

**The Nexus between Climate Change & Marine and Coastal Living
Resources in Africa:
A New Integrated Approach for Cost-Effective Poverty Reduction Outcomes**

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1. About the Report

1. Rationale

Marine and coastal living resources are not only a vital source of food security but also an engine for economic growth for many coastal countries across the globe, especially Africa. Throughout the continent, communities living off the coasts directly dependent on the services provided by these marine and coastal ecosystems, as they are often poor, vulnerable, and likely to suffer the most from changes to these environments. One of the biggest threats to the equilibrium of such setting is due to the occurrence of climate change, the impacts of which are already being detected in many cases and areas of Africa. These effects, moreover, are being amplified by several exogenous factors like coastal population growth, overfishing and illegal fishing, pollution, unsustainable tourism and other issues that further damage marine and coastal ecosystems in ways that diminish biodiversity, livelihood opportunities, and aggravate poverty.

For these reasons, the outline proposes the development of a comprehensive report that will put forth a new integrated approach between development strategies, and climate change mitigation and adaptation measures. Such an integrated approach is proposed in the belief that policy makers, donors and other stakeholders are in urgent need for cost-effective and prioritized options to guide investments and initiatives aimed at climate change mitigation and adaptation - for the ultimate goal of maximizing Africa's developmental and poverty reduction prospects.

2. Approach

To reach the above mentioned objectives, it is crucial to be able to carry out the following:

- Thoroughly map the dimensions of vulnerability across Africa coastal zones;
- Identify and measure climate change-driven risks;
- Determine priority-based, cost-effective adaptation and mitigation measures;
- Estimate costs, effects, net gains, and limits of implementing such measures.

This can only be achieved by unearthing reliable information directly provided by evidence-based data analysis - an input that is vital to properly guide decision making processes, political strategies, and investment decisions. The importance of generating such a reliable source of information is especially relevant in the context of Africa, a region of the world that severely lacks the availability of reliable data because of multiple reasons, including scarcity of resources to devote for such purpose by national governments and international donors.

3. Scope

The Report will be structured as a series of subsequent papers. This will allow each consequent paper to build on the results achieved by the previous one and gradually expand in scope; prioritize country and regions by gradually also expanding the geographical breath of the papers; generate customized knowledge for the varying contexts, environments and communities; and allow for a progressive scale-up of resources needed for the production of the Report. The focus of the first paper will be to clarify the available knowledge on the topic and consequently the knowledge gap to be filled: this will create the background on which to carry out a first survey and data

analysis on a pilot country. The knowledge, methodology and results of such study will offer a solid basis on which to expand and go deeper through the subsequent papers.

2. Introduction

1. The central role of marine and coastal living resources for Africa's development challenge

Africa is endowed with a large variety of marine and coastal living resources, including fisheries, mangrove forests and wetlands, and coral reefs - all providing critical services to coastal communities as well as to national economies.

A wide continental shelf that benefits from a strong upwelling current along the coast, spanning from Mauritania to Senegal, supports some of the richest fishing grounds in the world. The fisheries sector formally accounts for up to 30 percent of Gross Domestic Product (GDP) in countries like Seychelles, seafood exports in 2008 were reported to be approximately US\$1.3 billion in 2008 and local industrial fisheries comprise a substantial part of the foreign exchange earnings across the South-West Indian Ocean area. The fisheries sector further represents a major source of food and nutrition for African coastal communities by being the main provider (up to 50 percent) of their total animal protein intake and of essential vitamins and fatty acids in an otherwise starchy diet - mostly common among the poor. The fisheries sector is a vital provider of jobs to both men and women, and an important source of cash income for many households. It is also frequently integral to mixed livelihoods strategies where people resort to fishing when other forms of food production and income generation fall short. As mentioned, fish is one of the most traded food commodities in the region, consequently supporting economic growth: it provides an important source of cash revenue to service international debt, to fund governments' activities, and to import food for domestic consumption, which in turn contributes to national food security and diversification of diets.

African coasts are also naturally forested by mangrove species, which provide sheltered areas for abundant juvenile demersal and pelagic fish, as well as for other marine organisms. Mangroves enhance the biodiversity of surrounding marine habitats like sea turtles and dugongs, a rare marine mammal facing extinction. Mangroves contribute to stabilize coastlines, prevent erosion from waves and storms, protect coral reefs and seagrass meadows, and represent an important source of wood for construction, fuel, and the production of natural medicines for coastal communities. The most developed mangroves in Eastern Africa extend as far as 50km inland, with canopy heights up to 30m. Coral reefs found along the south and east coasts of Africa are crucial supporters of biodiversity and provide enormous value for the population: they serve as natural nurseries for ocean's fish, they are generators of tourism revenues and a potential source of alternative/additional source of income to the poor, they prevent coastal erosion, floods and loss of property on the shores by breaking the power of waves during storms, hurricanes or typhoons.

