



Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

Climate Proof

A four step guide for coastal projects



A pre-publication version approved by the MFF Secretariat, October 2010



Climate Proof

Introduction

This document has been produced by UNEP, in collaboration with UNDP, IUCN and MFF Secretariat, as a guide for MFF project partners and it presents an approach to mainstream climate change considerations into MFF projects.

The guide outlines a four-stepped approach to help you consider the potential impacts of climate change on your project design and enhances the resilience and adaptive capacity of your project. This approach is an integral part of the MFF Large Project proposal guidelines and it is closely linked with the preparation of the Logical Framework Analysis (LFA).

Why consider climate change in project preparation?

Scientific evidence suggests that the climate is changing. The globe is warming rapidly, weather patterns are changing and sea level is rising. These changes are inevitable and are likely to result in a number of impacts, particularly in coastal areas.

What impacts will climate change have in the coastal zone?

Climate change is likely to result in a number of impacts in the coastal zone, including:

- Higher sea levels;
- Higher sea temperatures;
- Changes in precipitation patterns and coastal runoff;
- Changed oceanic conditions; and
- Changes in storm tracks, frequencies and intensities.

These impacts have effects on the coastal environment including, but not limited to:

- Displacement of coastal lowlands and wetlands;
- Increased coastal erosion;
- Increased flooding; and
- Salinisation of surface and groundwaters.

Ultimately, all coastal ecosystems, communities and projects, will be affected by climate change, either negatively or positively. Consequently, any project that

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aims to strengthen the environmental sustainability of coastal development through promotion of increased investment and efforts in coastal ecosystem management, must consider how climate change may impact the ecosystem and communities. This will ensure that the project is sustainable despite a changing climate.

The approach to climate proofing MFF projects

Integrating climate change into MFF Large Projects can be completed using the following four steps:

- Step 1:** Set the context
- Step 2:** Identify the impacts
- Step 3:** Select *Adaptation* Options (response) to manage the identified impacts
- Step 4:** Determine project resources (inputs) required to implement the identified adaptation option

Each step is explained in detail in the following sections and an example of the outcome of this approach (applied to a hypothetical MFF large project proposal) is provided in Appendix 1.

The Climate Change Considerations (CCC) form is one of the forms requested in the MFF Large Project Guidelines; it should be completed to demonstrate that climate change has been considered in

the preparation of your MFF large project proposal.

Terms in italic throughout this guide are defined in the glossary (Appendix 3).

Understanding climate change impacts

Climate change will have wide ranging effects on the environment and socio-economic and related sectors, including coastal zones. Coastal ecosystems and communities will be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. The impacts of climate change on coasts is exacerbated by increasing human induced pressures (Nicholls et. al., 2007).

These combined impacts can result in alterations affecting the ability of coastal ecosystems to provide services. These include provisioning services such as food, water, wood, fiber and biomass fuel; regulating services that relate to floods, water purification and climate; cultural services – recreational, spiritual and aesthetic fulfilment. Consequently, it is important to understand how climate change will impact these services to enable the development of adaptation strategies that address the projected harm and take advantage of beneficial opportunities.

Step 1: Set the context

At the end of this step, you will have:

- An understanding of current coastal system behaviour and of climate change projections for the project area; and
- List of project objectives aligned to MFF PoWs.

The first step to start integrating climate change considerations into your MFF project is to perform a situation analysis with specific reference to the climate context, as described below:

To incorporate climate change considerations into a program or project, information on the process-response relationships in the coastal area, also referred to as *coastal system behaviour*, is essential. Without a clear understanding of how the coastal system responds to changes in climate, it is impossible to know how the system may behave in the future.

An important first step is to describe *current climate variability* and the main *climate drivers* causing physical change in the coastal area (see example - Step 1a, Appendix1).

The information available to each project proponent to complete this task will vary, however, as a baseline, it is important to gather an understanding of the current coastal behaviour (i.e. what are the key climate hazards within the project site) and


the projections for climate change. Information on current coastal behaviour can be gathered through:

- Community consultation;
- Local knowledge and expertise; and
- Local meteorological departments, UNFCCC focal points and other in country expertise.

Once an understanding of current coastal system behaviour is gained, *projections* for future climate change can be collected (Step 1b, Appendix 1). Projections for climate change can be obtained from the Intergovernmental Panel for Climate Change (IPCC) website (www.ipcc.ch) or your respective UNFCCC National Communication (NC) coordinators.

