

United Nations Development Programme

**AFRICA ADAPTATION PROGRAMME: CAPACITY BUILDING EXPERIENCES  
IMPROVING ACCESS, UNDERSTANDING AND APPLICATION OF  
CLIMATE DATA AND INFORMATION**

**DISCUSSION PAPER SERIES VOL. 2 • JUNE 2011**



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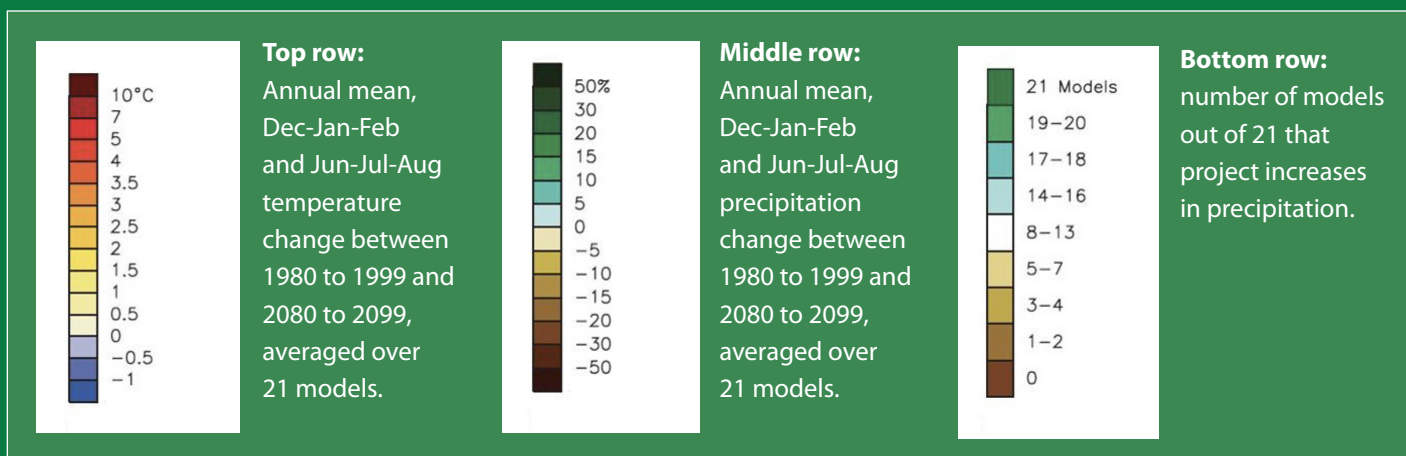
United Nations Development Programme  
Environment & Energy Group  
304 East 45th Street New York, NY 10017  
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**Authors:** Ryan Laddey

**Contributors:** Jennifer Stephens, Jennifer Baumwoll, Jose Levy, Joseph Intsiful, Mihoko Kumamoto and Met Office (UK)

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Figure 2: Gray, D. and C. Sadoff. 2004. Water, Growth and Development: A working paper for discussion. Washington: World Bank.

Figure 3: Watkiss, Paul, et al. 2010. AdaptCost Project: Analysis of the Economic Costs of Climate Change Adaptation in Africa. Nairobi: UNEP

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## INTRODUCTION

The Africa Adaptation Programme (AAP) is pleased to present the second edition of its *Discussion Paper Series*. Each paper in this series will focus on one issue related to climate change adaptation and sustainable development. These papers are intended to stimulate intellectual discussion, as well as share early lessons learned from the design and initial implementation of the AAP.

This discussion paper aims to emphasize the importance of historical climate data, climate projections and climate vulnerability and risk studies for building climate resilient communities. The AAP, one of UNDP's flagship programmes in Africa, is supporting improved access to, understanding of and application for climate data and information. The aim is for targeted countries to understand the overall risks and vulnerabilities triggered by climate and non-climate factors, which will then help countries develop robust climate resilient strategies and policies as well as national and sectoral development plans. We hope that this document will stimulate discussion on this very topical and important issue.

The Africa Adaptation Programme is a strategic initiative designed to help create more informed decision-making and more effective implementation of those decisions in 20 participating African countries. The AAP is supporting the long-term efforts of countries to further develop their capacity to successfully identify, design and implement holistic climate change adaptation and disaster risk reduction programmes within the context of national development policy, planning and practice. The AAP was established under the Japan-UNDP Joint Framework for Building Partnership to Address Climate Change in Africa, which was created at the Fourth Tokyo International Conference on African Development (TICAD IV) organized in Yokohoma, Japan (May 2008). The AAP was launched in 2008 by UNDP, in partnership with UNIDO, UNICEF and WFP, with funding of \$92.1 million from the Government of Japan. The 5 outcomes of the AAP are:

- Outcome 1:** Dynamic, long-term planning mechanisms to manage the inherent uncertainties of climate change introduced
- Outcome 2:** Leadership capacities and institutional frameworks to manage climate change risks and opportunities in an integrated manner at the local and national levels enhanced
- Outcome 3:** Climate-resilient policies and measures implemented in priority sectors
- Outcome 4:** Financing options to meet national adaptation costs expanded at the local, national, sub-regional and regional levels
- Outcome 5:** Knowledge on adjusting national and sub-national development processes to fully incorporate climate change risks and opportunities generated and shared across all levels

UNDP's experiences through AAP interventions to date have shown that countries in Africa are suffering from the risks and vulnerabilities triggered primarily by non-climate factors. Climate variability and change is adding pressure to existing risks and vulnerabilities; therefore, it is important that countries address climate and non-climatic risks and vulnerabilities in a comprehensive, integrated manner.

It is also found that countries need further assistance in gathering and analyzing relevant climate data and information to build understanding of climate risks and vulnerabilities (Lu 2006). Development decisions, including the need for adaptation, must be based on quality information that provides robust understanding of the likely climate impacts and costs of both action and inaction. Within the AAP, climate information is being collected and analyzed for enhancing long-term planning, while climatic and non-climatic risks and vulnerabilities are being integrated into national and sectoral development plans in the 20 countries.

This paper will examine some key types of information, explore opportunities for building a knowledge base in countries which have limited resources (e.g. computer software) and show how the AAP is using climate data and information to mainstream climatic variables into national risk assessment processes, thus ensuring that climate impacts are considered in long-term development decisions.