The rich endowment of these natural resources provides the basis for livelihood and nutrition to millions of people and represent a vital safety net for communities living off the coast of Africa, which are among the poorest and more marginalized groups of

society. Their livelihoods directly depend on the services provided by the marine and coastal ecosystem of the region, so that they are also likely to be the ones suffering the most from changes occurring to such environment.

The importance of these natural resources, however, is not circumscribed to the 'safety net' dimension. These resources are a natural asset that could boost economic output by providing significantly larger returns to the continent's economy over the long-term, if sustainably managed. The value of renewable natural assets is in fact linked to their environmental well-being: increases in sustainability lead to higher values, and conversely a reduction in asset value may reflect resource degradation. For such reason, a key economic growth strategy for the continent is to sustainably increase the value of its rich marine and coastal living resource base, and the portion of that value that is captured within Africa and invested in capital growth.

2. [The threat of climate change to Africa's marine and coastal living resources](#)

As mentioned, African coastal communities are one of the social groups most vulnerable to changes in the environment their livelihoods are so heavily dependent on. As evidence has already sadly started reporting, one of the biggest threats to the equilibrium of such environment is due to the occurrence of climate change. The current rise in global temperature of 0.7°C since pre-industrial times is already causing oceans and coastal areas to register the impacts of climatic changes, such as the ones described below. A thorough identification of the pathways and directions of current changes in global temperature however are highly complex to assess, and will be the subject of analysis within the scope of the proposed report.

- *Rising global sea levels*, a consequence of melting glaciers and polar ice, and thermal expansion of warmer water, with consequent serious impacts on coastal habitats which are already starting to get flooded. This is particularly relevant especially when considering that around 23% of the world population lives near coastal zones, with population densities about three times higher than the global average. The survival of mangrove ecosystems, which require stable sea levels, is also going to be seriously challenged by the consequence of sea levels' rise.
- *Water temperature rise at the ocean surface*, an effect of ocean's ability to absorb part of the heat generated by climate change. This phenomenon cause the ocean circulation patterns transporting warm and cold water around the globe to change, alter and disrupt marine ecosystems in many ways. Warmer surface temperatures might also contribute to profound effects on global climate due to the oceans' continuous interaction with the atmosphere: increases in surface temperature already led to a rise in the amount of atmospheric water vapor that in turn feeds weather systems producing precipitation. This could increase the risk of heavy rain and snow, shift storm tracks and potentially contribute to drought in certain areas. Increases in surface temperature are also expected to lengthen the growth season for

certain bacteria that can contaminate seafood and cause foodborne illnesses, thereby increasing the risk of health effects.

- *Acidification of oceans*, which are absorbing an ever increasing proportion of the carbon dioxide released by human activities. This phenomenon might impact on the survival of fish, squid and other gilled marine animals that require to extract oxygen from water. Shellfish, crabs, lobsters and corals might find it harder to build their calcium carbonate shells, which might even start to dissolve in some areas of the region.
- *Decreased ocean vertical mixing*, a phenomenon which is crucial for the transportation of nutrients from deep to shallow waters, as well as oxygen from surface into deeper waters.
- *Increasing extreme and unpredictable rainfall events*, causing consequential physical damages to coral reefs, coastal ecosystems, and most especially coastal communities;
- *Coral bleaching*, a stress response caused by high water temperatures that can lead to coral death. Recent years have already witnessed widespread coral bleaching and coral death throughout the world, with negative spill-overs on fish stocks and coasts;
- *Alteration of lifestyles of marine species*, for which the change in temperature affect metabolism, life cycle, and behavior. Marine turtles as well as some fish and copepods that serve as marine animals feed, for example, have the number of male and female offspring determined by temperature. This means that changing climate might skew sex ratios and therefore threaten the population's survival.

In addition, coastal countries of West and Central Africa are particularly endangered by the risk of coastal erosion and flooding caused by sea levels rise, because of the abundance of low-laying coasts and the expanding amount of rapidly growing cities along the coasts. East Africa coastal areas are also vulnerable to disastrous erosion and flooding phenomena as a consequence of the diminished buffer effect provided by coral reefs laying along major sections of the continental shelf. These factors could create the conditions for significant negative impacts on tourism-oriented economies, ecology, natural habitats and most of all, the population of such areas.

Climate change represents a compounding threat to the overall sustainability of the African marine and coastal ecosystem, consequently holding the power of negatively affecting millions of people, as well as the health and wealth of entire countries. This compels policy makers, donors and other stakeholders to explore new approaches and methodologies of intervention to address current and potential climate change-driven risks, so that investments in better preparation will pay dividends for present and future prospects of successful development efforts.