If you are unsure who your NC coordinator is, the focal points for National Communication are listed on the UNFCCC website (<http://unfccc.int/>). Look up focal points for individual countries at http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php. Networks of climate change coordinators also exist at regional and international levels (refer to the MFF, UNEP and UNDP focal point for further information).

As much as possible it is important to localise climate change projections to be used in the project site. However, in some cases this information may not be available. Contact your NC Coordinator or local



environment ministry to gather the available information for climate change projections within your region or proposed project area.

As a baseline, the climate change projections for the Asian region, developed by the IPCC, may be applied and they are available from: <http://www.ipcc.ch/ipccreports/ar4-wg2.htm> (chapter 10).

Extract the objectives of your project from the Logical Framework Analysis (LFA) and insert them into the Climate Change Considerations (CCC) form (Step 1c, Appendix 1).

Every large MFF Project proposal needs to have clearly identified objectives, based on, and aligned with, one of more of the MFF Programmes of Work (PoWs). Include the PoWs that correspond with each project objective (Step 1d, Appendix 1).

Climate change considerations have been aligned to each of the MFF PoWs (See, A Reference Tool to Coastal Climate Change in the Context of MFF). You can review the alignment between the PoW that your project is directed towards, and see what climate change considerations are relevant based on your projects focus.

Considerations to complete Step 1

The aim of Step 1 is to set the context for the project and clearly identify its objectives. To complete this step your team will require:

- An understanding of the coastal system behaviour within the area of interest, i.e. what are the main drivers of change affecting the natural and socio-economic environment at the project site?
- The ability to interpret climate projections for the area of interest.

The time and resources that can be devoted to the assessment of climate change may be limited. As a result, you should rely on readily available information and expert opinion to assess potential changes in climate parameters and to establish process-response relationships and coastal behaviour.

Additional reference:

A Reference Tool to Coastal Climate Change in the Context of MFF: provides indications on climate change considerations for each MFF PoW (Programme of Work), additional guidance for the four-stepped approach, tools relevant for integration of climate change into generic project cycle as well as background information on coastal climate change.

Step 2: Identify the impacts

Step 2 aims to identify how projected changes in climatic patterns may impact each of the project objectives. At the end of this step, you will have obtained a list of climate change impacts affecting each project objectives.

To complete this activity:

- Refer to your list of project objectives (as outlined in Step 1);
- List the key outputs for each objective; and
- List the climate changes that may impact the key output.

For example, (see also Step 2a & b Appendix 1):

Objective: Healthy and productive mangrove ecosystems

Key Output: Restore degraded mangrove ecosystems

Climate change impact on coastal zone: Sea level rise, amplification of storm surge heights, increase in intensity of extreme events.

Finally, determine the potential 'environmental impact' (Step 2c, Appendix 1) and the potential 'socio-economic impact' (Step 2d, Appendix 1) that the projected climate changes will have on each of the key outputs.

The identification of impacts should be based on one or more of the following: available literature, history of occurrence, expert judgment.

Information gathered through this step should be recorded under columns Step 2a, b, c, d in the CCC form (as per the example in Appendix 1).

The aim of this step is to develop adaptation actions to address each of the identified climate change impacts (such as environmental impacts and socio-economic, as identified in Step 2).

For more details refer to the introduction of this guide and to Section 4 in *A Reference Tool to Coastal Climate Change in the Context of MFF* (Tables 7, 8 & 9), for information on the projected impacts of climate change on coastal areas.

Important Note

The identification of impacts can range from a qualitative assessment based on expert judgement and/or past experience, to a quantitative assessment of natural and socio-economic response to climate changes.

The skills, training and resources required to complete a quantitative assessment of risk may be beyond those readily available to MFF.

Step 3: Select adaptation options

At the end of this step, you will have obtained the following information:

- A list of adaptation considerations for each output.
- A list of adaptation options to be incorporated within the project, to address climate proofing requirements for your project.

Follow the example in Appendix 1 to complete this step:

- Refer to the project objectives and the related MFF PoW outcome (as completed in Step 1); and
- Insert the relevant 'climate change consideration' for the identified MFF PoW outcome in Step 3a, Appendix 1 (this could be extracted from Section 1 in *A Reference Tool to Coastal Climate Change in the Context of MFF*).

