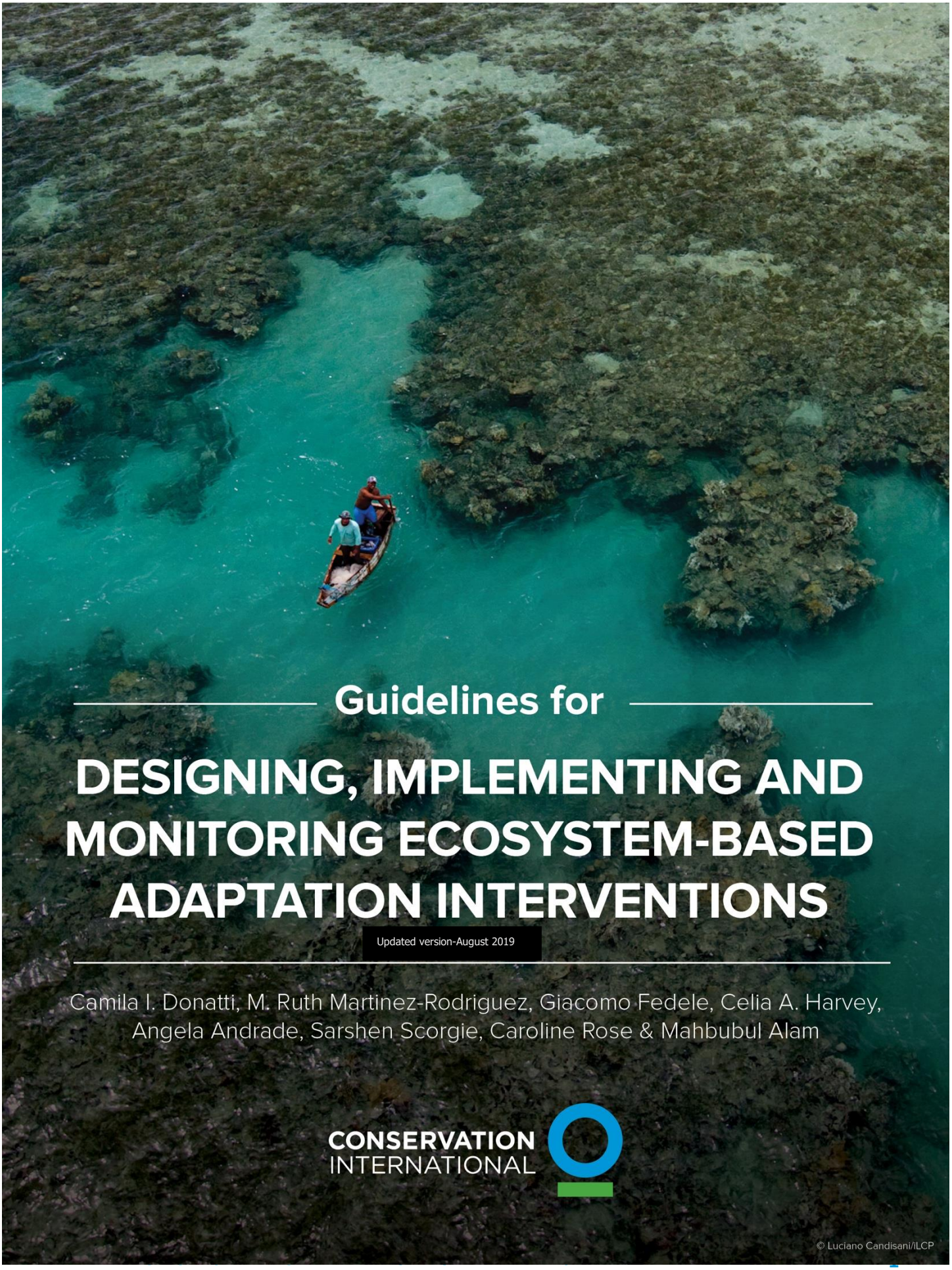


Guidelines for

DESIGNING, IMPLEMENTING AND MONITORING ECOSYSTEM-BASED ADAPTATION INTERVENTIONS

Updated version-August 2019

Camila I. Donatti, M. Ruth Martinez-Rodriguez, Giacomo Fedele, Celia A. Harvey, Angela Andrade, Sarshen Scorgie, Caroline Rose & Mahbubul Alam

CONSERVATION INTERNATIONAL

INTRODUCTION

What is EbA?

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). Conservation International (CI) has established the following three criteria that an internal project must meet to be considered EbA: (1) address one or more specific climate change threats or impacts; (2) include conservation, restoration and/or improved management of ecosystems and/or biodiversity, or the implementation of agricultural practices that are based on those; and (3) aim to improve livelihoods and/or increase resilience of vulnerable populations to climate change. Some examples of EbA include the conservation of mangroves to protect people against storms made more severe by climate change, the reforestation of degraded areas to prevent floods under changing climatic conditions, and the use of shade trees in coffee plantations to maintain production even as temperatures rise.

Why are EbA Guidelines Needed?

Even though EbA is an important part of Conservation International's climate agenda, we do not yet have a set of guidelines on best practices for EbA identification, implementation and monitoring. This lack of consistency across the institution limits our ability to compare and aggregate results achieved through EbA interventions. By doing so, we would increase the evidence base of EbA and information on its co-benefits and costs, and measure the institution's impact from the project site to the global level. A key barrier globally to EbA implementation at-scale has been an underdeveloped evidence base and lack of standard methods for EbA projects, from implementation to evaluation. Addressing these issues could ultimately lead to increased funding and scaled-up implementation of this important adaptation approach.

What is Contained in this Guidelines Document?

This document provides general guidance and best practices for the identification, design, implementation, monitoring and evaluation of EbA interventions, especifically for projects that already have the financial resources to implement such intervention(s). This document also includes information on vulnerability assessments, which are important for identifying the climate threats and impacts that EbA is meant to address. Stakeholder engagement is also addressed as it is key to ensuring that the visions of partners, governmental bodies and local communities are embedded in all the steps of the project.

This document is divided into five steps, each one addressing an important aspect for ensuring the successful implementation and monitoring of an EbA intervention (Figure 1). In each step, we list a set of activities to be done and the best practices on how to conduct them. We start each section with a description of the purpose and importance of the step. We also provide, throughout the text, examples in boxes to demonstrate some of the activities and best practices suggested. The assessment of costs and benefits of EbA is included at the end of the document as an additional, optional step, as its implementation depends on resources and time available. Key terms used in the document are included in the glossary.

The guidelines provided in this document can be used in a variety of different ecosystems and socioecological contexts. These guidelines build on the background information and discussions held at the EbA workshop that took place at CI in April 2017, on existing scientific and grey literature and on our own experiences designing, implementing, evaluating and monitoring EbA interventions. Please note that there are now a set of guidelines for design and effective implementation of Ecosystem-based approaches to climate change and disaster risk reduction developed by CBD (Conversion on Biological Diversity) secretariat and partners (CBD 2018), which present complimentary information to that presented here.

What needs to be considered before this Guidelines document is used?

Before you start any EbA project, and before you conduct the five steps proposed here, please first check the potential applicability of an EbA intervention in the target area. For example, if the target area needs an intervention and has the minimal biophysical conditions (i.e. can restoration be successful regardless of the type of terrain?) and the social conditions (i.e. do local communities have the minimal socio-economic conditions to be interested and to support the for EbA implementation?) to support it.

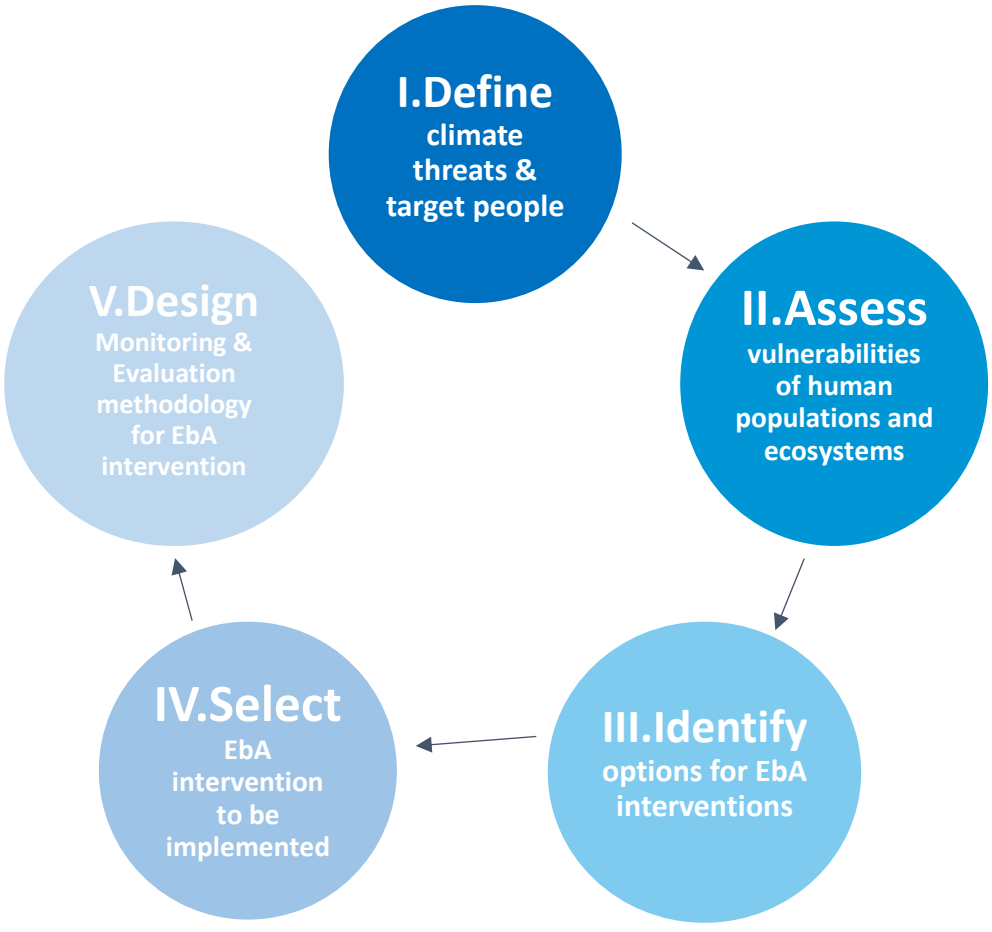


Figure 1. The five steps needed to properly design, implement and monitor an EbA intervention successfully. If information presented inside circles is already known, please skip that step.