3. The importance of a new integrated approach

Vulnerability is typically defined as a combination of the exposure to a hazard such as climate change; the sensitivity to the hazard; the lack of capacity to modify exposure/absorb/recover from losses stemming from the hazard; and also to exploit new opportunities that arise while in the process of adaptation. Multiple studies¹ analyzing the effects of climate change on oceans and coastal areas found Africa as being one of the most vulnerable regions in the world. This vulnerability is mainly due to the combined effect of predicted warming; the relative importance of ocean and coastal living resources to national economies; most importantly, the fact that countries are among the world's poorest and twice as reliant on natural resources like fish, mangroves, and coral reefs. Africa is therefore in great need of developing a new integrated approach to its developmental strategies: these need to factor in cost-effective mitigation and adaptation measures, so that the crucial contribution that oceans and coastal areas can make to poverty reduction is not lost, but rather maintained and enhanced. In the absence of enhanced capacity to cope with and adapt to the impacts of climate change, in fact, the disruptions are likely to affect large numbers of people dependent on such resources, and reduce the options for future economic development, poverty reduction, and shared prosperity.

Worth mentioning is that the effects of climate change on coastal habitats and marine resources are already being amplified by exogenous factors that further enhance the urgency for such an integrated approach. Coral reefs, seagrass beds, mangroves, and other key ecosystems in the African waters are already being destroyed by growing population densities living along the coast², the constant rise in global demand for

¹ Important contributions include publications by DFID, FAO, NOAA, OECD, UNEP, WWF, as well as academia. Among others: 'The threat to fisheries and aquaculture from climate change', DFID WorldFish Center Policy Brief, 2007. 'Strategy for fisheries, aquaculture and climate change. Frameworks and aims 2011-2016', FAO, 2011. 'Fisheries and Aquaculture in our Changing Climate', FAO Policy Note, 2009. 'Climate change implications for fisheries and aquaculture. Overview of current scientific knowledge', FAO Fisheries and Aquaculture Technical Paper 530, 2009. 'FAO Expert Workshop on climate change implications for fisheries and aquaculture', FAO Fisheries Report No.870, April 7-9, 2008. More from FAO at: <http://www.fao.org/fishery/climatechange/en>. 'The Ocean' In: 'Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects'. Contribution of Working Group II to the Fifth Assessment Report of the IPCC, Hoegh-Guldberg, O. et al., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1655-1731, 2014. NOAA resources at: http://www.fisheries.noaa.gov/stories/2014/03/climate_portal.html. 'The Economics of Adapting Fisheries to Climate Change', OECD, 2011. 'Environmental consequences of ocean's acidification: a threat to food security', UNEP Emerging Issues, 2010. 'In dead water. Merging of climate change with pollution, over-harvest, and infestation in the world fishing grounds', UNEP Rapid Response Assessment, 2008. 'Living Blue Planet Report. Species, habitats and human well-being', WWF, 2015. 'Vulnerability of national economies to the impacts of climate change on fisheries' Allison et al., 2009. Etc.

² In Nigeria, for example, about 22.6% of the national population lives along the coastal zone; while about 66.6% of the total Senegalese population live in the Dakar coastal area, and about 90% of the industries in Senegal are located within the Dakar coastal zone. In Ghana, Benin, Togo, Sierra Leone, and Nigeria, most of the economic activities that form the backbone of the national economies are located within the coastal zone. Coastal areas also form the food basket of the West African region. Offshore and inshore areas, support artisanal and industrial fisheries, accounting for more than 75% of fishery landings in the region. Coastal cities in East Africa like Dar Es Salaam and Mombasa are experiencing annual population growth of 6.75% and 5%, respectively. Coastal tourism and fisheries represent large inputs into the GNP of east African states ("The Regional Impacts of Climate Change: An Assessment of Vulnerability", Intergovernmental Panel on Climate Change (IPCC), 2007).

fish, and most of all by current policy failures that are causing unsustainable fishing practices to take place, and fish stocks to be dramatically depleted. Large areas of mangroves are being lost through conversion to rice paddies, salt pans, aquaculture and urbanization, or because of the high demand for timber and fuelwood. Besides being damaged by destructive fishing practices and overfishing, coral reefs are also being endangered by factors like careless tourism, pollution, erosion caused by construction, mining and logging, and also by coral mining practices. Climate change will also exacerbate.....