## KEY CHALLENGES FOR UTILIZING CLIMATE DATA AND INFORMATION

Africa is often considered the most vulnerable region to both climate variability and change (Dougill 2009). African countries also often have limited capacity to develop, generate, disseminate and effectively use climate data and information in climate risk reduction and management (Carberry 2008). Past, present and future climate data is critical for climate modeling, prediction and early warning, and is used to determine the climate baseline, variability and extremes (Ogallo 2010).

This section outlines four specific challenges contributing to the limited ability of African countries to use climate data and information for decision-making and national development planning which incorporates climate change adaptation (CCA). The four specific factors are:

1. Access to Climate Data and Information
2. Understanding of Climate Data and Information Needs
3. Assessing Risk and Vulnerability
4. Integrating Climate Risks and Opportunities into National Development Plans

### 1. Access to Climate Data and Information

One of the key challenges to the development of detailed climate change predictions in Africa is the lack of climate information available. Current infrastructure in Africa is often not as reliable or powerful as more developed regions. For example, Africa has an inadequate number of meteorological stations for climate data collection, and much of the data that exists has not been digitized (UNFCC 2007). The enhancement and modernization of observation networks is important for forecasting and understanding Africa's unique climate and its vulnerabilities to climate change.

Furthermore, in many African countries there is also limited hardware, software and other technology applications, such as climate models, to generate and distribute climate data and knowledge. Climate models such as General Circulation Models (GCMs) and Regional Climate Models (RCMs) are some of the most important tools for assessing future climate risks, defining needs and informing adaptation decisions.

Although important, climate model projections are uncertain, providing a range of future projections for temperature or rainfall. Projections on sub-national and national levels are also more uncertain than continental or global projections. Such uncertainty poses a challenge for their utilization in adaptation decisions, and can hinder action because it is uncertain what adaptation strategies would be most beneficial. Furthermore, these projections are often on long-term time scales, whereas decision-making is often based on short-term information. These levels of uncertainty can often lead to disagreement among stakeholders.

#### BOX 1: CLIMATE MODEL

A numerical representation of the climate system based upon physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties (Lu 2006).



In addition to limited available data and information, in many countries there is an insufficient exchange of information and a limited number of networking systems (Ogallo 2010). The lack of basic telecommunications in Africa, including Internet access is a strong limiting factor in exchanging information. Many countries are also not aware of the opportunity to link with existing knowledge platforms or develop partnerships with research institutes, universities and scientific organizations (Ogallo 2010). In recent years, many new initiatives have been developed in Africa to expand access to climate data. Improving access to both historical and projected climate data through partnerships and knowledge platforms could help African countries increase knowledge and awareness of climate change impacts and adaptation strategies.

## 2. Understanding Climate Data and Information Needs

Not only is access to climate data and information limited, but so is the capacity of national institutions, leadership and civil society to determine what climate data and information is needed for adaptation-related decision-making (UNFCCC 2008). Key challenges in defining needs include limited expertise and training in climate science, the application of climate models and other software (Ogodo 2009). Guidance on how to use existing climate observations and model projections to inform adaptation decisions is currently constrained.

### BOX 2: ADAPTIVE CAPACITY

The property of a system to adjust its characteristics or behavior in order to expand its coping range under existing climate variability or future change conditions. The expression of adaptive capacity as actions that lead to adaptation can serve to enhance a system's coping capacity and increase its coping range. Adaptive capacity represents the set of resources available for adaptation as well as the ability of the system to use these resources effectively in the pursuit of adaptation (Lim 2005).

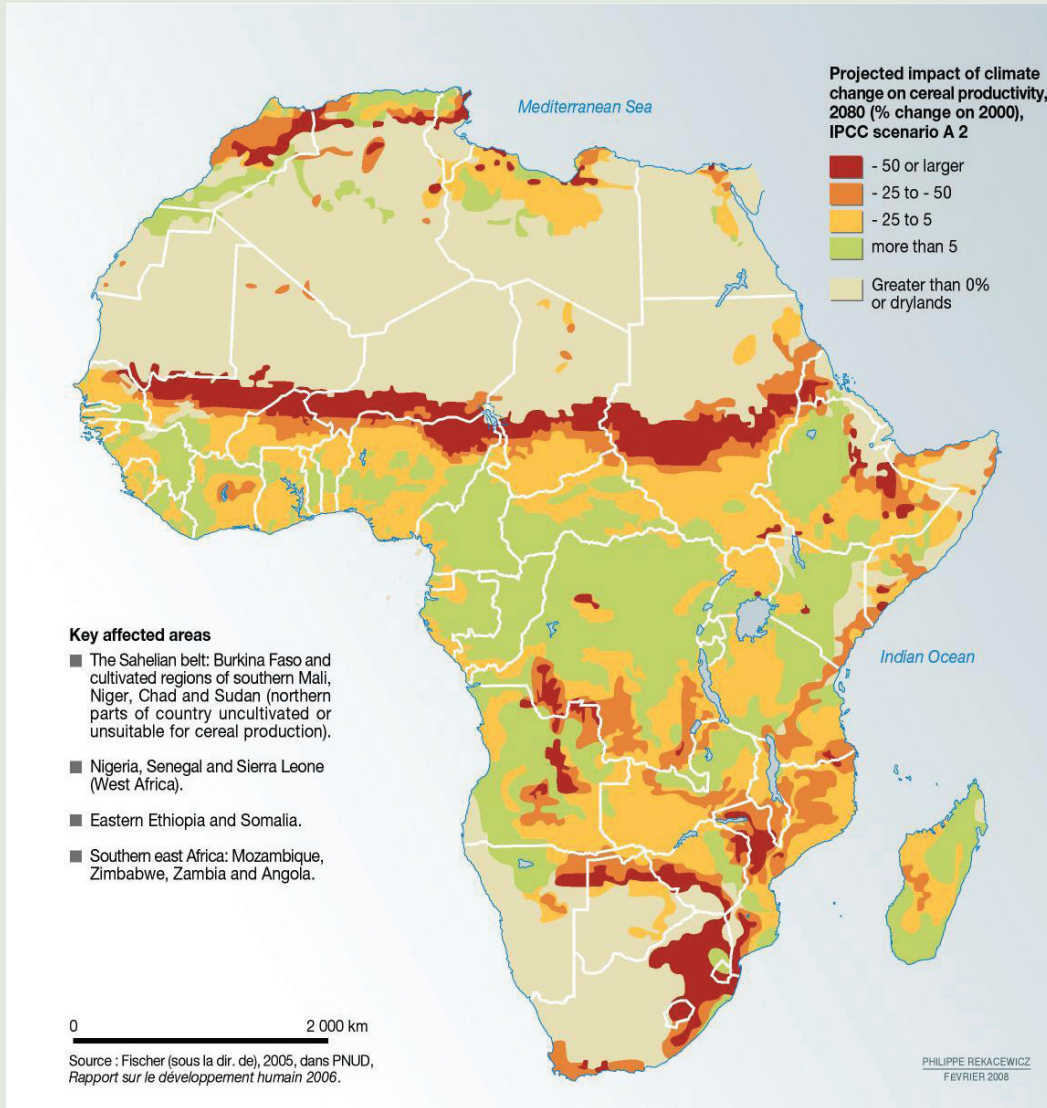
Because different countries have distinct climate impacts, defining the particular needs of each is important in order to prepare for future climate impacts. A country projected to be affected by sea level rise, and one expected to see decreases in water supply due to melting glaciers inland, require different types of climate information. For example, measuring the effects of glacial extent variability on water supply would require information on glacial and interglacial cycles and data on past rates of river flow and runoff. Analyzing rates of sea level rise would require data on thermal expansion and ocean temperatures. In some cases, a country will need both types of information, but the information will need to reach different areas. The need for such data and information varies depending on the context of the adaptation decision and the country.