STEP I. DEFINE THE MAIN CLIMATE THREATS FACING THE REGION AND THE TARGET POPULATIONS

PURPOSE OF THIS STEP:
To identify:

1. the main climate threats that currently exist or are expected due to climate change in a given region;
2. how climate threats may negatively affect people either through the direct impacts on the system (e.g. damage to crops) or through the impacts on ecosystem services or processes (e.g. reduction in water provision, pollination, food provision and coastal protection) and
3. the target population that exists within or outside the region (e.g. fishermen, farmers, coastal residents, downhill water users, city residents, women, children, hillside residents, etc.) that are or will be impacted by climate thrests, and for whom the EbA intervention should target in order to reduce those impacts, and
4. institutional and resources available to assess climate change vulnerability and to implement and/or support an EbA intervention, and political will and interest in implementing EbA in the target region.

WHY THIS STEP IS NEEDED:
The identification of both the climate risks and the target population are key to selecting the EbA intervention as EbA aims to help the target population (or a subset of the target population) to adapt to a specific threat or set of climate threats, by managing ecosystems to increase their resilience or by restoring them. This identification should be identified before an in-depth vulnerability assessment is conducted.

WHEN TO SKIP THIS STEP:
If project members already know the impacts of climate change on people (through the direct impacts on the system or through impacts on ecosystem services or ecosystem processes), as well as the population that the EbA intervention will target.

OUTCOMES OF THIS STEP:

- List of expected changes of weather and climate (current, potential and expected changes),
- Potential impacts of climate change on people (through the direct impacts on the system or indirectly through impacts on ecosystem services or ecosystem processes),
- Target population, and
- Assessment of the resources available and institutional capacity to conduct more in-depth assessment and to implement the EbA intervention.

ACTIVITIES PROPOSED FOR THIS STEP:

1. **Identify the current and expected changes in weather and climate in the region, and how those changes have impacted or may impact people's lives or livelihoods**

Why? the identification of the impacts of a changing climate and who may be most impacted (directly or through impacts on ecosystem service or processes) is important for defining the scope of the vulnerability assessment

a. Conduct a desktop study of information scientifically grounded in climate projects and data to identify how current and expected extreme weather events and changes in climate have affected or will likely affect people's lives and livelihoods in the future. These effects may be direct or indirect through impacts on ecosystems and their services or processes in the region (examples of how climate change may impact people's livelihoods are in Box 1).
b. information on the impact of those weather events and changes on lives and livelihoods. Sources of information include, for example:
    a. General: IPCC reports, NAPAS and NAPs of countries, World Bank's Climate Change knowledge portal;
    b. Country specific: governmental reports, scientific journals, thesis.

2. **Review the information on how climate change has impacted or may impact people's lives and livelihoods with scientists and local stakeholders, and identify the target population (see Box 2 for best practices on stakeholder engagement).**

Why? the revision of the information with scientists and local stakeholders can be used to validate what was found and to identify and incorporate information that was not previously considered

- Please consider how gender may play a role on the way the extreme weather events might impact the livelihoods of men and women in different ways. Examples of potential target populations include:
- **coastal communities** whose lives and assets may be impacted by hurricanes
- **urban communities** or **those living on steep hillsides** whose lives and assets may be impacted by landslides caused by strong rainfall events
- **smallholder farmers highly dependent on rain-fed agriculture** that may be impacted by changes in temperature and precipitation as those affect crop and livestock production

- **fishermen** that may be impacted by the migration of fish species to other areas driven by changes in ocean temperature
- **communities downstream** may be impacted by a reduction in water availability caused by an increase in temperature and decrease in rainfall

Box 1. Examples of changes in weather and climate and their impacts on people's lives and livelihoods

Stronger and more frequent storms damage the assets of **coastal communities** and infrastructure

More intense rainfall events produce landslides that damage the assets and infrastructure of **urban communities or those living in hillsides**

Decrease in rainfall reduces crop production affecting income and food security of **farmers**

Changes in ocean temperature affects the distribution of certain fish species affecting the livelihoods of **fishermen**

Decrease in rainfall and increase in temperature reduces water availability to **communities downstream**

3. **Identify, in collaboration with stakeholders, the target population(s) that the EbA intervention(s) may help adapt**

   Why? to identify who we need to design the EbA interventions for

   a. Review, with the help of stakeholders, such as local authorities, local communities, and researchers, the list of populations that may be impacted by climate change. From this review, identify the target population(s) that may be the most impacted by climate change and that can benefit from the protection, restoration and management of ecosystems and/or biodiversity, or from the implementation of agricultural practices that improve those.

4. **Identify the institutional capacity to conduct an in-depth assessment and to implement the EbA intervention**

   Why? to decide if additional staff or consultants should be hired to proper identify, implement and monitor the EbA intervention.

   a. Those are the minimum set of expertise that should exist in the project team (including staff, consultants and participants from partner organizations) to conduct all 5 steps listed in this document:
      - Climate change science
      - Social science
      - Policy
      - Gender
      - Data gathering (e.g. household surveys, interviews with key informants, literature review)
      - Data analysis

- Writing
- Project management
- Finance

Box 2. Best practices for stakeholder engagement

Ensure local participation in workshops conducted in all steps listed in those documents with invitations to representatives of different sectors:

- Community members: leaders (both men and women) of the different communities and/or villages, and others who are respected by villagers (this is culturally contextual; e.g. Elders, teachers, etc). *When access to indigenous and local knowledge is needed, it has to be done in ways that comply with the principles of free, prior, and informed consent, which is critical to ensure effective participation in the project.*
- Municipal staff: government staff working at the municipal office
- Members of different governmental departments, such as the Department of Agriculture, Rural Development, Department of Forest Protection, Agricultural Extension agents, among others
- Members of relevant unions and private sectors, which could be: Women's Union, Farmers' Union, cooperatives, private enterprises.
- Strive for gender representation of about 50% women and men. Women who are ordinary members of women's or farmers' unions should be invited to join the workshops.

Keep stakeholders informed on activities and next steps

- Ensure that there is liaison with the different stakeholders, and that these individuals receive and pass on relevant information in a timely- and language-sensitive manner.

Disseminate results and experiences

- Publish results as presentations, policy briefs, peer-reviewed publications and/or lessons learned documents; those materials must be in the local language and be made available to stakeholders.

STEP II. ASSESS THE VULNERABILITY* OF THE TARGET POPULATION(S) TO CLIMATE CHANGE

PURPOSE OF THIS STEP:
To have a deeper understanding of how climate change and extreme weather events impact the target population(s) either through the impacts on the systems, or through the impacts on ecosystems and their services and processes, and an understanding of their capacity to adapt to climate change.

WHY THIS STEP IS NEEDED:
Now that the target population has been identified, we need to assess the vulnerability of this target population to climate change, to:

a) specifically understand how climate change has impacted or may impact them directly or indirectly (by affecting the ecosystem services or precesses they rely on) and
b) to define if a subset of the target population should be focused on in the EbA implementation.
Therefore, you should focus on the vulnerability of the target population, as identified in the previous step, to current and expected impacts (e.g. damages to crops, reduction in water provision, pollination, food provision and costal protection).

WHEN TO SKIP THIS STEP:
If the subset of the target population or the most vulnerable communities that the EbA will target is already known and if the impacts on the ecosystems they rely on is also known.

OUTCOMES OF THIS STEP:
A map that presents areas where the target population have low, medium and high vulnerability, and an indication of what impacts of climate change and extreme weather events they are vulnerable to, (e.g. vulnerable to coastal erosion, vulnerable to water shortages, vulnerable to crop failure).

* the activities presented in this step in this document are based on the terminology found in the IPCC's 44th report and are well accepted by a variety of institutions and governments. It is not yet clear whether the new terminology presented in the 5th report will be adopted as widely.

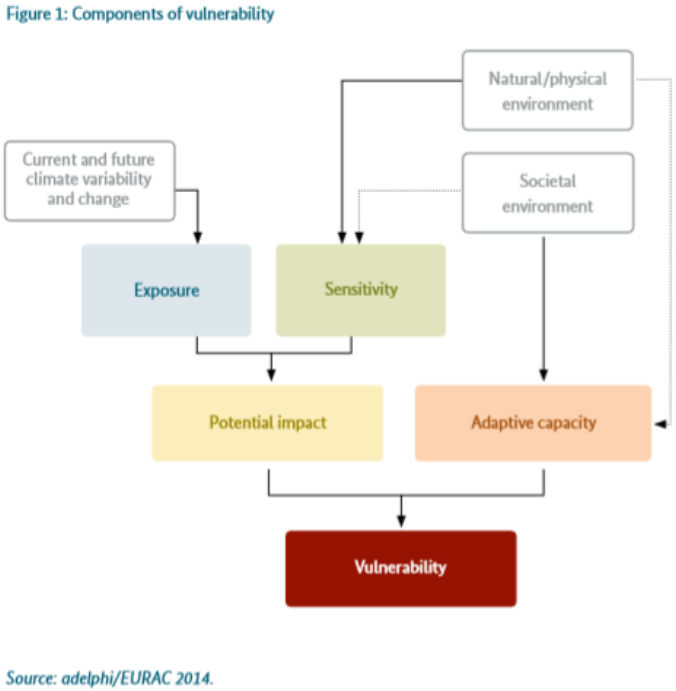


Figure 2. The components of vulnerability to climate change. Adaptation measures can be implemented to either decrease sensitivity or increase adaptive capacity with the main goal of reducing the vulnerability of the target system to climate change (from adelphi/Eurac 2014).