In order to fill in Step 3b, 'Response to guide adaptation', you may want to use:

- The content in Step 3a 'Climate Change considerations per MFF PoW'
- Your knowledge of potential impacts of climate change (Step 2), and
- Refer to the 'Tools and Methods' section of *A Reference Tool to Coastal Climate Change in the Context of MFF* (Sections 2 & 4), which outline a number of tools for adapting to the potential impacts of climate change and suggested adaptation measures.

Information gathered through this step should be recorded under Step 3a and 3b in the CCC form (see the example in Appendix 1).

When selecting a tool for adaptation, consider:

- The scale of your project (site specific <10km, or regional >50km)
- The time available to complete:
 - The entire project
 - The vulnerability and adaptation assessment component of the project, if required

Resources available, including:

- Information (data)
- Financial resources
- Human resources

Step 4: Determine required resources

To finalise Step 4 you will need to refer to the output of Step 3 which identifies a number of adaptation actions to be undertaken during project implementation. Each of the actions should be considered to determine the required resources (inputs) to implement the action.

At the end of this step, you will have obtained the following information:

- List of resources that will be required to implement the selected adaptation actions.
- An understanding of the anticipated timeframes for implementation of the adaptation options.

The above information will ensure that resource requirements are clearly encapsulated within the overall design of the project proposal.

If any tools were selected to support adaptation, review the recommended actions outlined in Section 2 of *A Reference Tool to Coastal Climate Change in the Context of MFF* to determine information and human capacity requirements. Once these requirements are outlined, indicative budgets and timeframes for implementation of the selected adaptation option or tool can be set.

Information gathered through this step should be recorded in Step 4 in the Climate Change Considerations form (see Appendix 1).

Summary

After completion of this four-step approach you will have:

- Gathered an understanding of current climate variability and the main climate drivers causing physical change in the coastal zone;
- Identified the potential impacts of climate change that may impact on the objectives of your project;
- Identified adaptation actions that will mitigate the potential impacts of climate change on your project; and
- Identified the resource requirements to be included in your proposal, to ensure that the identified adaptation actions can be implemented during project implementation.
- Most importantly, you have taken the preliminary actions to climate proof your project.

Note that the information gathered through this process should be incorporated in the appropriate sections of the Logical Framework Analysis (LFA) of your project.



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Appendix 1: Climate Change Considerations Form

Each cell should contain an output from each of the four steps

Step 1a Current Climate Variability and Coastal Behaviour ¹	Flooding is experienced during winter months. Storms are frequent in winter months, approximately five severe storms per year. These storms result in impacts on local infrastructure (including flooding of houses and roads) and damage to crops. According to local residents, the shoreline has retreated approximately 10 metres over the last decade. This has been a gradual process, and increased erosion is not associated with storm events. Mean sea level is affected by climate-driven inter-annual sea level fluctuations.			
Step 1b Climate Change Projections ²	Increase in mean annual temperature; Increase in mean annual precipitation; An increase in occurrence of extreme weather events including heatwave and intense precipitation events is projected. Amplification in storm-surge heights could result from the occurrence of stronger winds, with increase in tropical storms resulting in an enhanced risk of coastal disasters along coastal regions. Sea level rise projections of 0.59 metres by 2100.			
Step 1c The objectives of the project ³	Restore degraded mangrove ecosystems	Implement and establish an innovative model for local income generation through sustainable use of mangrove resources	Facilitate partnership between government agencies and local people for collaborative management of restored mangrove forest	Strengthen capacity and awareness at local and national levels of the importance of conservation and sustainable use of mangrove ecosystems and resources
Step 1d MFF PoW	2.2	10.1	8.4	6.1
Step 2a Key Output	Healthy and productive mangrove ecosystems	Local Income Generation Model	Established Partnership	Strengthened capacity
Step 2b Climate Change impact on coastal zone	Sea level rise	Sea level rise	Sea level rise	Sea level rise
	Amplification of storm surge heights	Amplification of storm surge heights	Amplification of storm surge heights	Amplification of storm surge heights
	Increase in intensity of extreme events	Increase in intensity of extreme events	Increase in intensity of extreme events	Increase in intensity of extreme events
Step 2c Environmental Impact	The increase in storm events and rise in mean sea level may impact the mangrove rehabilitation site	The increase in storm events and rise in mean sea level may lead to a reduction in the number of mangroves	The increase in storm events and rise in mean sea level may lead to a reduction in the number of mangroves	The increase in storm events and rise in mean sea level may lead to a reduction in the number of mangroves
Step 2d Socio-economic impact	Not applicable	The ability to generate income through sustainable use of mangrove resources may be compromised	None	None