## 3. Assessing Risk and Vulnerability

Climate, and particularly extreme weather events, can be a factor in social, economic and political stability. Climate change influences may increase negative impacts on socio-economics of countries, displacing large populations and causing contentious political debates over natural resources (Bryan 2009). There is a need to improve understanding of climate change in order to understand how it influences other risks and vulnerabilities in certain sectors and populations. Risk assessments are one way to understand the likelihood of a specific event occurring, its associated impacts and the population or sector's vulnerability.



**FIGURE 1: Cereal productivity in Sub-Saharan Africa under a scenario of the IPCC that shows CO<sub>2</sub> atmospheric concentrations at 520-640ppm by 2050**



Climate-induced changes to crop yields and ecosystem boundaries will dramatically affect some of the poorest people in sub-Saharan Africa partly because many of them live in areas most prone to extreme climate events and partly because they have little capacity to adapt by turning to irrigated agriculture, improved seeds or alternative livelihoods. Recent modeling has provided important insights that should serve as an early warning system. One illustration, shown on the map, is based on evidence of the relationship between water availability and productivity in the cereals sector. It highlights areas of acute threat, including a wide band across the Sahel region, stretching from Mauritania across Niger, Burkina Faso, Chad and Sudan. Large swathes of southern Africa face the prospect of steep declines in yields, along with chronically food-insecure countries such as Ethiopia and Somalia (Watkins 2006).



To perform quantitative climate change risk assessments, it is important to have knowledge of the baseline relationship between vulnerability, current climate and future climate projections. However, because of the limited access and availability of climate information in Africa, it is difficult to carry out comprehensive risk and vulnerability assessments. The models, tools and methodologies appropriate for these assessments are also not widely available (UNFCC 2007).

### BOX 3: RISK

The combination of the likelihood (probability of occurrence) and the consequences of an adverse event (e.g. tropical cyclone, drought, flood) (Lim 2005).

Further, it is critical to understand existing risks and vulnerabilities and recognize the current relationship between the climate and society, for example the relationship between rainfall and hydropower generation or agricultural production. In addition to specific climate information, it is also necessary to have socio-economic information and sector specific data to allow quantitative relationships to be established.

### BOX 4: VULNERABILITY

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (Lu 2007).

Risk and vulnerability associated with climate change depend greatly on socio-economic characteristics of a country (e.g. wealth, access to information/technology, level of economic development, settlement patterns and population growth). For example, a country with a high population density along its coast can be particularly vulnerable to rises in sea level. Additionally, climate change will impact a variety of economic sectors – including tourism, agriculture and forestry, all of which contribute to the overall national economy and will be affected differently by climate change. Different types of both climate and socio-economic data are needed to assess the added risks of climate change to these economic sectors and social systems to inform adaptation decisions and incorporate these risks into national development plans.

Africa, in particular is exposed to numerous socio-economic hazards. Many of the countries are classified as Least Developed Countries (LDCs). This means that they have limited economic and social stability, making them less capable of adapting to climate change. The economies of Africa are predominantly dependent on rain-fed agriculture. About 20-30 percent of GDP in sub-Saharan Africa, or 55 percent of the total value of African export, comes from agriculture (World Bank 2000). Seventy percent of all Africans – nearly 90 percent of the poor – work primarily in agriculture (World Bank 2000). In Ethiopia for example, agriculture supports roughly 42 percent of GDP and 85 percent of employment (Conway 2009). Therefore, the occurrence of extreme climate events such as droughts, floods and periods of extremely high temperatures above previous recordings can cause serious economic losses and affect national development goals. Climate projections for many parts of Africa show declines in precipitation over time, having a significant effect on food production (Livermore 2005). The vulnerability of African nations to climate variability will be heavily dependent on how well climate and non-climatic risks are factored into long-term development planning, particularly in the agricultural sector.



## 4. Integrating Climate Risks and Opportunities into National Development Plans

Several of the challenges discussed, namely limited amount of climate and socio-economic data, limited expertise in interpreting and applying climate science, and limited networking and collaboration, all pose a challenge to integrating climate change into development goals. Cost-benefit analyses, for example, are one way to assess the viability of adaptation options. These analyses, however, require large amounts of data about the region, future climate change scenarios and socio-economic information, which are often unavailable in countries.

Gaps remain in leadership and institutional capacity, limiting the ability to develop and implement policies to manage climate risks within the broader development context. Additionally, sectoral ministries often do not fully understand, nor do they address the additional risk factors associated with climate change.

### BOX 5: ADAPTATION IN MOROCCO'S OASES

Morocco has suffered severe and recurrent droughts over the past forty years (Lizcano). Between 1980 and 2000 Morocco experienced 2 droughts in four years and three consecutive years of drought (ibid). Morocco has also been susceptible to flooding events. Torrential rains with floods caused huge damage in the Errachidia province in August 2006, in the East in May 2007, and most recently in October 2008 in Errachidia. Climate projections for Morocco give, for 2020, a clear trend to an increase in average annual temperature between 0.6 and 1.1 °C and a trend towards lower average annual rainfall volume of about -4% compared to 2000 (ibid). Likely impacts are: increase in frequency and intensity of thunderstorms in the North and the West, an increase in frequency and intensity of droughts in the South and East, disruption of seasonal rainfall, a reduction in the duration of snow cover and accelerated snowmelt.