ACTIVITIES PROPOSED FOR THIS STEP:

1.Identify the steps and information needed to assess the vulnerability of the target population to certain impacts associated to climate change (e.g. damages to assets, damages to crops, reduction in water provision, pollination and food provision).

Why? there are no standardized ways to measure vulnerability, but there are lots of methodologies available (see Annex 1)

a. Select a methodology to assess the vulnerability of the target population. The selection should be based on the livelihoods of the target population and on the impacts of climate change on their lives and livelihoods, and on ecosystems and their services. Time, financial resources and institutional capacity available for this step should also be considered when selecting a methodology.

- There is no fixed rule to define which variables to consider when assessing vulnerability of human populations/communities to climate change. Annex 1 provides a list of potential methodologies and tools and the advantages and disadvantages of each methodology.

b. Identify the variables that need to be collected to apply the selected methodology.

- Most assessments focus on 3 main elements that then need to be analyzed in combination:
- Exposure of the target population to climate change, sensitivity to climate change of the livelihood systems/ ecosystem services that target population relies on, and the adaptive capacity of the target population (see table 1).
- For all 3 components, a set of variables need to be assessed and then aggregated into a single number (i.e. vulnerability score) that will determine the vulnerability of the target population. This score needs to be accompanied by an explicit description of what it means and how it was calculated. Keep in mind that the information collected in the assessment can be used as a baseline for monitoring and evaluating the impact of the EbA intervention on the target population (i.e. to monitor whether or not the vulnerability of the target community has decreased).
- See Annex 4 for an example of the variables used to assess the vulnerability of communities to coastal erosion driven by climate change in the Philippines. The Vulnerability assessment of the Namakwa District in South Africa (Bourne et al. 2015) also includes the variables used to assess the 3 components of vulnerability.

Table 1. Components of vulnerability to climate change, a description of each component and possible ways to assess it.

Component	Description	Ways to assess it
Exposure	Refers to changes in climate or weather (e.g. rainfall changes, temperature changes, changes in sea level, increased incidence of hurricanes and droughts, etc.) that are affecting/will affect the region where the target population lives.	- historical climate-related data -modeling work on how temperature and rainfall may change or studies/interviews on people's perceptions of changes in weather and climate. -Potential sources of data include: Climate wizard;
Sensitivity of the system or ecosystem services	Refers to the impacts that changes in climate or weather cause on the livelihoods of the target population (e.g. by affecting crop production, fisheries, etc). and by affecting ecosystem services and processes that they rely on (i.e. water, wild food, pest control, ecotourism, nutrient cycling)	-modeling of how changes in temperature and precipitation may affect crop production, provision of water and other ecosystem services -interviews of stakeholder's perceptions on how extreme weather events have changed crop productivity, water availability or other aspects of their livelihoods. - Potential sources of data include: IPCC reports, NAPAS and NAPs of countries, World Bank's Climate Change knowledge portal.
Adaptive capacity of the target population	Refers to whether the target population is able to adjust to the changes in climate and weather and its impacts. Capabilities include human, social, financial, physical, and natural capital, institutions and entitlements, knowledge and information, decision-making and governance (e.g. Africa Climate Change Resilience Alliance's Local Adaptive Capacity Framework, Holland et al. 2017).	- census data that can inform the adaptive capacity of the target population (i.e. literacy, income, ownership of assets) that are available to the target population. - interviews with local communities' members or local experts to get information on aspects related to adaptive capacity when census data is not available or incomplete - Potential sources of data include: Living Standards Mearument Study; IPUMS; Ci's Resilience Atlas

2. Review literature or conduct a workshop to assess information needed for the vulnerability assessment

Why? Studies should not be duplicated but be complementary, and information needed for the vulnerability assessment may already be available from other studies.

a. Identify the data/variables needed to assess exposure, sensitivity and adaptive capacity through a desktop study and/or workshop and check whether those are available. This information might come from peer-reviewed literature but also from grey literature, project reports from other organizations or research institutions, existing assessment of climate change impacts conducted by local government or other institutions or thesis done at local universities.

3. **Plan and conduct additional studies if needed**

   Why? If the data/variables that are needed to assess the vulnerability of the target population are not available, there is a need to conduct additional studies.

   a. Conduct targeted studies to collect missing information. The scope and methodology of those studies will depend on the resources available.
   b. Engage with stakeholders to assess local knowledge related to the data/variables needed.
   c. Identify potential partners (e.g. universities or other institutions) that could help to provide the information needed.

4. **Assess vulnerability of the target population to climate change using the selected methodology**

   Why? to identify who among the target population is the most vulnerable so the EbA intervention can be designed to target those stakeholders.

   a. Assess each component of vulnerability (exposure, sensitivity and adaptive capacity). Assigning a score to each component of the target community is highly recommended (see Box 3) so scores can be tracked through time and thus used in the monitoring and evaluation of the EbA intervention. Ideally the scores should be calculated for the highest resolution as possible (e.g. pixels, households, communities).
   - Even though there is not a standard methodology to calculate the vulnerability score, it could be a 0-5 rating system for each of the 3 components. The vulnerability score is calculated as the sum of exposure and sensitivity scores (assuming that a high number means a high exposure and/or high sensitivity) minus the adaptive capacity score (assumning that a high number means a high adaptive capacity). Please note that the scores can then be transformed to a grading system (see Figure 3). The Vulnerability assessment of the Namakwa District in South Africa (Bourne et al. 2015) includes the

Box 3. Example of developing scores for each component of vulnerability

To assess the vulnerability of the coastal communities of Mindoro region (Philippines) to climate change, Cogswell et al. 2016, used 18 variables to calculate exposure, sensitivity and adaptive capacity (see annex 4).

They categorized each variable into quintiles and then ranked them from 1 to 5, where 1 is the least vulnerable and 5 is the most vulnerable. The adaptive capacity variables were inverted so that 5 would represent the lowest adaptive capacity (this is the case because a low vulnerability is related to a high adaptive capacity).

To calculate the exposure index, they multiplied the ranking of all variables related to this component and divided them by the number of variables used. The same was done to calculate the sensitivity index. In this study, all variables had the same weight, but it is up to the team to decide whether to give different weights to different variables. To calculate the vulnerability index, they multiplied the exposure, sensitivity and adaptive capacity indices, and divided by three. The final result is presented in Figure 3.

Another great example of how climate change vulnerability of a District in South Africa can be found in Bourne et al. 2015.

variables used to assess the 3 components of vulnerability and ways to combine those components to assess climate change vulnerability.

5. **Prepare a map and description of the information gathered through the vulnerability assessment that shows the vulnerability scores for the unit of analysis (pixels, landscapes, households, communities etc.)**

   Why? This map, developed by overlapping the multiple variables needed to calculate the vulnerability score, will visually help to identify those who are the most vulnerable in the target region. Descriptions of the information gathered, methods used and what the score means should provide clear factors that explain the high vulnerability. An example of such map can be found in Figure 3.

6. **Conduct a workshop/meeting with the project team and stakeholders to review and validate the information gathered on the vulnerability assessment**

   Why? To make sure stakeholders agree with the findings of who are the most vulnerable within the target population, the factors that lead to this vulnerability and what impacts associated with climate change and extreme weather events they are most vulnerable to.

   a. Invite communities, local leaders, technicians, scientists and other stakeholders to participate in the workshop/meeting where information on vulnerability will be shared and discussed (see Box 4 for examples of stakeholders to invite)
   b. Present the final map of vulnerability, as well as the variables that were used to calculate each of the 3 components of vulnerability (exposure, sensitivity, adaptive capacity)
   c. Update the vulnerability scores and maps depending on the identification of new datasets or other variables during the workshop/meeting that should be included in the calculation of the vulnerability, or the weights that should be given to each variable used to assess vulnerability. For example, a new dataset on literacy, scholarity or income that exists but was not incorporated in the calculation of the vulnerability index due to lack of awareness on that specific information.

Box 4: Examples of stakeholders to be considered in the vulnerability workshop/meeting

Local stakeholders: associations based on livelihoods (farmers, fishers, forest users etc), women's groups, community leaders, local business and companies, land owners

NGOs: conservation, food security, healthy and development organizations

Government: (local and national) Public agencies (water, agriculture, forestry, fisheries, health, disaster management), statistical offices, meteorological offices

Academia: Members of local universities, academics with research on the target area and research institutes

