BRIEFING

Climate Change Challenges for Africa:

Evidence from selected Eu-Funded Research Projects

April 2012

Summary

Africa, while currently responsible for a negligible amount of total global greenhouse gas emissions, is under significant threat from climate change. Changes in precipitation levels, likely increase in temperature extremes and rising sea levels will have a wide range of direct and indirect impacts on Africa.

In order to adapt to these future climate challenges, it is important for decision makers in Africa to help reduce the negative consequences for society and, in particular, to protect vulnerable groups. Referring to sound research, it is necessary to understand what the future changes to the climate are likely to be, how impacts will be distributed across different regions, the direct and indirect impacts of these changes, and the appropriate adaptation responses to these impacts. Past and ongoing projects funded through the EU's Research Framework Programmes are contributing to this understanding thus helping to improve the capacity of African institutions to make informed decisions for future adaptation to climate change.

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Produced by: UNEP Division of Communications and Public Information

These projects also highlight the potential for Africa to benefit from low carbon development, and to harness the benefits associated with carbon sequestration. Investment in REDD projects in particular could allow Africa to contribute to international mitigation efforts through market-based instruments such as the Clean Development Mechanism.

This briefing explores the challenge of climate change to Africa, underlining the role of research conducted under the EU's Research Framework Programmes in understanding future climate change in Africa and the impacts that this change might have. It highlights Africa's current vulnerability to climate change, its existing level of adaptive capacity, and the role that EU-funded research projects can play in contributing to solutions to the current situation. The briefing further discusses how certain projects undertaken as part of EU-funded research can help reduce gaps in adaptive capacity while also facilitating African access to mitigation opportunities. It is intended to help familiarize decision makers with the on-going work of the EU in addressing climate change in Africa.

INTRODUCTION

Due to its current level of economic development, Africa is highly vulnerable to the impacts of climate change which threaten to stall or reverse its efforts on food security, human health and broad-based economic growth and development by mid-century. However, Africa only accounts for a small share of global greenhouse gas emissions – just under 7% in 2005 – and has contributed even less to historic emissions.[1] An effective global agreement to limit emissions and to mitigate the impacts of climate change is, therefore, of paramount importance to Africa.[2]

Africa requires financial resources and technical capacity to adapt to the impacts of climate change, and to develop appropriate low carbon technologies. A recent World Bank study estimated that it will cost developing countries between US$75 and 100 billion per year to adapt to a temperature change of approximately 2°C by 2050. For Sub-Saharan Africa, estimated annual adaptation costs are US$14-17 billion, corresponding to roughly half the amount of Official Development Assistance provided for all of Africa in 2010.[3] According to statistics published by the Organization for Economic Cooperation and Development, US$29.3 billion in bilateral assistance was provided to Africa in 2010.[4] Some economists predict that in order to achieve "climate resilient" Millennium Development Goals over the whole continent, Africa will require US$100 billion a year in the 2010-2020 period with approximately US$82 billion required for standard development assistance, and an additional US$11-21 billion for adaptation.[5]

The EU continues to play a significant role in supporting Africa in understanding and coping with the impacts of climate change. Cooperation between the EU and Africa has been established as part of multilateral initiatives such as the European Neighbourhood Policy established in 2008 – including countries in North Africa; the Cotonou Agreement concluded between the EU and the 77 countries in Africa, the Caribbean and the Pacific; the EU-Africa Joint Strategy established through the Lisbon agenda in 2007.[6] These initiatives are further complemented by the work of the Science and Technology for Development Programme which has been supporting research in Africa since 1983.[7] Funding as part of this programme has resulted in the conclusion of a number of projects administered by DG Research.

Written by Jane Desbarats, this briefing explores the potential for research funded through DG Research to further the understanding of Africa's exposure to climate change, and its ability to cope with climate change impacts. The potential for DG Research funding to minimise the cost of climate change could also have implications for future policy measures forming the basis of international cooperation between the EU and Africa, financial contributions to scientific research and Official Development Assistance.