The Africa Adaptation Programme is coordinating with Morocco's ongoing climate change adaptation efforts. A major focus of Morocco's climate change adaptation efforts has been protecting its oasis regions. The oases are characterized as semi-arid to arid with erratic rainfall from one year to another. The average annual rainfall is only 132 mm and the number of rainy days is barely twenty; however, rainfall is often extreme and concentrated as large storms over short periods of time, causing severe floods (ibid). The Moroccan government has developed a strategy and action plan for rehabilitation and development of the oases. The AAP, in coordination with Morocco's other programmes, such as the South Oasis Programme and the Oasis Development Programme, is establishing long-term planning mechanisms to manage the risks posed by climate change. Information on the climate of the oases is being collected and analyzed for a better understanding of the impacts of climate change on the oases and its people, and to develop coping strategies for extreme weather events. Institutions are being equipped to undertake better management of natural resources, particularly water, which is the most important factor vulnerability in the region. For example, early warning systems are being developed to respond to extreme weather events. Additionally, the national project is strengthening institutional capacity to quantify the sectoral impacts of climate change in social and economic terms, to clearly understand the costs and benefits of adaptation. These studies will provide ways to identify adaptation options to be integrated into national planning.





## AAP APPROACHES FOR BUILDING CAPACITY TO UTILIZE CLIMATE DATA AND INFORMATION

This section illustrates how the AAP is supporting countries to improve understanding of, access to, and application of climate data and information to inform adaptation decision-making. This process will help countries consider climate change risks and opportunities when undertaking national risk analysis and assessments. In this section, examples of AAP measures relating to climate data and information are categorized by the four challenges described above.

A key activity of the Data Analysis component of the Inter-Regional Technical Support Component (IRTSC) of the AAP is to enhance long-term development planning through capacity building, information exchange and the introduction of new technology. These interventions support outcome 1 of the overall programme – introducing dynamic long-term planning mechanisms to manage the inherent uncertainties of climate change. Climate information is being shared among countries to contribute to a much broader regional knowledge base. In cooperation with other partners, centers of expertise are being established and the knowledge generated is being applied to support the development of climate resilient strategies and policies.

The AAP is addressing the problem of the lack of current infrastructure (data, tools, institutions) in Africa for the generation of climate data and information through the development of an e-infrastructure. This multi-tiered e-infrastructure system will allow countries to access, store and process climate related data. Its user-friendly decision support tools are being used by climate scientists and planners to help advise decision-makers on appropriate actions to take. This approach is allowing for regional sharing of experiences, knowledge and best practices related to climate data and information.

### 1. Access to Climate Data and Information

The AAP countries are establishing climate change units, creating data collection systems and training experts on how to access and process climate data. These activities aim to increase capacity to support vulnerability and risk assessments and use climate information to inform national development and sectoral strategies and policies. The AAP is working hard to build knowledge, platforms and access to the best available data, to assist countries in developing an understanding of the magnitude of the consequences of inaction.

The AAP countries are forming partnerships with universities, research institutes and scientific organizations to improve the access to historical, present and future climate data. These partnerships are useful in sharing knowledge on climate science, impacts and adaptation approaches. To expand access to data to all participating countries, the AAP has established collaboration with several key global and African regional institutions.<sup>1</sup> It is partnering with the Abdus Salam International Centre for Theoretical Physics (ICTP), which maintains a range of GCMs, RCMs and climate datasets. ICTP coordinates the Regional Climate Research Network and maintains a Regional Climate Model (REGCM4), which is being adopted in many African countries.

<sup>1</sup> Key regional institutions include: African Center of Meteorological Application for Development (ACMAD), IGAD Climate Prediction and Application Centres (IPAC), Southern African Development Community Drought Monitoring Centre (SADC-DMC), University Corporation for Atmospheric Research (UCAR), World Meteorological Organization (WMO), International Research for Climate and Society (IRI) and Met Office (UK).



## BOX 6: PRECIS

PRECIS is based on the UK Met Office Hadley Centre's regional climate modelling system. PRECIS was developed in order to help generate high-resolution climate change information for as many regions of the world as possible. The intention is to make PRECIS freely available to groups of developing countries in order that they may develop climate change scenarios at national centres of excellence, simultaneously building capacity and drawing on local climatological expertise. These scenarios can be used in impact, vulnerability and adaptation studies, and to aid in the preparation of National Communications, as required under Articles 4.1, 4.8 and 12.1 of the United Nations Framework Convention on Climate Change (UNFCCC).

In recent years, many regional and global initiatives have emerged, aiming to increase access to climate data and information in Africa. The AAP is coordinating a number of these efforts. These include the Africa Monsoon Multidisciplinary Analyses (AMMA)<sup>2</sup>; PRECIS regional modeling system, an initiative of the UK Met Office; the Coordinated Regional Climate Downscaling Experiment (CORDEX)<sup>3</sup>, an initiative by the World Climate Research Programme; and the Global Climate Observing System (GCOS), a joint undertaking of the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC), the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU).<sup>4</sup>

Examples of actions countries are implementing to expand access to climate data and information are provided below:

- **Tunisia** is conducting thorough research to identify existing institutions, research centres, academic research units, observatories, the meteorological institute, ministries and various technical service organizations that are, or could be, involved in a coordinated mechanism/network for climate monitoring and forecasting in Tunisia.
- In **Namibia**, the AAP team is establishing early warning systems and information centres to make climate data more accessible. These will be established in high-risk areas and incorporated into ongoing government services (e.g. information centres in Ongwediva, Katima Mulilo and Mariental). This process is being coordinated jointly by the Ministry of Agriculture, Water and Fisheries; Directorate of Water Affairs; Disaster Risk Management Unit under the Office of the Prime Minister and regional authorities and municipalities.

2 AMMA is an international project to improve our knowledge and understanding of the West African Monsoon (WAM) and its variability.