Private sector: representatives of business that operate in the target region

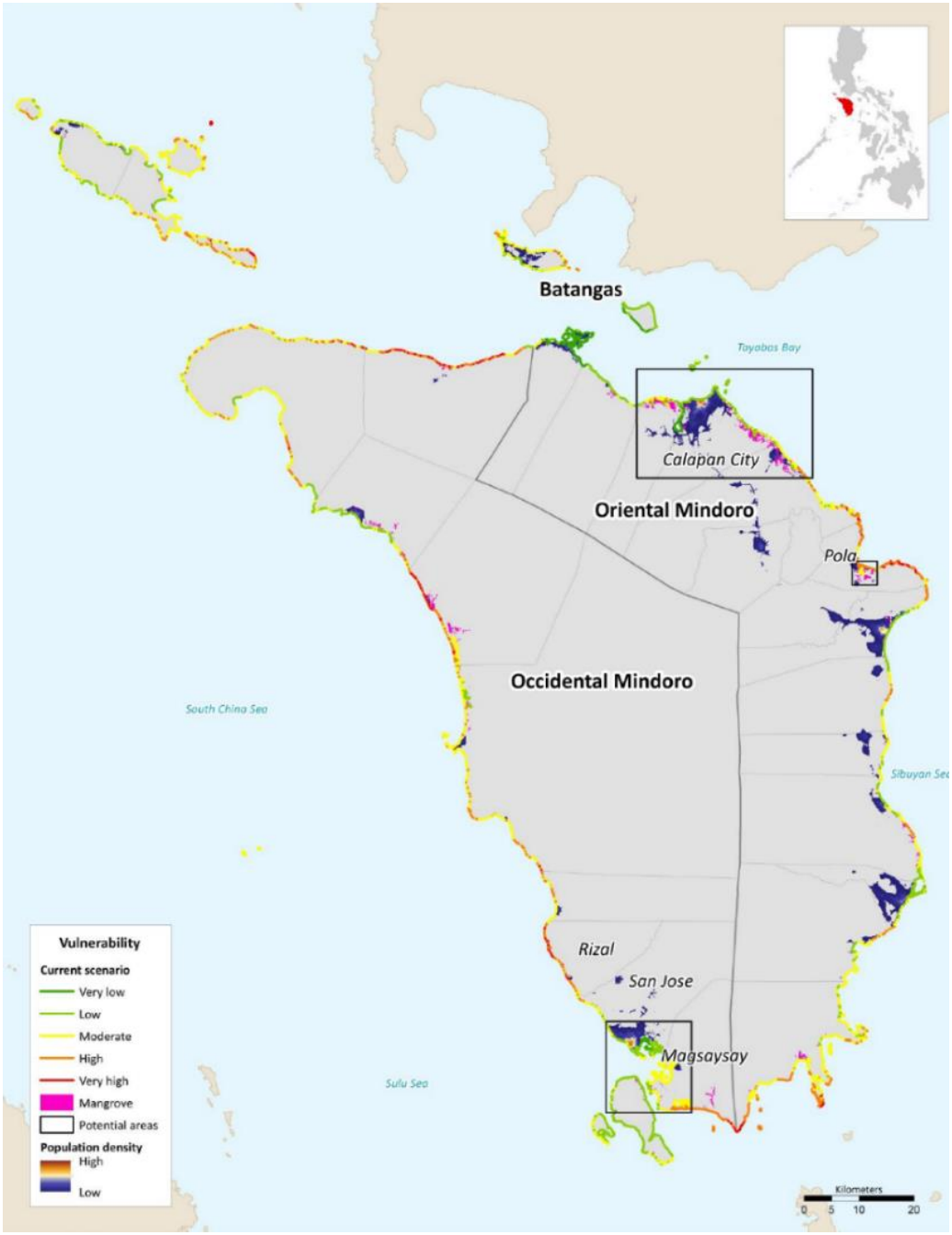


Figure 3. Map of vulnerability to coastal erosion for the Mindoro area in the Philippines. The map also shows vulnerability index (colors in the coast line) where mangroves are currently located (pink), potential area for EbA implementation (mangrove restoration and protection) and population density (colors inland). (From Cogswell et al. 2016).

STEP III. IDENTIFY A SET OF POSSIBLE EBA OPTIONS

PURPOSE OF THIS STEP:
To identify the EbA interventions that could help the most vulnerable communities adapt to climate change.

WHY THIS STEP IS NEEDED:
To ensure that the suite of EbA options are discussed and that they address the most important adaptation needs of the target (or subset of) population.

WHEN TO SKIP THIS STEP:
If you already know which EbA intervention(s) will be implemented to help the most vulnerable adapt to climate change.

OUTCOME OF THIS STEP:
Description of the possible EbA interventions that could be used to address climatic threats on the target population, and a description of how the EbA interventions could help the most vulnerable people adapt to climate change.

ACTIVITIES PROPOSED FOR THIS STEP:

1. **Identify and locate the ecosystems and biodiversity that can moderate the climate threats on the target population**

   Why? Those ecosystems and biodiversity should be identified, so the set of potential EbA interventions to address the climate threats can be also identified. For example, if project team identifies that increased frequency of drought is a key climate impact of concern, the ecosystem functions that moderate that impact should also be identified, such as important places for ground water recharge, natural services that support soil fertility, and ecosystems that provide local climate regulation.

   a. A great example of methods used to identify key areas of ecosystems important for moderating certain climate threats can be found in the Annex 2 of a climate change vulnerability assessment conducted in Namakwa District in South Africa (Bourne at al. 2015).

2. **Conduct a workshop/meeting to identify the EbA options that can be implemented based on the results of the vulnerability assessment (examples of stakeholders are listed in Box 3—this and the previous workshop/meeting could be organized at the same time if resources are limited):**

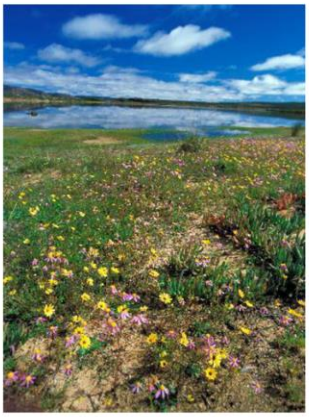
   Why? the results of the assessment—who are the most vulnerable communities and their climate change vulnerabilities—should inform the identification of the set of possible EbA options that could be implemented

   b. Identify, together with the stakeholders, the suite of EbA options that can be implemented to address the climate change vulnerabilities. For example, if the target population are communities living on hillsides whose lives and assets may be impacted by landslides caused by strong rainfall events, what are the suite of EbA options that could be

implemented to address that? (see Box 5 and Annex 2 for examples of EbA interventions that address certain impacts of climate change in specific communities). This suite of EbA options will then be prioritized, based on the number of beneficiaries, co-benefits provided and risks (see step IV).

Box 5: Examples of EbA interventions

Mangrove restoration can help reduce the loss of assets of coastal communities and infrastructure located by physically protecting the communities against stronger and more frequent storms



Rangeland restoration can enhance water quantity to protect the local communities and livestock from drought events

Forest restoration can reduce flooding events and intensity by improving water infiltration in the soil after extreme rainfall events

The protection and restoration of high altitude forests can reduce the loss of assets and infrastructure of urban communities downstream by preventing landslides to occur after intense rainfall events

Agroforestry can improve the livelihoods of farmers by providing protection to crops that have been negatively affected after extreme temperature events

3. **Review literature on current and future impacts of climate change on ecosystems and biodiversity that are the focus of the EbA interventions**

   Why? Climate change can also impact the ecosystems and biodiversity that can help reduce the vulnerability of people to climate change. For example, an increase in sea temperature may negatively impact coral reefs, and reduce the ability to provide adaptation services such as costal protection. Understanding those impacts are important to determine the types of management that should be done and whether those ecosystems and biodiversity can in fact help people adapt, and those ecosystems may be impacted by climate change themselves.

   a. Assess the status of the ecosystem and biodiversity that are the focus of the EbA intervention (e.g mangrove, coral reefs, cloud forests, specific plant species used in restoration and agroforestry) and determine their environmental boundaries through which they thrive. This may be through existing studies and/or expert opinion.
   b. Address how climate change may impact those ecosystems and biodiversity that are the focus of the EbA intervention through existing studies and/or expert opinion. Please note that if the ecosystem or biodiversity that will be the focus of the EbA intervention is highly vulnerable to climate change, this information needs to be considered during the selection of the EbA intervention (see item 6) and while designing the intervention (i.e. whether certain plant species should not be used during restoration as future climate condition in the target area may not be ideal for their survival).

4. **Identify complementary measures (infrastructure, technical, policies and regulations) to each of the EbA options identified, if necessary.**

   Why? EbA interventions alone may not be able to deliver the desired adaptation outcome(s)

   a. For example, EbA solutions alone may not be able to withstand the high intensity risks such as floods or storm surges
   b. Likewise, implementation of EbA interventions may be accompanied by technical capacity (e.g. on agricultural practices) or policies and regulations (e.g. on the protection of ecosystems) in order to be successfully implemented and maintained (see Table 2).

Table 2. Examples of complementary measures that can be implemented in combination with the EbA intervention to achieve adaptation outcomes, when necessary.

Risk	EbA solution	Adaptation outcome	Complementary measure
Storm surges	Mangrove restoration	reduce the loss of assets of coastal communities and infrastructure located by physically protecting the communities against stronger and more frequent storms	Gabions (cage or box filled with rocks or concret)
	Coral protection		Waterbreaks
Extreme rainfall events	Implementation of agroforestry	reduce the loss of agriculture productivity due to extreme rainfall events	Training on incorporating trees in field and how to maintain them

5. **Identify the location where the implementation of each of the EbA options would take place to address the vulnerability of the target population(s) to climate change**

   Why? Each EbA intervention can be implemented in many locations to help people adapt to the impacts identified. It is important to find where the implementation may be most successful, help a high number of people, maximize the co-benefits and minimize risks (please refer to items 6 and 7 of this step).

6. **Identify how the selected EbA solution (combined with complementary measures if applicable) can help the most vulnerable to adapt to climate change within the target population**

   Why? The articulation of how EbA will help reduce the vulnerability of people to certain climate threats is key to preparing the theory of change, for monitoring and evaluation purposes and making sure that the intervention may have the capacity to achieve the desired adaptation outcome.

   - Examples of such articulation include:
   - Mangrove restoration (EbA intervention) that will reduce the loss of lives and assets of coastal communities (desired adaptation outcome) resultant from more frequent storm surges (Climate threat);
   - Implementation of trees in agricultural lands (EbA intervention) that will reduce the loss of agricultural productivity of smallholder farmers (desired adaptation outcome) due to extreme rainfall events (Climate threat).