3. Objective of the Report

Despite the recent proliferation of studies providing insightful assessments on the relevance of marine and coastal living resources for the developmental prospects of Africa, as well as on the importance of factoring into the equation climate change - the precise direction and impact of such changes is still unclear, especially for Africa. Policy makers, donors and other stakeholders urgently need thorough analyses, evidence-based information, and most especially prioritized, cost-effective options to guide investments and initiatives towards climate change mitigation and adaptation, for the ultimate goal of maximizing developmental and poverty reduction prospects for the continent. The proposed report aims at meeting some of these objectives by putting forth a new integrated approach between development strategies and climate change mitigation and adaptation measures. To achieve such goals, the report will be structured around the two following pillars:

- 1) *First pillar. Identify the current knowledge gap:* This pillar will help clarify the currently available knowledge on the effects of climate change on African marine and coastal living resources. The pillar will then identify where the knowledge gaps reside;
- 2) *Second pillar. Provide a toolbox of cost-effective options for enhanced resilience and improved development prospects:* This second pillar will build on the outcomes of the first pillar. Based on the knowledge gaps identified, it will focus on assessing current and future effects of climate change on Africa's marine and coastal living environment. It will subsequently put forth a range of possible priority-based approaches and cost-effective decision making options, to assist policy makers, donors and other stakeholders in mitigating climate change-driven effects, enhance resilience, and ultimately improve developmental prospects for some of the most vulnerable categories of Africa's society.

4. Scope of work

The report plans to be developed through an iterative process, and will be composed of a series of independent papers. A first paper will be produced with the budget currently available and concentrate on achieving the objectives of the first pillar. A series of subsequent papers would then build on the results identified by the first, and focus on reaching the objectives of the second pillar. The report also intends to be a collaborative exercise, including inputs and contributions from relevant institutions and stakeholders.

The two pillars will be structured as follows:

1) *First pillar. Identify the current knowledge gap:*

- 1) Define vulnerability and the target group: identify which are the groups of society most vulnerable to the effects of climate change on marine and coastal living resources, and quantify them;
- 2) Define resilience and its importance: identify why it is crucial to analyze current and expected impacts of climate change on African marine and coastal living resources for developmental and poverty reduction prospects;
- 3) Map available knowledge: map out current knowledge available on the effects of climate change on Africa's marine and coastal living resources as well as their impact on the identified vulnerable groups and their resilience options;
- 4) Identify the knowledge gap: highlight what type of knowledge and analysis is not yet available while being needed for the development of priority-based and cost-effective options for policy makers/other relevant stakeholders to enhance resilience amongst the most vulnerable.

2) *Second pillar. Provide a toolbox of cost-effective options for enhanced resilience and improved development prospects:*

2.1) Building on the identification of the knowledge gap obtained through the first pillar, assess current and future risks and vulnerabilities based on robust climate modelling;

2.2) Identify realistic, priority-based approaches that could lead to effective adaptation practices and mitigation measures;

2.3) Estimate costs, effects, net gains and limits of implementing such measures;

2.4) Develop a framework to inform policy makers/donors/other stakeholders on the most practical, cost-effective and priority-based options to increase resilience.

5. Methodology

- Desk review of available literature;
- Climate modeling;
- Structured and non-structured interviews to key stakeholders;
- Survey on selected vulnerable groups and analysis of results.

6. Geographical scope

- Continental (Sub-Saharan Africa):
 - Desk review for the whole Sub-Saharan Africa;

- Climate modelling on selected representative countries or environments;
- Survey on selected population groups of selected representative countries.

7. Timeline

- The report will be developed through an iterative scale-up plan. It will start with the production of a first paper focusing on the first pillar, and then proceed with the development of a series of successive papers centering on the second pillar. The plan has been designed as such to second the status of resources, generate a prioritization of countries/regions, and take into account that socio-economic effects of climate change vary depending on conditions that are specific to changing environments, communities, countries and regions. The timeline will be as follows:

6.1 First paper:

- First Pillar. Identify the current knowledge gap

6.2 Second paper:

- Second pillar (country focus). Based on the results of the first paper, provide a toolbox of cost-effective options by conducting analyses on one selected pilot country (e.g., Senegal);

6.3 Third paper:

- Second pillar (regional focus). Replicate/expand results obtained in the second paper by focusing on other selected countries representative of a determined region;

3. Fourth paper:

- Second pillar (global focus). Replicate/expand results obtained in previous papers by focusing on other regions.

8. Budget

- Current budget: US\$ 200,000 from the GEF-financed 'Regional Partnership for African Fisheries Policy Reform (RAFIP, P155961)'

- Target budget: US\$ 2,000,000

1. Proposed analysis with current budget (US\$ 200K)

- First paper and first pillar.

2. Proposed analysis with target budget

- Following papers and second pillar. Specifically:
 - Execute climate modelling to refine the assessment of future risks and vulnerabilities;
 - Complement results obtained through the first paper by carrying out empirical analysis on a first pilot country, then expanding the analysis at the Regional level, and finally at the Continental level.