This briefing provides an overview of the impacts of climate change in Africa, possible ways to adapt and mitigation techniques such as the potential for

carbon sequestration. All sections reflect the findings of research projects and give concrete examples of what is being done to adapt to climate change in the region. The policy implications of all types of projects are provided as part of the briefing conclusions. Full project name and website details for all EU Framework Programme (FP) projects mentioned in this briefing are provided in Annex.

EU–Funded Climate Change Research in Africa

Under the EU Sixth and Seventh Framework Programmes (FP), a total of €146 million has been made available to 1241 participants for research projects in Africa. The budget allocated to the Africa 2010 call for tender, for example, was 63 million.[8] These projects have explored the following climate change related research: mitigation and carbon sequestration potential; modelling climate change uncertainties and projected impacts; increasing knowledge base of climate change impacts; improved earth observation and monitoring; impacts on water availability; impacts of transport on climate change (and vice versa); the impact of climate change on agriculture and hence food security; impacts of climate change on health; impacts of climate change on natural resources and ecosystems; and work to quantify the cost of climate change impacts and response measures.

IMPACTS OF AND VULNERABILITY TO CLIMATE CHANGE IN AFRICA

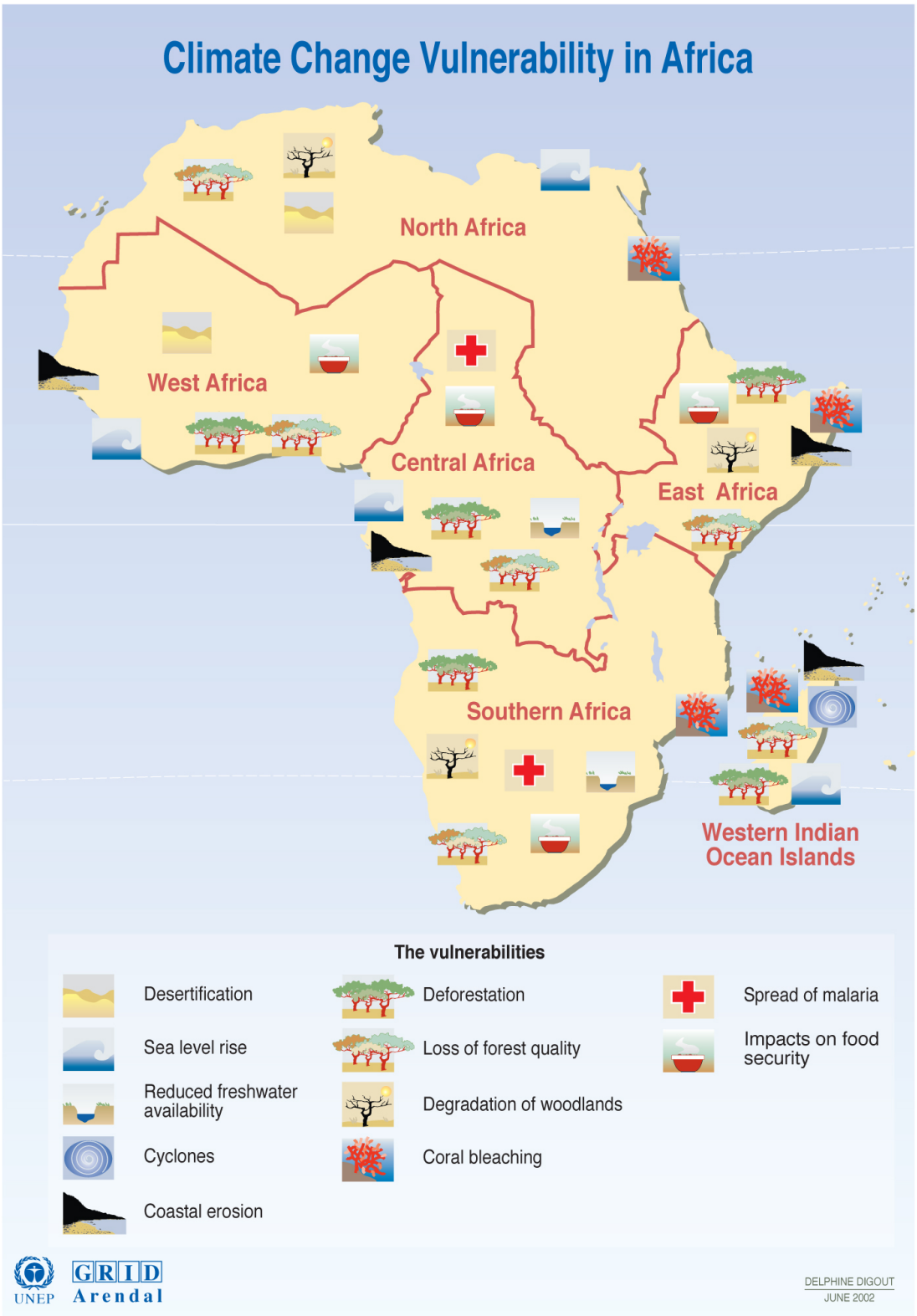
There are a number of issues to consider when describing the range of impacts of and the underlying vulnerability to climate change in Africa. In addition to regional variability, there are manifold challenges associated with the ability of current models to project the likelihood of heat extremes and precipitation events, which is expected to have secondary impacts on economic development.