7. **Identify potential number of beneficiaries, co-benefits and tradeoffs of the EbA interventions identified through the workshop with stakeholders**

   Why? EbA interventions provide viability of several biodiversity, mitigation and social co-benefits and trade-offs. The identification of those variables can help select the intervention to be implemented among the suite of available EbA options (see Annex 3 for a list of co-benefits that are usually associated with EbA interventions). Some factors to consider are included below. If time and resources are available, additional data should be compiled to address each of them. If time and resources are limited, a simple ranking of how important different EbA options are for each of the follow is sufficient:

   - Potential number of direct and indirect beneficiaries i.e. people whose vulnerability will be reduced by the EbA intervention to be implemented;
   - Biodiversity co-benefits: e.g. key species that may be protected or re-introduced to the area due to the EbA intervention, habitat connectivity;
   - Mitigation co-benefits: e.g. potential carbon stored, or emission avoided due to the EbA intervention;
   - Social co-benefits: e.g. increased income, food security, livelihood diversification
   - Possible trade-offs of implementing EbA at different temporal scales: e.g. limited access to natural resources due to protection measures, loss of productive area when restoration is implemented, reduction in productivity after agroforestry is first implemented.

Table 3. Examples of EbA interventions in agricultural landscapes, adaptation benefits, and co-benefits provided (Adapted from Viguera et al 2018).

EbA intervention	Adaptation benefit	Mitigation benefits	Co-benefits			
		Carbon sequestration	Food security increase	Income diversificatio	Improves or maintains productivity in face of CC	Increases productivity and biodiversity
Shaded coffee management 	• Regulates microclimate • Buffers extreme temperatures • Buffers extreme rainfall • Protects against extreme winds • Reduces soil erosion	X	X	X	X	X
Live barriers 	• Improves water infiltration • Reduces landslides • Minimizes hydric stress • Controls erosion	X		X		X
Windbreaks 	• Buffers extreme temperatures • Reduces the impact of extreme winds on the crops, livestock and soils • Contributes to soil conservation	X		X	X	X

8. Identify potential risks and constraints to the implementation of each of the EbA interventions (see Annex 3).

Why? This information could help select the EbA intervention to be used. This information can be identified through a workshop/meeting (please note that this workshop can be the same as the one described previously under this topic, (point 3.1) and a review of relevant background documentation. Possible risks and constraints to EbA implementation include:

- Costs for implementing and maintaining the intervention;
- Lack of political will and interest;
- Lack of institutional support;
- Limited capacity to implement, maintain and monitor the intervention;
- Technical limitations (e.g., insufficient vegetative material for reforestation, limited knowledge of appropriate species, etc)
- Legal and cultural limitations;
- Long timeframes for the delivery of adaptation benefits

STEP IV. SELECT THE EBA INTERVENTION

PURPOSE OF THIS SECTION:
To provide steps for EbA prioritization in case several EbA options exist.

WHY THIS STEP NEEDS TO BE DONE:
Sometimes, several EbA interventions can achieve the same adaptation outcome, therefore the selection of the EbA intervention needs to be based on factors such as the magnitude of the intervention, benefits, trade-offs, costs, buy-in, and capacities.

WHEN TO SKIP THIS STEP:
If the EbA intervention has already been selected.

OUTCOME OF THIS STEP:
Identification of the EbA intervention to be implemented.

ACTIVITIES PROPOSED FOR THIS STEP:

1. **Conduct a workshop/meeting to review the EbA options and prioritize them (please note that this workshop and the previous one can be organized at the same time--whenever possible try to include members of the multidisciplinary team to get input from different perspectives).**

   Why? A suite of EbA options could be identified to help reduce the vulnerability of the target community. In those cases, a prioritization of EbA options and locations where they can be implemented, may need to be done. When prioritizing, the following order of importance is suggested (please note that you may want to weight some criteria more heavily than others based on what the multidisciplinary team thinks is the most important):

   - Magnitude of the intervention (the higher the magnitude, the higher the prioritization):
     - Number of beneficiaries of the adaptation outcome provided by the intervention
     - Biodiversity, mitigation and social co-benefits provided by the intervention
   - Trade-offs (the lower the trade-off, the higher the prioritization)
     - Trade-off of implementing the EbA intervention
   - Costs (the lower the costs, the higher the prioritization)
     - Costs of the intervention, and ability to leverage additional funds if needed (further in section VII)
   - Buy-in and political will (the higher the buy-in, the higher the prioritization)
     - Support from stakeholders (community leaders, local cooperatives, government, etc.), especially from the communities that will be the beneficiaries of the intervention
   - Capacities (the higher the capacity, the higher the prioritization)
     - Technical and financial capacity to implement the intervention
     - Technical and financial capacity to track and monitor the intervention in the long-term

2. **Select the EbA intervention to be implemented**
   a. Based on the criteria above, and any other information reviewed, select the EbA intervention(s) to be implemented

b. Idenify the specific location where the EbA intervention(s) will be implemented

3. Conduct modeling work or rely on existing studies to identify the details of the implementation

Why? The details of the intervention (number of hectares restored or protected, area that should be under an improved management, number and density of trees to be planted) should be identified based on scientific studies that take into accont how much of the climate threats can be addressed by the intervention.

a. Define by how much climate-driven threats can be reduced by each of the EbA options. For example, if mangrove restoration is to be implemented to reduce the loss of assets of costal communities, we need to know how many meters of mangrove need to be planted from the shoreline to reduce the impact of waves. This information will allow us to understand the magnitude of the intervention that are needed to achieve the desired adaptation benefits. It will also allow us to identify the magnitude of supplemental adaptation measures (e.g. grey infrastructure, evacuation/early warning systems, financial inclusion measures, etc.), if needed. This information will also help us to identify collaborators, such as engineers, disaster risk reduction specialists, finance sector experts, and to define the costs of the selected intervention.

4. Prepare a theory of change for the EbA intervention selected

Why? This information will be important during the monitoring and evaluation process as it will be clear what will be implemented, what the outputs and outcomes of the intervention will be, as well as the long-term goal of the intervention (adaptation outcome).

a. Use a theory of change (TOC) to map the relationship between a long-term goal of a project and the intermediate and early changes that are required to make it happen (see Conservation International 2013). In the theory of change, a clear articulation of how activities contribute to outputs, outcomes, and the long term goal (ultimate adaptation outcome) should be included (see Figure 5).

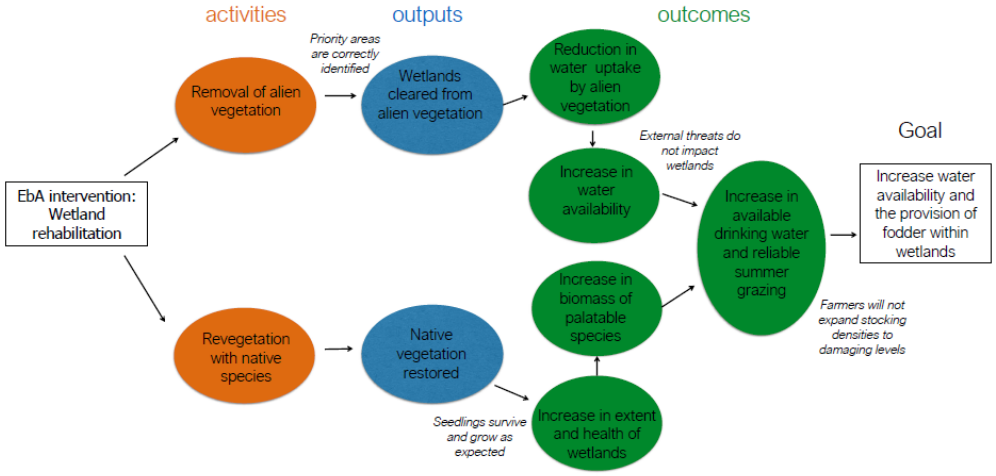


Figure 5. Theory of change for one EbA intervention (wetland rehabilitation) conducted in South Africa. Assumptions are included in italic (prepared by Camila Donatti).

5. **Identify the assumptions related to the intervention to be included in the theory of change**

   Why? Assumptions related to the intervention need to be identified and discussed as they may prevent the EbA intervention from achieving the ultimate adaptation outcome.

   - For example, if the EbA intervention implemented is restoration of wetlands one of the assumptions is the restoration will increase the extent and ecological health of the wetland (see figure 5).
   - If the EbA intervention is forest protection, one of the assumptions is that protection will be effective in the long-term.
   - If the intervention entails building local capacity, it is assumed that there will be capacity builders and that the target audience will put the acquired knowledge into practice.

6. **Revisit the theory of change periodically to update activities and assumptions**

   Why? As the selected intervention is implemented, the theory of change should be reviewed and updated periodically to ensure the proper delivery of the adaptation outcomes and that the activities are being implemented as planned, given that ecological and social conditions may change over time.

   - This can be done when milestones of the intervention are reached, for example when monitoring and evaluation information is available or when a report to the donor is due.
   - In any case, activities, assumptions and other information on the theory of change should be reviewed every 6 months or so.

STEP V. MONITOR AND EVALUATE THE EbA INTERVENTION

PURPOSE OF THIS STEP:
To identify the metrics and indicators that should be used to monitor and evaluate the success of the EbA implementation (i.e. what has worked and what has not) and the adaptation outcomes achieved.

WHY THIS STEP NEEDS TO BE DONE:
To track progress on the outputs and adaptation outcomes of the EbA intervention to be implemented in the short and long terms. This will provide information about the success of the project and more broadly help to increase the evidence base of EbA.

WHEN TO SKIP THIS STEP:
When a framework is already selected for monitoring and evaluating the EbA intervention.

OUTCOMES OF THIS STEP:
Identification of metrics and indicators to track the outputs and outcomes of the EbA intervention, when and how they will be measured.

