bores/ Tubewells for Domestic Water Supply During Drought	Increasing access to groundwater through the installation and or improvement of boreholes to ensure a source of potable water during periods of drought	Hard	Freshwater	Increased water security	Medium–High	*http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationWater.pdf*
	Desalination	Desalination is the process of removing sodium chloride (salt) from brackish water as well as sea water. Desalination can be achieved through either thermal processes (evaporation) or membrane processes	Hard	Freshwater	Increased water security High quality water supply	High	*http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationWater.pdf*

Guidance on process-based and outcome-based indicators
Synthesized from: Brooks et al. 2011; Dudley et al. 2010; OECD 2008; Pringle 2011; Sparks et al. 2012; UNFCCC April 2011; Travers et al. 2012; GIZ & WRI 2011.

Scale	Types	Process-based Indicators	Outcome based Indicators
National	Environmental	▸ Indicators measuring the implementation of policies or actions to prevent or reduce biodiversity loss. Pressures: indicators monitoring the extent and intensity of the causes of biodiversity loss that responses aim to address. State: indicators analyzing the condition and status of aspects of biodiversity. Benefits: indicators quantifying the benefits that humans derive from biodiversity ▸ To what extent has adaptation interventions increased the resilience of key sectors and natural/managed systems on which human populations depend?	▸ Coverage of climate change adaptation interventions ▸ Impact of extreme weather events on ecosystems ▸ Evidence of changed quality of climate-sensitive natural resource base;
	Economic/ Financial	▸ The effectiveness of macro-economic management for climate resilience ▸ To what extent have adaptation interventions increased the resilience of key sectors and natural/managed systems on which human populations depend?	▸ Value of assets and economic activities protected or made less vulnerable as a result of adaptation interventions (e.g. based on capital assets with reduced physical exposure compared with business-as-usual scenario, turnover of businesses incorporating adaptation measures resulting from projects, etc.). ▸ Benefit/cost ratios of adaptation options identified/ implemented (based on ratio of value of assets and productivity made less vulnerable to adaptation expenditure).
	Social/Cultural	▸ Degree and quality of participant involvement in adaptation decisions	▸ Numbers of beneficiaries of climate change adaptation interventions (either absolute or in terms of proportion of national or other population) ▸ Numbers of people experiencing reductions in vulnerability, represented by movement from more vulnerable to less vulnerable category/score in key indicators that are defined in particular contexts. ▸ Change in degree of exposure to climate risks and threats ▸ Change in stakeholder response to climate risk, or utilization of adaptation options ▸ Evidence of community, sectoral, or institutional understanding and capability to deal with or avoid climate-induced losses
	Technical	▸ How well the components of the national system conduct National Adaptive Capacity functions (with reference to, for example, the World Resources Institute National Adaptive Capacity framework11). ▸ Qualitative assessments of the management competency and performance at different points of hierarchy will be made. ▸ By aggregating across adaptation interventions estimates of accumulative climate effects on development will be made. ▸ Relevance and quality of informational inputs to adaptation decisions ▸ Whether and how the adaptation process is sustained	▸ Proving causality between upstream and downstream interventions ▸ Proportion of development initiatives that are modified compared to a 'business-as-usual' case in order to make them more climate-resilient ▸ Coverage of Climate Change interventions (proportion of portfolio that includes measures to address climate change). ▸ Utility and quality of early warning systems