The Special Report Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) shows how the likelihood of extreme weather events is expected to increase, while also illustrating the range of impacts throughout Africa.[9] The Summary for Policy Makers released by the IPCC in February of 2012, indicates that while eastern Africa is expected to face more extreme flooding events, western and southern Africa are likely to suffer from increased drought events.[10] Research completed by other climate experts emphasizes the notion that the variability in direct impacts manifests itself in a broad range of secondary or indirect impacts, that include: the increasing spread of vector-borne diseases such as malaria and dengue; sea level rise that will affect areas such as the Nile Delta, and hotter and drier conditions giving rise to desertification and declines in agricultural productivity in some areas.[11] Figure 1, below, illustrates more of Africa's key climate vulnerabilities. This section outlines the key impacts of climate change in Africa – drought, water scarcity and flooding, and threats to food security and health – and what DG Research projects are doing to provide a better understanding of the problems and to give possible solutions.

Drought and Water Scarcity

Increased temperatures and a greater likelihood of extreme weather events resulting from climate change will no doubt increase the threat of drought and increased water scarcity in Africa. As a way to combat this, FP projects like CLIMB, CLICO and WASSERMED have looked at improved hydrological modelling in order to assess the risk of increasing water scarcity and the threat to human security. The CLICO project looked at the risks of both drought and flooding in Sudan, noting the impact on food security, and their ability to exacerbate existing regional conflicts. Despite these challenges, the AIDA FP6 project indicated that agricultural innovation in drought-prone areas has the potential to improve crop yields.

Figure 1: Overview of Climate Change Vulnerability in Africa



Sources: Anna Ballance, 2002.