ACTIVITIES PROPOSED FOR THIS STEP:

1. **Define metrics and indicators to measure, respectively, the success of EbA implementation and effectiveness in achieving adaptation outcomes for the intervention.**

   Why? Given that EbA can be implemented to achieve a variety of adaptation outcomes, it is important to identify metrics and indicators that will inform the success of the EbA intervention in achieving a specific adaptation outcome. Suggested indicators are presented in Annex 2. Indicators should measure the adaptation outcome that the EbA intervention is planning to achieve in the long-term.

2. **Describe the metrics and indicators used to monitor the intervention, as well as any assumptions made.**

   Why? It is important to describe what will be measured through time, and any assumptions made for the goal of the intervention to be achieved, and how that will help measure the achievement of the adaptation outcome. In this way, the project team will be able to ensure that the suggested metrics and indicators are in fact the best ones to assess the success of the EbA intervention.

   a. Metrics and indicators that will be used to track the EbA intervention, as well as any assumptions made, should be included in the theory of change and in the workplan of the EbA intervention (see previous steps)
   b. Clarification of when selected metrics and indicators will be collected (i.e. both within the lifetime of the intervention and thereafter)

3. **Engage with scientists, researchers and the government that may already be collecting information on metrics and indicators so those can be incorporated in the project**

Why? there is a possibility that the metrics and indicators that need to be tracked through time are already being measured (probably at a different scale, e.g. national level) by other initiatives or by the government, especially in the framework of UNFCCC NDCs. These need to be identified so efforts are not duplicated

a. Identify other initiatives in the broader region or at the national level that are similar to the one to be implemented, to check whether other projects or entities are already collecting information that may be used to monitor and evaluate the EbA intervention.

4. **Collect baseline information and describe the situation prior to implementation.**

   Why? Our suggestion is that all indicators suggested in annex 2b are measured prior to the implementation of the EbA intervention (i.e. baseline), and either through time (on a yearly basis) or after an extreme weather event so later measurements on the same indicator, when the EbA intervention has been implemented, can be compared to this baseline to address whether adaptation outcomes were achieved.

5. **Involve local communities and stakeholders in monitoring to achieve community buy-in and enhance local capacity**

   Why? To ensure that there is ownership of the intervention from the local communities and sustainability after the project ends, at the same time that important information for monitoring and evaluation is collected.

   a. Partner with local institutions that can recruit members of the community (both local community and other types of stakeholders, such as universities and research institutions) to conduct the monitoring activities

6. **Analyse results and plan for 2 possible scenarios:**

   Why? To esure that the intervention is on track to achieve the desired adaptation outcome.

   a. If the intervention seems to be working (activities are on track and delivering the expected outputs and outcomes as identified in the theory of change): an exit strategy should be planned to make sure the intervention is sustainable after the project ends
      - Identify how the intervention will be monitored after the projects ends
      - Develop a plan on how the intervention will continue, be monitored and maintained after the project ends, and budget for these activities. This can be simply a set of activities that need to be done or continue to be done over time to ensure the delivery of the adaptation benefits by the EbA intervention, and budgets associated to those.

   b. If the intervention is not showing the expected results (activites are not on track and/or are not delivering the expected outputs and outcomes as identified in the theory of change): the sustainability of the intervention should be evaluated and the intervention should be re-designed if necessary.
      - Identify what should be changed in the intervention (e.g. increase the restored area, incorporate a engineer or more 'traditional' activity as part of the intervention) and if such change may allow the delivery of the expected outcomes and outputs. In that case, the theory of change should be updated.
      - If the proposed changes may not deliver the expected outcomes and outputs, an alternative EbA or non-EbA intervention should be considered. In that case, an updated theory of change should be prepared, as well as a new monitoring and evaluation plan.

The step below is a very important one, but optional, as it requires considerable financial and personnel resources. If resources are available, it should be done prior to section IV (Select the EbA option). The following are some essential activities to conduct an analysis of the costs and benefits of EbA, recognizing that there may be some flexibility given the resources available to conduct such an analysis.

STEP VI. ASSESSING THE COSTS AND BENEFITS OF THE EbA INTERVENTION

PURPOSE OF THIS STEP:
To outline a list of activities for the implementation of economic analyses of EbA options.

WHY THIS STEP NEEDS TO BE DONE:
Cost-effectiveness is an important criterion for the selection of adaptation options. This step is also required for some projects and in certain circumstances, such as donor or project requirements.

WHEN TO SKIP THIS STEP:
If cost-effectiveness/benefit-cost analysis is not required for selecting adaptation strategies or if the project does not have resources to conduct such analysis.

OUTCOMES OF THIS STEP:
Activities and methodological best practice guidelines.

1. **Understand the context**

   Why? The assumptions, methodology and data required for economic analysis are tightly linked. The economic analysis requires understanding of the context of the EbA intervention, getting stakeholder inputs, developing scenarios and coupling physical analysis with economic assessments.

   a. **Review the information collected and summarize in the previous steps**

   - review results from biophysical and spatial analyses done in the project
   - review the suite of EbA options to be implemented
   - understand who are the beneficiaries of the different EbA interventions

2. **Conduct the economic analysis**

   Why? This part is the core economic analysis that provides measurements, modeling and valuation of ecosystem services to allow the calculation of the costs and benefits of the EbA options and alternative to those (e.g. non-EbA such as engineering solutions).

   a. **Take a tiered approach using tools from a range of methodological options**

   - There is no "one-size-fits-all" when it comes to economic analysis. Some analyses are more resource intensive than others
   - Take a "Tier-1" approach if all necessary resources are available to collect data and conduct the analysis

- Take a "Tier-2" approach for a rapid economic assessment, if budget and resources are inadequate for a comprehensive analysis
- However, beware of the tradeoffs between approaches chosen because of the limitations associated with the finding, as well as different interpretations

b. Develop the scenario with and without the EbA intervention, as well as the scenario where other types of adaptation solutions (e.g. engineering) would be implemented

- Develop a baseline business-as-usual/no-action scenario to compare amongst options, and extrapolate into the future
- Develop alternative EbA implementation scenarios which are plausible and applicable given environmental and socio-economic context
- The scenarios should take into consideration potential changes in, for example, population, resources consumption and vulnerability of communities to climate change

c. Gather data

- Review literature for gathering secondary data on existing works including natural capital assessments, economic valuation etc.
- Census data (agricultural, population, forest inventories) often provide important information for methodology and analysis
- Sometimes complementary primary data collection is required through, for example, household and field surveys
- Workshops are a good way to collect qualitative information and stakeholder perspectives

Table 4: Examples of indicators and data needs to asees the value of benefits and co-benefits provided by EbA for economic analysis

Benefits/co-benefits	Indicators and data needs	
	Physical measurements	**Economic valuation**
All provisioning services	Quantity harvested annually	Market price and shadow price
Carbon	Tons of carbon sequestered or emitted	Social cost of carbon; Carbon price
Water quality regulation	Changes in water quality parameters such as dissolved nutrients	Changes in water purification cost
Tourism	Changes in the number of tourist visits	Changes in the income of local businesses; Revenue earned
Water provision	Amount of water supplied for different sectors such as irrigation, domestic water	Beneficiary-specific value of water, such as tariff for domestic water consumption
Erosion control	Sediment loads in irrigation channels, hydroelectric dams etc.	Dredging costs or equipment depreciation costs
Pollination	Changes in crop productivity	Cost of replacing natural pollination
Non-timber forest products	Total volume harvested by communities	Equivalent market price

d. Select valuation and decision-support tools

Why? To make sure that the best tool is used based on the existing information

- **Net Present Value (NPV):** used if benefits and costs are realized over a longer time frame, with a specific discount rate
- **Annualized Net Present Value (ANPV)**: can be used instead of NPV in cases where there are two distinct time horizons for two different options
- **Internal Rate of Return (IRR)**: If the intent is to compare return on investment with opportunity cost of capital
- **Benefit to Cost Ratio (BCR)**: in case the interest in the project is to weigh total benefits against costs incurred. Both costs and benefits are measured in monetary terms.
- **Cost-Effectiveness Analysis (CEA)**: to compare relative costs and effects of different courses of actions. In this case the outcome is not measured in monetary terms
- **Multi-Criteria Analysis (MCA)**: A subjective method of prioritizing investments based on several monetary and non-monetary criteria

3. Interpret and integrate results

Why? Often results of economic analysis come with uncertainties and a range of tradeoffs. It is therefore important to outline how to interpret the results, communicate uncertainties and tradeoffs and integrate them in the broader assessment.

a. Assess the uncertainties

- Outline uncertainties in economic assessments due to physical measurements and modeling
- Perform sensitivity analysis to demonstrate a range of values instead of point estimates
- Make explicit the sources of uncertainties due to projected indicator values assessed

b. Identify the trade-offs

- Communicate tradeoffs between alternative scenarios clearly, especially the fact that not all benefits can be maximized, or costs minimized at the same time

ANNEXES

Annex 1. Examples of methodologies to conduct vulnerability assessments to climate change.