3 The purpose of CORDEX is to develop a coordinated framework for evaluating and improving Regional Climate Downscaling (RCD) techniques and producing a new generation of fine-scale climate projections for identified regions worldwide.

4 The goal of the GCOS is to provide comprehensive information on the total climate system, involving a multidisciplinary range of physical, chemical and biological properties, and atmospheric, oceanic, hydrological, cryospheric and terrestrial processes.



- **Nigeria** is designing and setting up a national climate change knowledge platform that will serve as a repository for data and studies to support information and data sharing, linked with the Adaptation Learning Mechanism; and commissioning the development of knowledge products required for the awareness-raising and targeted training activities.
- The AAP team in **Burkina Faso**, working closely with sub-regional and regional agencies, is initiating the establishment of a database for observed climate variability and trends over time to provide a better understanding of long-term climatic changes. Burkina Faso's AAP team is partnering with the Department of Meteorology and the University of Ouagadougou to collect data and to produce and distribute the required information.
- In March 2011, members of the AAP team attended the International CORDEX Conference. CORDEX will provide an unprecedented amount of data (about 14 models) over Africa for the next IPCC assessment report. The access to data from a range of climate models will enable the production of robust climate products.

## BOX 7: CORDEX

CORDEX is a World Climate Research Programme (WCRP) sponsored programme to organize an international coordinated framework to produce an improved generation of regional climate change projections worldwide for input into impact and adaptation studies within the IPCC Fifth Assessment timeline and beyond. CORDEX will produce an ensemble of multiple dynamical and statistical downscaling models considering multiple forcing GCMs from the WCRP archive.

## 2. Understanding Climate Data and Information Needs

In addition to access to climate data overall, country needs must also be clearly defined in order to determine the types of data required. In each of the AAP countries, priority sectors for adaptation have been identified (See Annex 1). In their project documents, many of the AAP countries have identified agriculture as a priority concern, because it is an important economic sector and many African countries are expected to have significant crop losses (Fischer 2004). Activities and actions in many of these countries are focused on reducing the vulnerability of the agricultural sector to climate change (e.g. Ethiopia, Nigeria). In others, the threat climate change poses to public health has been identified as the priority issue (e.g. Cameroon, Lesotho). Other sectors, which have been identified as priorities for adaptation are: coastal zone management, energy, preservation of biodiversity and management of water supplies.

In AAP countries, GCMs and RCMs provide climate change projections including changes in precipitation patterns and sea level rise. Further analysis and modeling presents additional information, such as biodiversity and disease patterns, to help determine sensitivities to climate change. These simulations can help in understanding how anthropogenic greenhouse gas emissions are impacting the climate system and the resultant feedbacks on climate. Depending on the particular concern of the country (e.g. future trends in drought frequency or sea level rise), different types of baseline information on climate are required (e.g. multi-decadal temperature changes or precipitation patterns); and then future projections of these variables are produced using GCMs and RCMs.



# POLICY OPTIONS AND ACTIONS

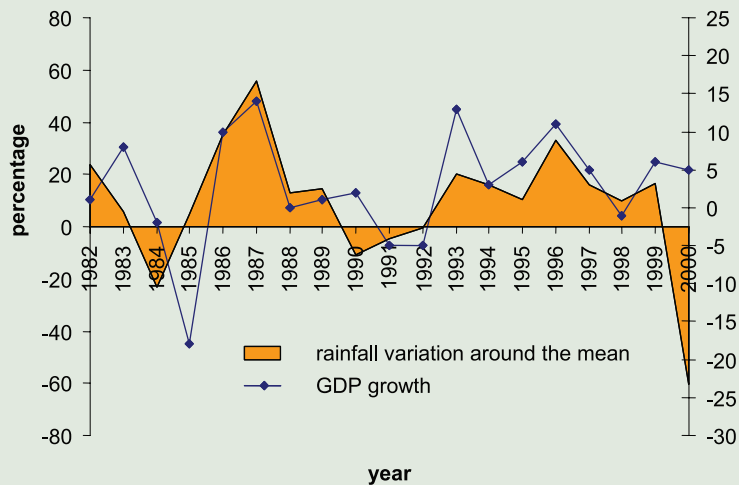
Below is a sample of actions the AAP countries are carrying out to gather and use the particular types of climate data and information, which will be most important for their needs:

- **Lesotho** is using climate information to develop an environmental health information and disease monitoring system, Geographic Information System (GIS) based, specifically for plague, malaria and bilharzia.
- **Mauritius** is using climate information to construct inundation risk maps to illustrate the full extent of sea level rise and flash flooding events.
- **Senegal** is completing technical and scientific information and data gap-analysis for CCA – with a specific focus on accessing data which provides information on sea level rise and water security. Many data deficits have already been identified (e.g. inundation maps showing future flooding).
- The AAP team has been involved in activities to increase the understanding of particular climate change impacts in the AAP countries. At the end of 2010, the team participated in a workshop on the ‘Use of Climate Model Scenarios for Water Resources Management,’ held at the IGAD-Climate Prediction and Application Centre (ICPAC) in Nairobi. The workshop trained 20 scientists from 10 countries in Eastern and Southern Africa to use regional climate modelling to assess the impacts of climate change on water resources. These skills can be used as tools for integrated water resources management.

### 3. Assessing Risk and Vulnerability

The AAP countries are working to analyze their risks and vulnerabilities to climate change, a crucial component for long-term and effective development planning. Risk and vulnerability assessments are carried out on a sector-by-sector basis by climate scientists, economists and social scientists, most commonly on water resources, agriculture and terrestrial ecosystems (UNFCC 2008). With access to climate and socio-economic information, AAP countries can understand climate risks and their particular vulnerabilities in order to develop robust development and adaptation strategies.

**FIGURE 2: Ethiopia Rainfall Variability and Related Growth in GDP**



In many African countries, there is a high correlation between rainfall variability and GDP growth. For example, in Ethiopia, periods of drought have correlated with declines in GDP growth (Gray 2004).



In the AAP countries, climate data and information is being used in risk assessments to identify extreme climate events, overall climate trends and patterns in climate and inter-annual variability. An increased likelihood of a climate hazard over time increases risk (Lim 2005). Identifying the probability of an event is important for informing development strategies and policies.

There are a number of countries conducting climate risk assessments.