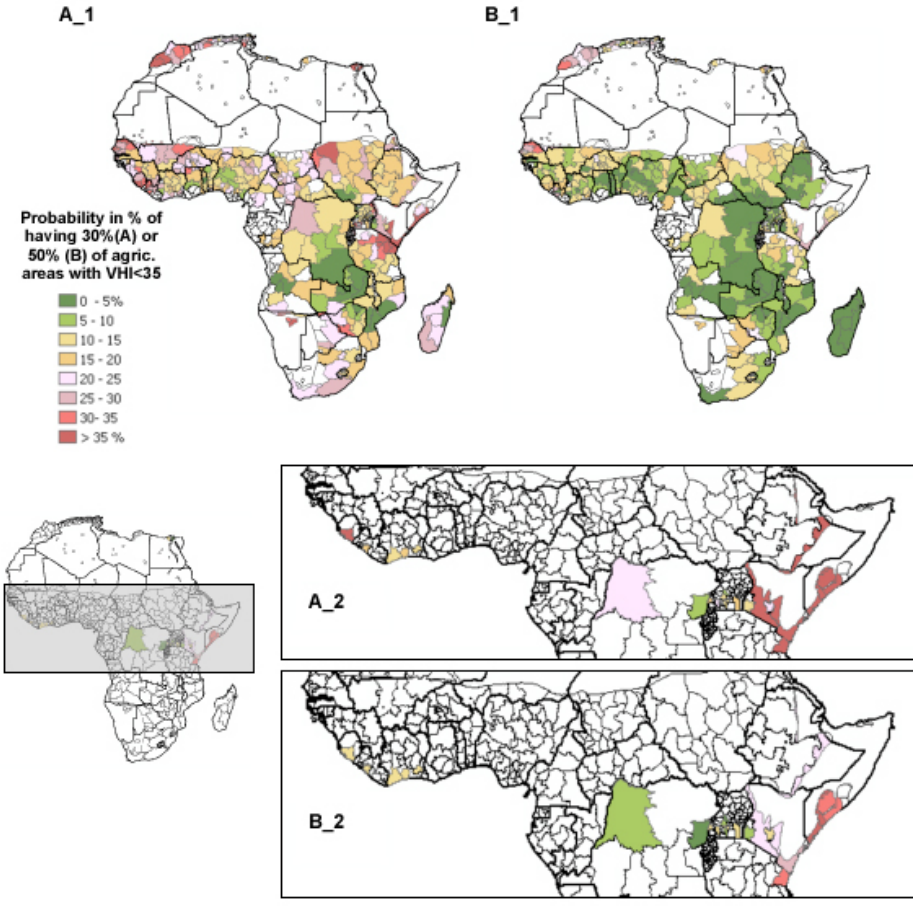
Source: Anna Ballance, UNEP/GRID-Arendal, 2002, Cartographer/Designer: Delphine Digout, Revised by Hugo Ahlenius.

Assessing Drought Risks for Agricultural Areas in Africa

The CLIMAFRICA project has developed a novel method for calculating the probability that a significant proportion of the total agricultural area will be affected by drought at the sub-national level using drought intensity indicators derived from the Vegetation Health Index. This proved to be a valid indicator for the African continent as vegetation health was highly correlated to drought events during the 1981-2009 period.

In practice, two thresholds relating to water scarcity and drought can be set: when 30% of the total agricultural area is affected by drought, a large number of agricultural households experience its consequences; when more than 50% of this land is affected, the region is faced with an extreme drought event with serious impacts on regional food security. Figure 2 below shows the probability of exceeding these thresholds. With this method several local "hot spots" of agricultural areas at high risk of extreme drought were identified. These areas are: Tensift and Centre in Morroco, Brakna in Mauritania, North Darfur in Sudan, Semenawi Keih Bahri in Eritrea, Coast and Eastern in Kenya, Manyara, Tanga, Arusha and Kilimanjaro in Tanzania, Juba Hoose, Juba Dhexe and Shabelle Hoose in Somalia, Kaabong and Kiruhura in Uganda, Southern in Sierra Leone, Gbarpolu in Liberia and Otjozondjupa in Namibia (Fig. 2-A1).

Figure 2: Empirical probability of occurrence of having more than 30% (a_1, a_2) or more than 50 % (b_1, b_2) of the agricultural area affected by drought by administrative unit (1) during the first crop season (2) during the second crop season.