Tool	Pros	Cons	Available at	Produced by:
The vulnerability sourcebook: concept and guidelines for standardized vulnerability assessments	Utilizes a standardized index to quantify vulnerability, multiscale, based on latest scientific concepts	To be done at the community level, to a minimum, good facilitation required, indicators are not presented (but case studies are)	https://www.giz.de/expertise/html/15485.html	GIZ 2014
CoBRA: Community Based Resilience Analysis	Annex with potential indicators, explicitly include capacities indictors, focus on monitoring & evaluation	It describes the process but only generally the data collection methods, time consuming	www.undp.org/content/undp/en/home/librarypage/environment-energy/sustainable_land_management/CoBRA/cobra_guide.html	UNDP/EU 2012
SHARP: Self-evaluation and holistic assessment of climate resilience of farmers and pastoralists	action oriented, specifically designed for farm systems; based on scientific literature	Time consuming, based on perceptions/ self-assessment, prior understanding needed	http://www.fao.org/in-action/aicca/tools-and-methodologies/sharp/en/	FAO 2013
SEPLS: Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes	identify priority areas and community-based interventions for resilience, identify trends	Not focused on people vulnerability, complexity of concepts might hinder implementation with communities	www.bioversityinternational.org/e-library/publications/detail/toolkit-for-the-indicators-of-resilience-in-socio-ecological-production-landscapes-and-seascapes/	UNU, Bioversity, UNDP 2014
CVCA Climate Vulnerability and Capacity Analysis	participatory assessments, well-described and practical methods, emphasis on multi stakeholders	mostly qualitative information	http://careclimatechange.org/tool-kits/cvca/	Care International 2009
LAC Local Adaptive Capacity framework	Focuses on characteristics of adaptive capacities,	Not specific to climate variability, mostly qualitative	www.odi.org/publications/5854-towards-holistic-conceptualisation-adaptive-capacity-local-level-insights-local-adaptive-capacity	ACCRA 2010
CEDRA Climate change and Environmental Degradation Risk and adaptation Assessment	Provides worked examples and forms, includes examples of adaptation options per sector	Dependent on secondary information	https://learn.tearfund.org/en/themes/environment_and_climate/cedra/	Tearfund 2011
CARI Consolidated Approach for	Standardized quantitative methods,	Lack of qualitative data, lack of	https://www.wfp.org/content/consolidated-approach-	WFP 2014

Reporting Indicators of Food Security	use baseline and monitoring	information on environment	reporting-indicators-food-security-cari-guidelines	
CSA Climate-smart Agriculture Sourcebook	It elaborates the concept of CSA and demonstrates its potential with case studies, focus on land-use sector	Methodologies not described, technical	http://www.fao.org/docrep/018/i3325e/i3325e00.htm	FAO 2013
Crystal Food Security	Well-structured and computed based, with checklists	Desktop application, not very customizable	https://www.iisd.org/cristaltool/	IISD et al. 2012

Annex 2a. Examples of EbA interventions (this is a non-exhaustive list) that can lead to the adaptation outcomes and the dimensions of human well being linked to those outcomes

EbA interventions	Adaptation outcomes from EbA interventions	Dimensions of human well-being affected by the EbA interventions
Establishment of marine non-take zones; Restoration of mangroves	Reduced loss of assets of coastal communities and infrastructure due to extreme weather events	Assets
Protection and restoration or high-altitude forests	Reduced loss of assets of urban and non-urban communities and infrastructure due to extreme weather events	
Restoration of coral reef; Rangeland management; Development of policies to regulate the use of forest	Reduced impacts of climate change on ecosystems that maintain livestock production, marine and freshwater fisheries, and natural products for household consumption	Food security
Training on agriculture practices; Implementation of agriculture practices, (e.g. agroforestry and soil conservation)	Reduced negative (and direct) impacts of climate change on livestock and crop production (mainly through physical damage) for household consumption	
Implementation of agriculture practices (e.g. agroforestry and soil conservation)	Reduced impacts of climate change on ecological interactions (pest, diseases, pollination) that affect crop and livestock production for household consumption	
Restoration of coral reefs; Rangeland management; development of policies to regulate the use of forest	Reduced impacts of climate change on ecosystems that maintain livestock production, marine and freshwater fisheries, and tourism for profit	Livelihoods
Training on agriculture practices; Implementation of agriculture practices, (e.g. agroforestry and soil conservation)	Reduced negative (and direct) impacts of climate change on livestock and crop production (mainly through physical damage) for profit	
Implementation of agriculture practices (e.g. agroforestry and soil conservation)	Reduced negative impacts of climate change on ecological interactions (pest, diseases) that affect crop and livestock production for profit	
Forest restoration, capacity building on forest restoration	Reduced impacts of climate change on water quality and quantity for human use	Safety and resource security
Protection and restoration or high-altitude forests	Reduced loss of lives in urban and non-urban communities due to extreme weather events	
Establishment of marine non-take zones; Restoration of mangroves	Reduced loss of lives in coastal communities due to extreme weather events	
Restoration of swamp forest; Development and restoration of overflow areas and reed marshes	Reduced impacts of climate change on the incidence of vector borne diseases	Health
Establishment of green roofs and trees in urban areas	Reduced negative health effects (respiratory distress and heat stroke) due to temperature extremes and fires	

Annex 2b. Suggested indicators to measure the adaptation outcomes that can be achieved through EbA, suggestions on how to take measurements, and the mid-term, process-based indicators that can be used in mid-term evaluation of the intervention and/or in case the 'goal standard' indicators cannot be tracked due to lack of data or financial resources.

Adaptation outcomes from EbA interventions	Suggested 'gold standard' indicators for measuring adaptation outcomes	Extreme events and long-term changes addressed by the interventions	Suggestion on how to take the measurements	Suggestion on where and when to take the measurements/ collect data	Mid-term, process-based indicators
Reduced loss of assets of coastal communities and infrastructure due to extreme weather events Reduced loss of assets of urban and non-urban communities and infrastructure due to extreme weather events	1.**% of infrastructure damaged after extreme events.** (e.g. hospitals schools (% of facilities damaged), homes (% of houses damaged), roads (% of km of roads damaged), protected areas (% of area damaged), agricultural land (% of hectares of agriculture damaged), cultural and recreation sites (% of area damaged).	Extreme events: such hurricanes, typhons, and storms[1], flooding[2], landslides[3], heatwaves[4] and fires[5]	1.Use of satellite images to take stock of existing infrastructure, agricultural land and extent of ecosystems (see UNISDR 2017); information on damages collected during emergency responses measures.	•after an extreme event, when the intervention was not yet implemented (baseline) •after an extreme event, when the intervention was implemented	1a. Decreased erosion (costal or hillside) before and after the EbA implementation
Reduced impacts of climate change on ecosystems that maintain livestock production, marine and freshwater fisheries, and natural products for household consumption Reduced negative (and direct) impacts of climate change on livestock and crop production (mainly through physical damage) for household consumption Reduced impacts of climate change on ecological interactions (pest, diseases, pollination) that affect crop and livestock production for household consumption	2. **Prevalence of moderate or severe food insecurity in the population after extreme weather events or through time.**	Extreme events: flooding[6], droughts[7], storms[8], fires[9], heatwaves[10], sea level rise[11] Long-term changes: terrestrial and oceanic temperature[12] that can affect crop, livestock and fish production	2. Questionnaire with communities to get information on % of the population that is food insecure. (Food Insecurity Experience Scale from FAO provides a set of questions to ask communities on that matter); surveys with communities to gather information on income from crop and/or livestock production, sustainable marine and freshwater fisheries, and/or tourism; Census data held by local administration	•after an extreme event or through time (yearly basis) when the intervention was not yet implemented (baseline) •after an extreme event or through time (yearly basis), when the intervention was implemented	2a. Crop, livestock and fish production for household consumption in the growing/production season before and after the implementation of the EbA intervention.

Reduced impacts of climate change on ecosystems that maintain livestock production, marine and freshwater fisheries, and tourism for profit Reduced negative (and direct) impacts of climate change on livestock and crop production (mainly through physical damage) for profit Reduced negative impacts of climate change on ecological interactions (pest, diseases) that affect crop and livestock production for profit	3.**Average income from sustainable crop and/or livestock production, sustainable marine and freshwater fisheries, and/or eco-tourism of small-scale per household after extreme weather events, or through time**.	Extreme events: flooding[6], droughts[7], storms[8], fires[9], heatwaves[10], sea level rise[11] Long-term changes: terrestrial and oceanic temperature[12] that can affect crop, livestock and fish production	3.Surveys with communities to get information on income from crop and/or livestock production, sustainable marine and freshwater fisheries, and/or tourism of small-scale, producers /fisherman/ businessman per household	•after an extreme event or through time (yearly basis) when the intervention was not yet implemented (baseline) •after an extreme event or through time (yearly basis), when the intervention was implemented	3a. Crop, livestock and fish production for profit in the/production season before and after the implementation of the EbA intervention
Reduced impacts of climate change on water quality and quantity for human use	4.**% of population with access to enough and clean drinking water under extreme events, or through time.**	Extreme events: droughts[13], flooding[14], heatwaves[15] Long term changes: precipitation[16]	4. Use census information to get data on the number of people in a location that have access to water year-round and during extreme events	•after an extreme event or through time (yearly basis) when the intervention was not yet implemented (baseline) •after an extreme event or through time (yearly basis), when the intervention was implemented	4a. Water provision for human consumption before and after the implementation of the EbA intervention.
Reduced loss of lives in urban and non-urban communities due to extreme weather events Reduced loss of lives in coastal communities due to extreme weather events	5.**Percentage of deaths and missing persons in various demographic groups after extreme events.**	Extreme events: hurricanes, typhons and storms[17] and the associated flooding[18], landslides[19], extreme heat[20], fires[21]	5.Use local or national statistics to get the number of people that have died from extreme weather events (see UNISDR 2017)		5a. not available

Reduced impacts of climate change on the incidence of vector borne diseases Reduced negative health effects (respiratory distress and heat stroke) due to temperature extremes and fires	6.**People's years lost or deaths due to vector borne diseases of various demographic groups within the population.** 7. **People's years lost or deaths due to vector borne diseases related to climate change, respiratory distress and heat stroke, during extreme events, of various demographic groups within the population.**	Extreme events: flooding events[22] and drought[23] Extreme events: extreme heat[24] and fire[25]	6 and 7. Use national or regional statistics to calculate the Disability-adjusted life year (DALY) from WHO, a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death; use local or national statistics to get the number of people that have died from extreme weather events (see UNISDR 2017)	•after an extreme event, when the intervention was not yet implemented (baseline) •after an extreme event, when the intervention was implemented	6a. Prevalence of vector species before and after the implementation of the EbA intervention. 7a. Levels of pollution in the air before and after the implementation of the EbA intervention. 7a. Local air temperature before and after the implementation of the EbA intervention.