This table is an example based on a hypothetical MFF large project proposal. For a blank form visit www.mangrovesforthefuture.org

Step 3a Climate Change considerations per MFF PoW	The increase in storm events and rise in mean sea level may impact the mangrove rehabilitation site	Mangrove resources identified to support income generation should focus on species resilient to climate change (i.e. with high adaptive capacity)	The impacts of climate change on mangrove systems will vary dependent upon exposure to climatic drivers and available land for propagation. Activities to add value to local use and marketing of non-fish mangrove products should consider the potential impacts of climate change on the site, to ensure sustainability of the activities	Incorporate information on the potential impacts of climate change in awareness raising programs
Step 3b Response to guide adaptation	Undertake climate change risk assessment (applying relevant tools) to identify the potential impacts of climate change in the region and develop context specific adaptation strategies. Based on outcomes of the climate change risk assessment, define locations for mangrove restoration	Review knowledge on biology of mangrove species of economic value, or potential value	The activities undertaken under 10.1 will ensure that the impacts of climate change on mangrove systems have been accounted for	Incorporate information on the potential impacts of climate change in awareness raising programs. The information to support awareness raising can be drawn from the outputs of the climate change risk assessment process
Step 4 Determine required resources ⁴	Resources required include: <ol style="list-style-type: none"> 1. Consultant/staff member with experience in applying the selected climate change risk assessment tool 2. Time for staff to complete a review of mangrove species resilient to the projected impacts of climate change 3. Costs for purchasing climate resilient mangrove species 4. Time and staff resources to incorporate the potential impacts of climate change into the scheduled awareness-raising program 			

¹ This information could be obtained through interviews with local communities, data and information from local meteorological services, literature sources, etc.

² This information could be obtained from IPCC AR4, 2007; respective National Communications and other sources

³ As reported in the LFA matrix of your project.

⁴ This example only outlines the resources required. Estimates of time and cost are not included in the example, as they will differ between projects dependant upon what tool is selected. To add estimates of time and cost to your CCC form, review the recommended actions as outlined in Section 2 of *A Reference Tool to Coastal Climate Change in the Context of MFF*. Importantly, estimates of time and cost should be included within this section of the CCC form when submitting your application.



Appendix 2: Coastal climate change adaptation options

Adaptation options to manage the potential impacts of climate change are summarised here. For further details, please see Section 4 in *A Reference Tool to Coastal Climate Change in the Context of MFF*.

Coastal climate change adaptation measures commonly fall within three categories:

- **Protect:** hard structures (dykes, sea-walls, tidal barriers, detached breakwaters); soft structures (dune or wetland restoration or creation, beach nourishment); indigenous options of walls of wood, stone or coconut leaf, or afforestation.
- **Retreat:** establishing set-back zones; relocating threatened buildings; phasing out development in exposed areas; creating upland buffer; rolling easements.
- **Accommodate:** Early warning and evacuation systems; hazard insurance; new agricultural practices, such as using salt-resistant crops; new building codes; improved drainage; desalination systems.

The type of measure appropriate to reduce sensitivity (and increase resilience) is dependant upon the characteristics of the system in which it will be placed. USAID (2009) identified a number of adaptation measures to mitigate the potential impacts of climate change in the coastal zone. The measures were aligned to 'anticipated

outcomes' to demonstrate the potential effects of implementing the adaptation option (Table 1).

In selecting an adaptation response to manage the potential impacts of climate change, the objectives of the coastal management should be considered. For example, if the management goal is to maintain and restore coastal wetlands, adaptation measures may include: coastal development setbacks, coastal zoning, protected area management, integrated coastal management, and actions to protect living shorelines (USAID, 2009). Importantly, the best response is often a combination of adaptation measures, rather than a single adaptation response.