- **Tunisia** is harmonizing data, protocols and methodologies for climate change risk assessments in coastal areas in order to promote the integration of climate risk consideration in coastal land use and investment decisions. This action will take place through collaboration between institutions involved in climate risk assessments through the creation of a network of technical partners.
- **Ghana** is facilitating the integration of climate information and climate change projections into the risk assessment, monitoring and warning services, and establishing a GIS based information management system on climate change induced disaster and natural hazard risk information.
- **Cameroon** is generating improved risk assessments based on the Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC). These are sector-specific risk studies led by sector ministries to prioritize risks. From these studies, best response options are being developed.

In other AAP countries, vulnerability assessments are also being used to identify the vulnerability of the system to a climate hazard. Vulnerability assessments require a consideration of climate change scenarios and projections of biophysical changes (Lu 2006), along with socio-economic data, to define which sectors and populations are most vulnerable to these risks. Understanding of and access to socio-economic data informs decision makers of the unique characteristics of a country, its vulnerability to specific risks, and existing adaptive capacity.

Many AAP countries are conducting vulnerability assessments to identify their needs.

- **Congo** is assessing the vulnerability of sectors to specific climate-induced impacts, including increased incidence of disease (e.g. malaria, meningitis), extreme heat stress, drought and flooding. The AAP is helping Congo to prepare for such hazards by strengthening existing climate risk management capacity to predict and disseminate information on climate hazards (e.g. disease outbreaks, flooding and drought) and develop plans and strategies to reduce mortality, morbidity and economic losses resulting from such hazards.
- **Senegal**, as a coastal country that is increasingly dependent on coastal tourism to support its economy, is particularly vulnerable to sea level rise (Bedford 2009). Senegal is conducting an assessment to identify current vulnerabilities to this hazard, along with coping strategies, adaptation interventions and measures to address its impact. Local techniques are also being reviewed, building on the Senegalese experience of adapting to coastal erosion for many decades.
- In **Tanzania**, socio-economic data from University of Dar es Salaam, Sokoine University of Agriculture, National Environmental Management Council and others is being used for adaptation planning by ministries, departments and local government agencies. This data will be consolidated with climate information to understand climate risks and vulnerabilities.



## 4. Integrating Climate Risks and Opportunities into National Development Plans

Understanding the sectors and populations most vulnerable to climate change allows policy makers to: 1) assess and analyze the effectiveness of current adaptation strategies, policies and processes 2) identify policies and processes for integrating adaptation into development planning and 3) analyze the effectiveness of newly implemented adaptation policies and processes (Lim 2005).

In sectors recognized as most vulnerable, AAP countries are identifying the potential for adaptation and proposing how to improve policy design and implementation to incorporate risks and opportunities. Sectoral adaptation strategies, policies and measures are being developed and integrated into national and regional development programmes. These strategies, policies and measures will ensure human development achievements in the face of climate variability and change.

Pilot adaptation projects are being identified for priority sectors based on vulnerability and risk assessments. The AAP is monitoring the implementation of these pilot adaptation measures for lessons learned and to build understanding of how climate information and vulnerability data can be best used to mainstream CCA into development policy. In many AAP countries, climate centres are being established to share these lessons and make them available to local communities, national institutions and other AAP countries.

Climate data and information is crucial for effective climate change mainstreaming. Under Output 3 of the AAP – implementing climate-resilient policies and measures in priority sectors, countries are undertaking a general review of all major national and sectoral policies to reduce climate risks and vulnerabilities and performing an in-depth analysis of the key instruments for adaptation. A variety of adaptation strategies and sectoral policies to integrate CCA into national and sectoral development policies and plans have been identified. They can differ from place to place, depending on the characteristics of the country.

- **Mauritius** is undertaking an in-depth review of policies, strategies and legislation pertaining to natural resources and other sectors vulnerable to climate change. The AAP is developing and implementing tools and instruments to integrate climate change into sectoral and national policies, using measures such as policy briefs, targeted policy support, toolkits for decision makers and parliamentary briefings.
- **Rwanda** is undertaking a comprehensive analysis of sectors and national policies and programmes to assess climate resilience and adaptation needs. In addition, the country is developing sector specific plans of how to address climate change and mainstream CCA into various sector policies, budgets and strategic plans.
- **Mozambique** is using climate data and knowledge of climate change risks and opportunities to enable integration of adaptation into policy documents, including through the development of mainstreaming guidelines.

Economic assessments and cost-benefit analyses will be important for comparing the costs of climate change with and without adaptation. These assessments will help guide investment decisions for national and sectoral adaptation.

- **Congo** is undertaking a cost-benefit analysis, investigating the cost of future climate change without the implementation of adaptation measures (i.e. the business-as-usual scenario) versus the cost of adaptation measures. The economic assessment is being conducted by the Adaptation Unit, with substantial input from key ministries. The Adaptation Unit comprises a core group of experts and analysts and is hosted by Marien Ngouabi University.

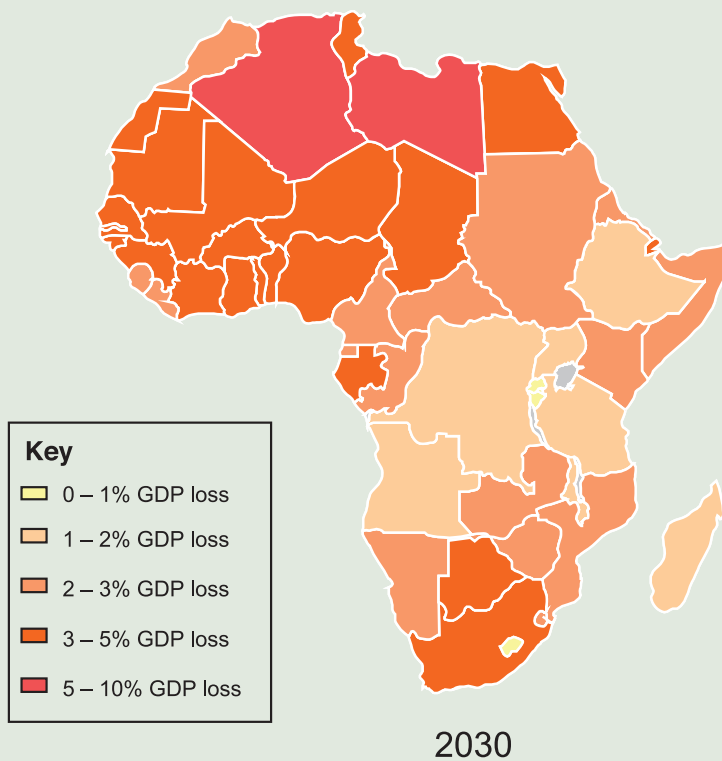


## BOX 8: COST-BENEFIT ANALYSIS

A quantitative method that makes a detailed comparison of the costs and benefits of a particular measure, or set of measures (Lu 2009). A decision to fund a project can depend on the ratio of benefits to costs – the higher the ratio, the more attractive the investment (ibid).