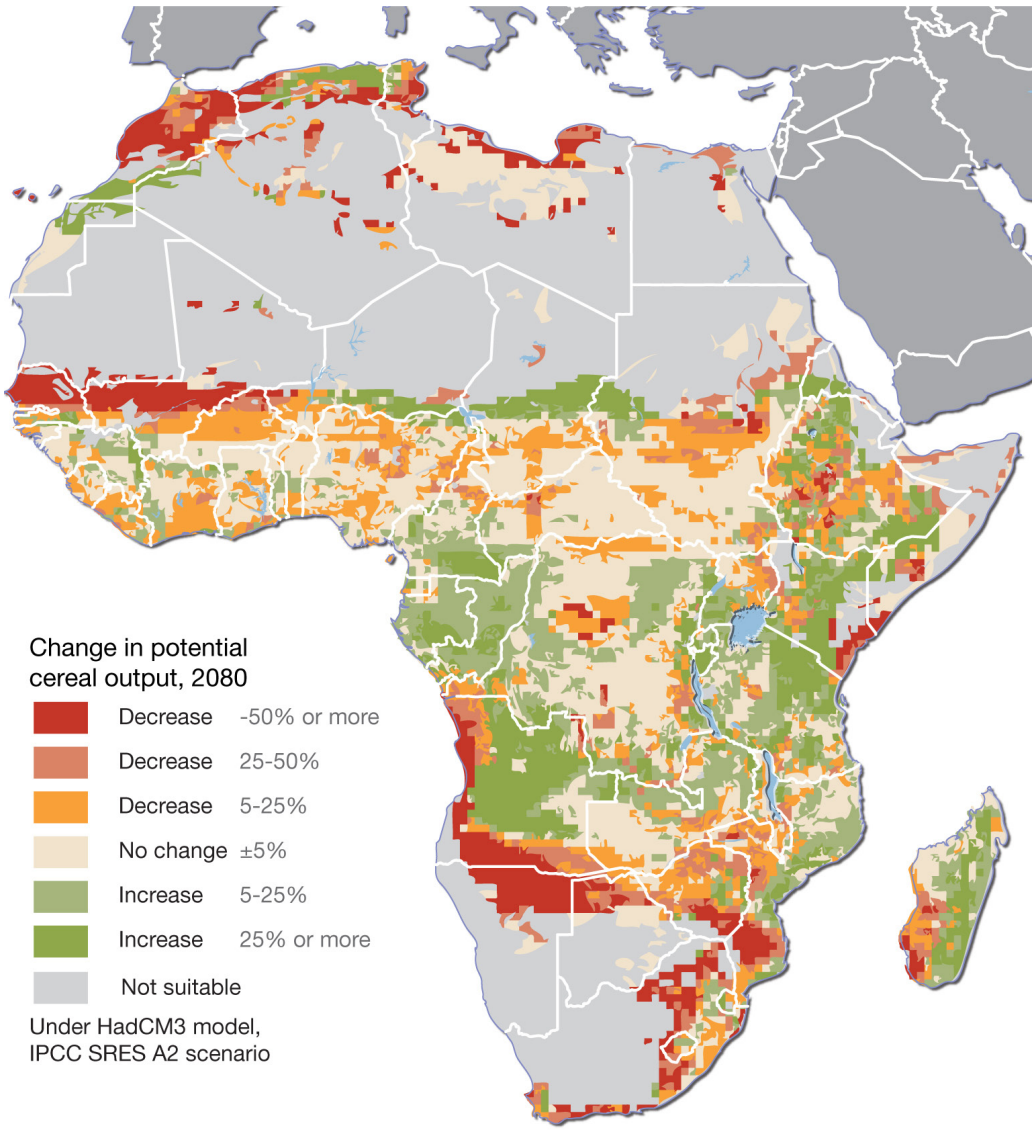


Source: Rojas O., Vrieling A., Rembold F., 2011. Assessing drought probability for agricultural areas in Africa with coarse resolution remote sensing imagery. Remote Sensing of Environment, 115 343–352.