Table 1: Adaptation measures aligned to anticipated outcomes, **X** Primary outcome, **o** Secondary outcome (USAID, 2008)

Adaptation Measure	Functioning and healthy coastal ecosystems	Reduced exposure and vulnerability of the built environment	Strengthened governance, policy and planning	Diversified livelihood support	Enhanced human health and safety
Beach/dune nourishment		X		o	
Building Standards		X	o	o	o
Coastal development setbacks	o	X			o
Coastal tourism best practises	o	o		X	o
Conservation agreements (marine)	X	o			
Coastal watershed planning*	o	o	X	o	o
Community-based disaster risk reduction*	o	o	o	o	X
Fisheries, livelihood and food security	X		o	o	o
Flood hazard mapping		o			X
Integrated coastal management*	o	o	X	o	o
Landuse planning and zoning	o	o	X		o
Living shorelines	X	o			o
Mariculture best practises	o	o		X	o
Marine protected areas	X		o	o	
Payments for environmental services	X	o		o	o
Shorefront stabilisation	o	X		o	o
Special area management planning*	o	o	X	o	o
Wetland protection and restoration	X	o		o	o

* An overarching management approach or strategy that can be used to bundle a series of measures



Appendix 3: Glossary

Adaptation (IPCC 2007b): Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.


Climate Change (IPCC 2007b): Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. UN-FCCC make a distinction between climate variability and climate change attributed to human activity, and thus define climate change as ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’.

Climate drivers: Climate drivers refer to the elements of climate that cause the most change in the coastal zone. While the coast may respond to a number of climate variables, climate drivers are the climatic elements that dominate coastal response. For example, climate drives may include storms, strong wind, or water level (tides).
Coastal system behaviour: This term is used to describe the way the natural coastal system changes in response to changes in weather and ocean conditions. For example, an area of coastline may erode during storm events, or may be-

come flooded during extreme high tides. Sediment may move alongshore under certain wind directions. Patterns of coastal behaviour can be used to estimate future coastal behaviour under changed climatic conditions. Coastal behaviour can also referred to as ‘process-response relationship’, where weather or ocean conditions (process) result in a change (response) in coastal form.

Climate variability: (IPCC 2007b): Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). Current Climate Variability refers to the variations in mean state and other statistics of the climate experienced over the recent historic record (past 30 years) to natural internal processes within the climate system.

Climate change projection (IPCC 2007a): A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasize that climate projections depend upon the



emission/concentration/ radiative forcing scenario used, which are based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realised and are therefore subject to substantial uncertainty.

Climate Change Impacts (MFF 2008): The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts: Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts: the impacts of climate change that would occur after adaptation. See also aggregate impacts, market impacts, and non-market impacts.

Quantitative assessment: Analysis applies numbers, measurements and statistics – hard data. In general terms, quantitative information is more difficult to obtain and more resource intensive (there may be a cost associated with obtaining quantitative information).

Qualitative assessment: Analysis is concerned with meaning rather than numbers. Emphasis is on subjective understanding, communication, and empathy rather than on prediction and control. Qualitative methods vary and are generally based on empirical research. Qualitative information can be obtained through semi-structured interviews.

Response to Guide Adaptation: At the project preparation stage we cannot develop specific adaptation actions to treat all the identified climate change impacts. However, we can identify the tasks that should be conducted to provide the required information to select specific adaptation actions during project implementation. These tasks are referred to as ‘Response to Guide Adaptation’. For example, a risk to our project may be an ‘increase in storm events and rise in sea level impacting the mangrove rehabilitation site’. At the project preparation stage we cannot say how we would treat this risk, because we require further information on the exact nature of the impact. However, we can say that, as part of our project, we need to obtain information to be able to address this risk, i.e. by undertaking a climate change risk assessment. Undertaking a climate change risk assessment is a ‘Response to Guide Adaptation’.



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Scientific evidence suggests that variations in temperature, weather patterns and sea level will impact coastal ecosystems and communities.

This easy to use four step guide has been developed to help coastal project managers effectively address the potential impacts of climate change and enhance the resilience and adaptive capacity of projects.

The four step guide helps project managers:

- Understand climate drivers that cause physical changes in coastal zones;
- Identify potential impacts of climate change on achieving project objectives;
- Identify appropriate adaptation actions; and
- Identify resource requirements to implement adaptation actions and ensure long-term sustainability of interventions.

Get the full guidelines and reference tool at:

www.mangrovesforthefuture.org

or contact: secretariat@mangrovesforthefuture.org