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Guidance on process-based and outcome-based indicators *(continued)*
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Scale	Types	Process-based Indicators	Outcome based Indicators
	Institutional/ Political	Use of climate and M&E information in policy and program design ((e.g. policies and programs informed by evidence of emerging climate trends and scenarios of future climate change). ▸ How well national systems conduct climate risk management functions ▸ Mechanisms for targeting the climate vulnerable poor ▸ Institutional frameworks of regulatory and legislative support of adaptation ▸ Building Adaptive Capacity (BAC) involves developing the institutional capacity to respond effectively to climate change. This means compiling the information you need and creating the necessary regulatory, institutional and managerial conditions for adaptation actions to be undertaken ▸ To what extent have adaptation interventions helped to keep development 'on track' with respect to existing development targets such as those related to the MDGs, where climate change and variability act to make the achievement of these targets more difficult? ▸ Climate risk management by key national to local authorities will be assessed ▸ The extent of Climate Risk Management policy implementation will be tracked ▸ Institutional capacity for CRM will be examined. ▸ The integration of climate risk management (CRM) into development processes, actions and institutions. Assessment of CRM integration or mainstreaming is likely to be largely qualitative in nature, and might follow a 'certification' type approach. Incorporating nationally-developed indicators that track climate risk management on the one hand, and climate-relevant development and vulnerability indicators on the other hand. ▸ Indicators of drivers of adaptation, such as relevant legislation, barriers, such as a possible lack of compliance and enforcement of legislation, and other developments that decease or increase vulnerability, such as improvements in the health or education sector, are also desirable. ▸ Thoroughness of accounting for climate risks and vulnerability in decision making ▸ Number and quality of laws or policies addressing climate change,	▸ Proportion of development initiatives that are climate-proofed. ▸ Delivering Adaptation Actions (DAA) involves taking practical actions to either reduce vulnerability to climate risks or to exploit positive opportunities and may range from simple low-tech solutions to large scale infrastructure projects. ▸ To what extent have adaptation interventions resulted in the integration of climate risk management into development policy and planning, or enhanced existing climate risk management capabilities? ▸ Evidence of community, sectoral, or institutional understanding and capability to deal with or avoid climate-induced losses
Local	Environmental	▸ State: indicators analyzing the condition and status of aspects of biodiversity. Benefits: indicators quantifying the benefits that humans derive from biodiversity	▸ Evidence of changed quality of climate-sensitive natural resource base;
	Economic/ Financial	▸ Front-loaded investments in baseline and indicator setting may be necessary. ▸ By tracking changes in the developmental status and vulnerability of the climate vulnerable poor it will be possible to estimate the costs climate effects to these groups, and the costs and benefits of adaptation.	▸ Value of assets and economic activities protected or made less vulnerable as a result of adaptation interventions (e.g. based on capital assets with reduced physical exposure compared with business-as-usual scenario, turnover of businesses incorporating adaptation measures resulting from projects, etc.). ▸ Benefit/cost ratios of adaptation options identified/ implemented (based on ratio of value of assets and productivity made less vulnerable to adaptation expenditure). ▸ Impact on livelihood outcomes.

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Guidance on process-based and outcome-based indicators *(continued)*
Synthesized from: Brooks et al. 2011; Dudley et al. 2010; OECD 2008; Pringle 2011; Sparks et al. 2012; UNFCCC April 2011; Travers et al. 2012; GIZ & WRI 2011.

Scale	Types	Process-based Indicators	Outcome based Indicators
	Social/Cultural	▸ Engagement with minority groups (women, indigenous, vulnerable, etc.) ▸ To what extent have adaptation interventions increased the ability of individuals, communities and institutions to development and pursue their own adaptation strategies and measures (building adaptive capacity)? ▸ To what extent have adaptation interventions reduced the vulnerability of individuals and households to hazards associated with climate variability and change? ▸ Quantitative indicators of development performance and climate vulnerability of the climate vulnerable poor will be identified. ▸ Traditional knowledge is vital in monitoring change in ecosystem services. Local stakeholders are best placed to recognize the gradual or 'weak' signals of change in ecosystems and their service delivery over short timeframes. Consequently, qualitative data can be collected via discussions with local stakeholders ▸ Degree and quality of participant involvement in adaptation decisions ▸ Relevance and quality of informational inputs to adaptation decisions	▸ Numbers of people experiencing reductions in vulnerability, represented by movement from more vulnerable to less vulnerable category/score in key indicators that are defined in particular contexts (based on variety of context specific indicators converted into scores that can be aggregated across contexts). ▸ Change in degree of exposure to climate risks and threats ▸ Change in stakeholder response to climate risk, or utilization of adaptation options ▸ Evidence of community, sectoral, or institutional understanding and capability to deal with or avoid climate-induced losses
	Technical	▸ Qualitative assessments of the management competency and performance at different points of hierarchy will be made. ▸ Whether and how the adaptation process is sustained	▸ Proving causality between upstream and downstream interventions ▸ Proportion of development initiatives that are modified compared to a 'business-as-usual' case in order to make them more climate-resilient ▸ Utility and quality of early warning systems
	Institutional/ Political	▸ Mechanisms for targeting the climate vulnerable poor	▸ Evidence of community, sectoral, or institutional understanding and capability to deal with or avoid climate-induced losses

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