Food Security

One of the indirect impacts of climate change associated with increased drought and water scarcity is the threat to agricultural production. The need to address food security in light of these impacts is highlighted by the International Food Policy Research Institute, whose research shows how climate change in Sub-Saharan Africa may decrease crop yields and increase food prices thus reducing the affordability of food and potential caloric intake, potentially resulting in increased rates of childhood malnutrition.[12] Furthermore, scenario analysis undertaken by the Food and Agriculture Organization (FAO) indicates that by 2080, Gross Domestic Product from agriculture could decline in Africa from 2 to 9%. The FAO stresses that changes in agricultural practises will be required to respond to these impacts including changes to crop species, new irrigation techniques, the use of different fertilizer inputs, seasonal changes and sowing dates.[13] The specific predicted changes to the production of cereals (positive and negative) are illustrated in Figure 3.

Figure 3: Projected changes in cereal productivity in Africa, due to climate change – current climate to 2080



Source: Fischer, G., Shah, M., Tubiello, F.N., van Velhuizen, H. 2005. Socio-economic and climate change impacts on agriculture: an integrated assessment, 1990–2080. Philos Trans R Soc Lond B Biol Sci. 2005 November 29; 360(1463): 2067–2083, http://maps.grida.no/go/graphic/projected-changes-in-cereal-productivity-in-africa-due-to-climate-change-current-climate-to-2080

Health

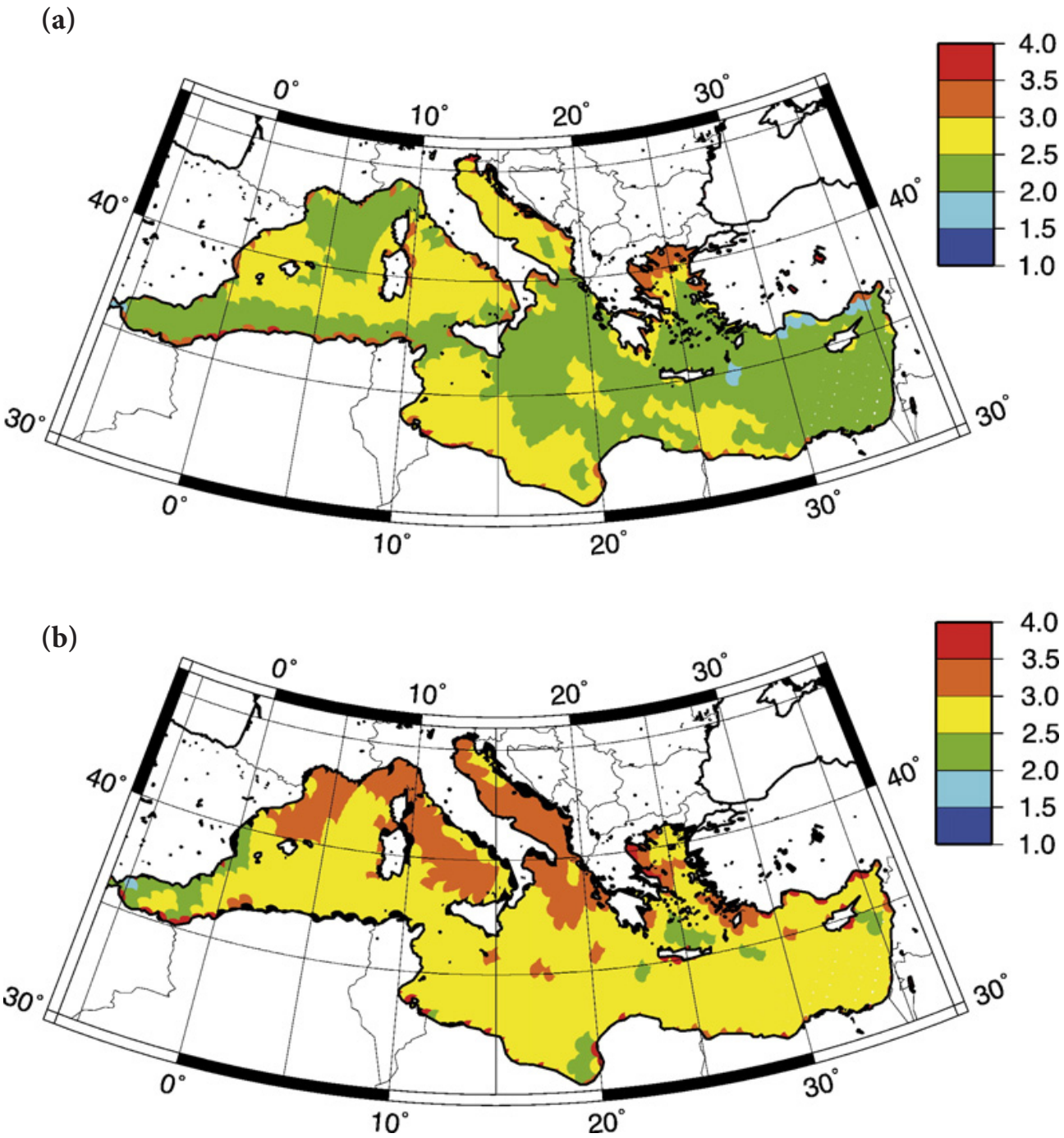
The World Health Organization (WHO) is exploring the relationship between climate change, poverty, and the spread of infectious diseases. A number of FP 6 and 7 projects also highlight the importance of developing the evidence base to support this relationship. These projects aim to provide specific examples of how the impacts of climate change throughout Africa have expanded the spread of infectious diseases to a vulnerable population. The WHO maintains that the indirect impacts of climate change on health are not the result of isolated extreme weather events, but of the gradual erosion of "natural, economic and social systems that sustain health, and which are already under stress in much of the developing world." Vector-borne diseases such as malaria, and infections associated with under nutrition, are likely to spread with climate change affecting those who lack access to affordable food, clean water, and who are already suffering from medical conditions.[14]