- **Senegal** is undertaking an in-depth socio-economic and environmental analysis comparing the costs of business-as-usual versus the costs and benefits of early adaptation action using cost-benefit analysis, systems modeling and other tools.

**FIGURE 3: Annual Costs of Climate Change in Africa in 2030**



Cost-benefit analyses show the economic costs of climate change. Climate change is expected to reduce GDP growth in Africa in the future (UNEP FUND national model).



## CONTINUING EFFORTS

Access to climate scenarios, historical climate data and information on climate change impacts will be a major asset to aid in development decision-making processes. Due to constraints in many countries, climate information is either unavailable or inaccessible. Expertise in the application of climate data to decision-making is also limited.

With a focus on developing capacity to incorporate climate change within development planning, a major component of the AAP is to strengthen evidence-based planning and decision-making. Actions are moving forward to connect the AAP countries to knowledge platforms, networks and resources to further build understanding of climate risks, vulnerabilities and opportunities. The AAP is building the capacity of countries to carefully gather the most pertinent and best available climate data and tools. The AAP is improving access and expertise to assess and apply historical climate data, climate projections and climate risk and vulnerability studies. A wide range of initiatives is being developed to encourage the use of climate information to inform development policies and strategies. This process will assist countries in understanding both the magnitude of, and vulnerability to climate change and other non-climatic impacts and risks. Building the capacity of AAP countries in these areas will assist in long-term development strategies, policies and processes to address climate change influences while accelerating human development.





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# ANNEX 1

## PRIORITY SECTORS

COUNTRY	COASTAL ZONE MANAGEMENT	AGRICULTURE AND LAND MANAGEMENT	WATER MANAGEMENT	ENERGY	HEALTH	WASTE MANAGEMENT
Burkina Faso		x	x		x	
Cameroon	x	x	x	x	x	
Congo	x	x	x	x		
Ethiopia		x	x	x	x	
Gabon	x	x				
Ghana	x	x		x	x	
Kenya		x	x	x		
Lesotho				x	x	
Malawi		x	x	x	x	
Mauritius	x	x	x			
Morocco		x	x			
Mozambique		x	x	x	x	x
Namibia		x	x		x	
Niger		x	x	x	x	
Nigeria		x	x	x		
Rwanda		x	x		x	
Sao Tome-Principe	x	x	x	x	x	
Senegal	x	x	x	x	x	
Tanzania		x	x	x	x	
Tunisia	x	x	x			



Below is a list of actions and activities the AAP countries are using to expand access, understanding and application of climate data and information. These actions and activities assist countries in developing long-term planning policies and strategies to manage the inherent uncertainties of climate change.

### *Burkina Faso*

- Identify the climate-related information needs of those involved in development, sectoral and local planning. The aim is to ensure the Department of Meteorology becomes more 'client-oriented', providing data that is used and useful. This will ensure that the equipment provided for data collection/analysis will be sustainable.
- Establish a database for observed climate variability and trends over time to provide for better understanding of long-term climatic changes.

### *Cameroon*

- Generate improved risk assessments for Cameroon; tap on international experience as appropriate, (learning e.g. from Mozambique risk assessment).
- Identify most vulnerable and priority sectors for Cameroon.
- Undertake vulnerability assessment studies (e.g. as per sector or in integrated manner).
- Conduct sector specific risk studies lead by sector ministries; use an ecological zones approach; prioritize risks.

### *Congo*

- Identify gaps and generate the critical information and data required to inform timely adaptation planning.
- Assess the vulnerability of sectors to specific climate-induced impacts, including increased incidence of disease (e.g. malaria, meningitis), extreme heat stress, drought and flooding.
- Undertake critical technical information/data needs assessment for key sectors to determine what equipment, information and data is required in order to enable decision-makers to revise existing relevant policies, strategies and plans to incorporate climate change (CC) considerations.
- Allocate resources to each affected key line ministry in order for them to undertake technical needs assessments, assess economic risks, undertake climate risk assessments, construct inundation risk maps and collect meteorological data. Sufficient resources will also be allocated for policy revision capacity building (as outlined in later outputs).
- Incorporate CC risk assessment and adaptation into policies, strategies, legislation and investment decisions.
- Undertake a cost-benefit analysis, investigating the cost of future climate change without the implementation of adaptation measures (i.e. the business-as-usual scenario) versus the cost of adaptation measures.

### *Ethiopia*

- Assess local knowledge systems for environmental management in selected Woredas and integrate with best practices and climate information.
- Undertake financial risk assessments of CC for priority sectors.
- Establish databank of all CCA projects and initiatives in Ethiopia.
- Technical and financial support for the generation of evidence from target demonstration areas for assessing the vulnerability of communities in different agro-ecological zones and climate variability and risk assessments.
- Building on enhanced climate capacity, disseminate climate information to inform planning and investment programmers.

### *Gabon*

- Acquire, rehabilitate and operationalise weather stations and data processing systems to produce information on climate trends.
- Complete an integrated model of CC impacts on coastal areas.



## ANNEX 2

### *Ghana*

- Establish systematic, standardized process to collect, assess and share data, maps and trends on hazards and vulnerabilities.
- Implement community vulnerability assessments that integrate gender, disability, access to infrastructure, economic diversity and environmental sensitivities in 3 pilot areas where climate risk is high.
- Integrate climate information and CC projections into the risk assessment, monitoring and warning services in the pilot areas and at national level.

### *Kenya*

- Support provided for key priority sectors to conduct targeted needs assessments and identify issues and options for improving their long-term planning mechanisms to contribute to implementation of the National Climate Change Strategy.
- Support the establishment of systems to enable data and information to be organized, processed, quality controlled and shared amongst stakeholders in a way that they can usefully interpret and use.
- Access improved forecasting information to strengthen and scale-up existing early warning systems to support local knowledge system.