Annex 3. Examples of co-benefits that can be achieved through EbA, as well as risks and constraints of EbA interventions.

a. Examples of biodiversity co-benefits of EbA interventions:

- ☐ Species protection
- ☐ Assistance in species movement and natural re-introduction of species
- ☐ Establishment of nursery areas for marine and aquatic species
- ☐ Increased species diversity
- ☐ Increased genetic diversity
- ☐ Improvement in ecosystem resilience to climate change and other threats (i.e. sedimentation, pollution)

b. Examples of mitigation co-benefits that can be achieved through EbA interventions:

- ☐ Avoid the emissions of greenhouse gases through deforestation
- ☐ Avoid the emissions of greenhouse gases through the reduction of forest burning
- ☐ Increase carbon sequestration through forest restoration
- ☐ Increase carbon sequestration through the implementation of trees in agricultural fields

c. Examples of social co-benefits of EbA interventions:

- ☐ Conflict resolution because of increase water availability
- ☐ Enhanced water supply due to watershed restoration
- ☐ Increased food security and income due to improvement in fisheries and natural resources
- ☐ Increased food security and income through the implementation of trees in agricultural fields
- ☐ Improvement in the aesthetic value of the area due to more trees
- ☐ Increased in livelihood diversification
- ☐ Establishment of network due to training on and implementation of the EbA intervention
- ☐ Increased natural capital

d. Examples of risks and constraints of EbA:

- ☐ High costs of implementation and monitoring
- ☐ Low cost-benefit ratio
- ☐ Lack of buy-in from the target community
- ☐ Lack of buy-in from local governments
- ☐ Limited capacity to implement, maintain or monitor the intervention
- ☐ Legal limitations
- ☐ Cultural limitations
- ☐ Long timeframes for results to appear

Annex 4. Variables used to assess the Vulnerability of coastal communities to climate hazards in the Philippines.

Component of vulnerability	Variable	Source	Resolution
Exposure	Wave exposure	InVEST* output / NOAA Wave Watch III	Site-specific
Exposure	Shore exposure	InVEST output	Site-specific
Exposure	Surge potential	InVEST output	Site-specific
Exposure	Cyclone frequency	UNISDR, PreventionWeb	Site-specific
Adaptive Capacity	Road density	Open Street Map	Barangay
Adaptive Capacity	GDP	Worldpop.org and National Statistical Coordination Board	site-specific
Adaptive Capacity	Hospital beds	Philippine Department of Health	Province
Adaptive Capacity	Mean years of schooling	Philippines Human Development Index	Province
Adaptive Capacity	% HH with electricity	National Statistical Office Census 2010	Municipality/city
Adaptive Capacity	% HH with internet access	National Statistical Office Census 2010	Municipality/city
Adaptive Capacity	Good Governance Index	National Statistical Coordination Board	Municipality/city
Sensitivity	Poverty	National Statistical Coordination Board	Municipality/city
Sensitivity	Population density	Worldpop.org	Site-specific
Sensitivity	Main occupation - farmers, fishermen and forestry workers	National Statistical Office Census 2010	Municipality/city
Sensitivity	% HH without piped water	National Statistical Office Census 2010	Municipality/city
Sensitivity	Geomorphology of the area	InVEST output	Site-specific
Sensitivity	Natural Habitats	InVEST output	Site-specific
		Mangrove: U.S. Geological Survey	
		Coral Reef: UNEP, World Conservation Monitoring Centre	
		Coastal Forest: ESA Climate Change Initiative	

*https://www.naturalcapitalproject.org/invest/

GLOSSARY

Activities: Specific actions implemented to bring about each of the outputs or outcomes on the pathway to change

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.

Adaptive Capacity: The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC 2014)

Climate change vulnerability: the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Discount rate: what economists use to give a present day value on something that will oly happen in the future

EbA intervention: activities that include one or more of the following:

- protection, restoration and management of ecosystems, biodiversity, ecosystem services, and species to help people adapt to climate change
- implementation of specific agricultural practices and new crop varieties to help people adapt to climate change
- establishment of engineer structures that protect or enable the protection, restoration (or natural regeneration) and management of ecosystems, biodiversity, ecosystems services and species to help people adapt to climate change (e.g. gabions to facilitate wetland restoration)
- policies and plans for EbA
- awareness raising on EbA
- training on EbA
- incentives for EbA

Ecosystem services: benefits that humans gain from the natural environmental and functioning ecosystems. Examples include food and water provision, crop pollination, and spiritual and recreational benefits.

Ecosystem processes: physical, chemical and biological actions or events that link organisms and their environment.

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected

Gender: refers to the socially constructed roles, behaviors, activities and attributes that a given society considers appropriate for men and women, whereas sex refers to the biological and physiological characteristics that define men and women

Mitigation: an anthropogenic (man-made) intervention to reduce the source of greenhouse gasses or enhance their sinks

Modeling: simulation of climate behavior and how elements (species distribution, crop production, wave dynamics) may change based on how climate may change

Outcomes of EbA intervention: The effects or changes to ecological or social systems that result from intervention
Outputs of EbA intervention: Products or events produced by an activity
Participation: a process through which all members of a community or organization are involved in and have influence on decisions related to development activities that will affect them
Project: set of activities that include, but are not limited to, the EbA intervention.
Resilience: the amount of change the system can undergo and still retain the same control in function and structure; the degree a system is capable of self-organizing; the ability to build increased capability for learning and adaptation
Sensitivity analysis: a method to determine the robustness of an assessment by examining the extent to which results are affected by changes in methods, models, values of unmeasured variables, or assumptions
Sensitivity: The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).
Target population: the population under a type of livelihood (fisherman, farmers, indigenous communities
Theory of Change: specific and measurable conceptual model of the goals, interventions, assumptions, and outcomes of a project that forms the basis for strategic planning, on-going decision-making, monitoring and evaluation
Vulnerability: the degree to which human and environment systems are likely to experience harm due to perturbation or stress

REFERENCES

Africa Climate change resilience alliance. 2010. Local adaptive capacity framework.

Bourne, A, P. deAbreu, C. Donatti, S. Scorgie, and S. Holness. 2015. A Climate Change Vulnerability Assessment for the Namakwa District, South Africa: The 2015 revision. Conservation South Africa, Cape Town.

CBD. 2009. Connecting biodiversity and climate change mitigation and adaptation. Report of the second ad Hoc Technical Expert Group and Climate Change. CBD Technical series No. 41. Secretariat of the convention on Biological Diversity.

CBD. 2018. Voluntary guidelines for the design and effective implementation of Ecosystem-based approaches to climate change adaptation and disaster risk reduction. 18 p.

CARE International 2009. Climate vulnerability and capacity analysis. 43 p.

Cogswell N., Veiga H., Li X. 2015. Assessing and mapping coastal vulnerability in order to scale up ecosystem-based adaptation in the Philippines. Washington DC, USA. 77p.

Conservation International 2013. Constructing theories of change for ecosystem-based adaptation projects. Conservation International. Arlington VA, USA. 20 p

Donatti C.I., Andrade A., Burke L., Chhetri N., Cook J., Fedele G., Friedrich C., Goldstein A., Harvey C.A., Hole D., Kontorov A., Leiter T., Mack S., Menazza S., Ndiaye D., Panfil S., Ries F., Rizvi A.R. & Schurman H. 2016. Measuring the adaptation outcomes of Ecosystem-based adaptation. Conservation International. Arlington VA, USA.

Donatti, C.I., Harvey C.A., Hole D., Panfil S., Schurman H. in prep. Measuring the adaptation outcomes of Ecosystem-based adaptation.

FAO. 2013. Self evaluation and holistic assessment of climate resilience of farmers and pastoralists (SHARP) tool.

FAO 2013. Climate smart agriculture sourcebook.

GIZ 2004. The vulnerability sourcebook. Concepts and guidelines for standardized vulnerability assessmens. Bonn, Germany. 177p.

Holland, M.B., Shamer, S.Z., Imbach, P., Zamora, J.C., Moreno, C.M., Hidalgo, E.J.L., Donatti, C.I., Martínez-Rodríguez, M.R., and Harvey, C.A. (2017)**. Mapping adaptive capacity and smallholder agriculture: applying expert knowledge at the landscape scale.** Climatic Change Doi:10.1007/s10584-016-1810-2

IISD 2012. Crystal food security.

Luers, A., Lobell, D., Sklar, L.S., Addams, C.L., Matson, P.M., 2003. A method for quantifying vulnerability, applied to the Yaqui Valley, Mexico. Global Environmental Change 13, 255–267

Tearfund. 2011. Climate change and environmental degradation risk and adaptation assessment.

UNDP. 2014. SELPS. Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes

UNDP. 2017. Community-based resilience analysis (CoBRA). Implementation guidelines. Version 2. New York, USA. 35 p.

Viguera, B., R. M. Martínez-Rodríguez, F. Alpizar y C.A. Harvey. 2018. Adaptación basada en Ecosistemas como una opción de adaptación de la agricultura al cambio climático en Centroamérica. Policy Brief. Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) & Conservación Internacional (CI). Turrialba, Costa Rica. 6 pp

WPF. 2014. Consolidated approach for reporting indicators of food security.

ACKNOWLEDGEMENTS

This work was supported by a grant from the Conservation International's climate strategy. Special thanks to Luciano Andriamaro, Michelle Andrianarisata, Jennifer Howard, Alex Zvoleff, Renata Pereira, Atsuko Nishikawa, Erin Beasley, Shyla Rhagav and Martha Zeymo for kindly reviewing and providing comments and suggestion in this document.

HOW TO CITE THIS WORK:

Donatti, C.I., Martinez-Rodriguez, M.R., Fedele, G., Harvey, C.A., Scorgie, S., Andrade, A., Rose, C., Alam, Mahbub. 2018. Guidelines for designing, implementing and monitoring ecosystem-based adaptation interventions. Conservation International.