### *Lesotho*

- Develop an environmental health information and disease monitoring system (GIS based) specifically for plague, malaria and bilharzia.
- Design, set up and develop mechanism for sustainable maintenance of a web-based knowledge platform.

### *Malawi*

- Deliver training to key stakeholders on evaluating market-based, fiscal and financial instruments, preparing relevant datasets, undertaking economic analysis and piloting of innovative financing instruments.
- Provide technical and administrative support to institutions to use climate risk assessments as part of the planning process.

### *Mauritius*

- Identify gaps and generate the critical information and data required to inform timely adaptation planning.
- Undertake technical needs assessments of all sectors to determine what technical and methodological tools and information/data is needed.
- Undertake climate risk assessments for vulnerable areas such as coastal zone.
- Allocate resource to each affected key line ministry to undertake technical needs assessments, assess economic risks, undertake climate risk assessments, construct inundation risk maps and undertake ecosystem services assessment.
- Disseminate climate information to relevant ministries to drive budgetary amendments and like policy to financing of solutions.

### *Morocco*

- Provide institutions with the tools, information and skills to acquire and analyze information in a decentralized climate.
- Compile existing information on risk and vulnerability in Morocco and in oasis and complete vulnerability assessments by an analysis of risk perception by the communities. This analysis will be conducted on the basis of existing information using structures and local associations.
- Conduct a downscaling of climate models for the oasis zone. This action will be entrusted to the Directorate of National Meteorology and will be conducted according to the methodology already tested for the catchment area of Souss-Massa, in order to provide the authorities and communities a clearer scenario on the effects and impacts of expected CC at the oasis.
- Provide technical means and human resources to model water resources, integrating data from projected climate-through training and acquisition of modeling tools data.



- Training on climate risk management for the integration of CC to regional plans, such as schemes of regional planning, master plans and integrated management of water resources and the National Strategy for Oasis.

### *Mozambique*

- Conduct three risk assessments following up on the National Disaster Management Institute (INGC) study recommendations.
- Use knowledge of CC risks and response options to enable integration of adaptation into policy documents, including through the development of mainstreaming guidelines.

### *Namibia*

- Develop GIS based risk assessment tools (e.g. flood risk maps).
- Undertake specific gender vulnerability assessment, and address finding in future programming of flood responses.
- Establish relevant early warning systems and information centres to make climate data more accessible. These will be established in high-risk areas and incorporated into ongoing government service.

### *Niger*

- Identify climate change information and data needed for analyzing climate change risks in key sectors at national and provincial levels with active stakeholder engagement.
- Assess economic, social and environmental impacts of climate change. Appropriate tools to inform the assessments may include systems modelling (e.g. Threshold 21) and cost-benefit analyses.
- Incorporate CC risk assessment into policies, strategies, legislation and investment decisions.

### *Nigeria*

- Design and set up a national CC knowledge platform that will serve as a repository for data and studies to support information and data sharing.
- Collate existing studies on CC impacts, vulnerability and analysis.

### *Rwanda*

- Identify existing data and information systems in key sectors (infrastructure, agriculture, natural resources and health).
- Identify gaps on CC related data for these priority sectors.
- Create a database system/information centre on CC within the project coordination unit.
- Comprehensive analysis of sectors and national policies and programmes to assess climate resilience and adaptation needs.
- Develop sector specific plans of how to address CC and mainstream CCA into various sector policies, budgets and strategic plans.

### *Sao Tome Principe*

- Assess current information availability and analyze current meteorological capacity to inform development of national and regional baseline on CC.
- Develop new CC platform with online and face-to-face information sharing opportunities.
- Assess current information availability and analyze current meteorological capacity to inform development of national and regional baseline on CC.
- Establish plan for information-sharing activities, working closely with Committee on Climate Change.



### *Senegal*

- Complete technical and scientific information and data gap-analysis for CCA - with a specific focus on sea level rise (SLR), agriculture and water sectors. Many data deficits have already been identified (e.g. inundation mapping).
- Fine-tune critical climate change modeling e.g. of SLR (inundation mapping) and collate downscaled CC information for use in decision-making.
- Undertake an in-depth socio-economic and environmental analysis comparing the costs of the business-as-usual versus the costs and benefits of early adaptation action (e.g. using cost-benefit analysis, systems modeling and/or other tools).
- Conduct climate risk assessments in key sectors, particularly for coastal zones and agriculture.
- Conduct a vulnerability assessment to identify current vulnerability and coping strategies, adaptation interventions and measures.

### *Tanzania*

- Strengthen capacities of Tanzania Meteorological Agency; National Environmental Management Council; other research institutions; ministries, departments and agencies; and local government authorities in CC data collection, analysis, dissemination and development of planning tools.
- Conduct a capacity needs assessment and develop long-term capacity building plans for research institutions on CCA data collection, analysis and packaging of results of targeted sectors and ministries, departments and agencies.
- Gather socio-economic data from University of Dar es Salaam, Sokoine University of Agriculture, National Environmental Management Council and others for adaptation planning by ministries, departments and local government agencies. This data will be consolidated with climate information to understand climate risks and vulnerabilities.

### *Tunisia*

- Consolidate all CC data, information and related research through government scientific institutions and private sector.
- Identify existing institutions, research centres, academic research units, observatories, the meteorological institute, ministries and various technical service organizations that are, or could be, involved in a coordinated mechanism/network for climate monitoring and forecasting in Tunisia.
- Determine the best institutional arrangement such as technical network, for the operationalization of a climate forecasting and monitoring function that is based on collaboration and creates institutional incentives for data and information sharing.
- Harmonize data, protocols and methodologies for CC risk assessments in coastal areas to promote the integration of climate risk consideration in coastal land use and investment decisions.
- Introduce GIS based risk assessment tools for key decision-makers at local and national levels.
- Review the applicability and introduce a set of existing coastal risk assessment tools such as Dynamic Vulnerability Assessment, Community Vulnerability Assessment and Coastal Zone Simulation Model.
- Promote the use of satellite remote sensing technologies and data with spatial hydrological models to support cutting-edge water resource planning, monitoring and management in coastal regions that are at risk from sea water intrusions into ground water.





**United Nations Development Programme**

Environment and Energy Group  
304 East 45th Street, FF-944  
New York, NY 10017  
Tel: 1 (212) 906-6387

**For more information:** <http://www.undp-adaptation.org/africaprogramme/>