Similarly, the HEALTHY FUTURES PROJECT pays close attention to the impact of water scarcity on the spread of vector borne diseases. The project consortium includes universities and research institutes in Tanzania, Kenya, Rwanda and Uganda, (in addition to those in the EU), and will serve to map both the spread of diseases in relation to the areas that are most vulnerable to the disease. The WETwin project developed a methodology to better integrate the prevention of water-related diseases in wetland and river basin management plans referring to the Inner Niger Delta in Mali. In the same vein, the QWECI project, involving a number of academic institutes in Senegal, Ghana and Malawi, determined that in the case of rift valley fever, the spread of the disease is facilitated by changes in standard weather patterns that can be brought on by climate change, and that the implementation of an early warning system could reduce the time lag between outbursts of the epidemic and the required response measures. The EDEN project focuses on the interaction between climate and ecosystems and the ability of this interaction to influence the spread of human pathogens throughout Europe, North and West Africa.

Flooding

Climate change is also expected to increase the risk of flooding in Africa. The FP6 project CIRCE looked at climate change impacts in the Mediterranean region (including North Africa) and outlined a framework for action given the urgency of the issue. Figure 4 shows that the overall temperature in the Mediterranean is expected to increase from 2 to 4°C and levels of precipitation from 10% to 50% by the 2080s; the impacts in North Africa are expected to be greater with temperature increases in the range of 5 to 8°C.[15] The vulnerability of specific areas to flooding in the following developing countries was further explored as part of individual case studies: the Gulf of Oran in Algeria, the Gulf of Gabes in Tunisia, and the Western Nile Delta in Egypt. In Algeria, the risk of increased flooding and sea level rise is complicated by the lack of effluent treatment, and the importance of three major harbours to the national economy. In Tunisia, the significance of tourism and the fishing industry is underlined, while in Egypt the relationship between sea level rise, coastal erosion and agriculture is deemed equally problematic for socioeconomic development.

Figure 4: Atmosphere-Ocean General Circulation Model response to the climate change for the 30-year average sea surface temperature (in °C) between the 2070–2099 period and the 1961–1990 period (a) in winter and (b) in summer



Source: Hertig and Jacobeit, 2007; Somot et al., 2007, based on the A2 scenario

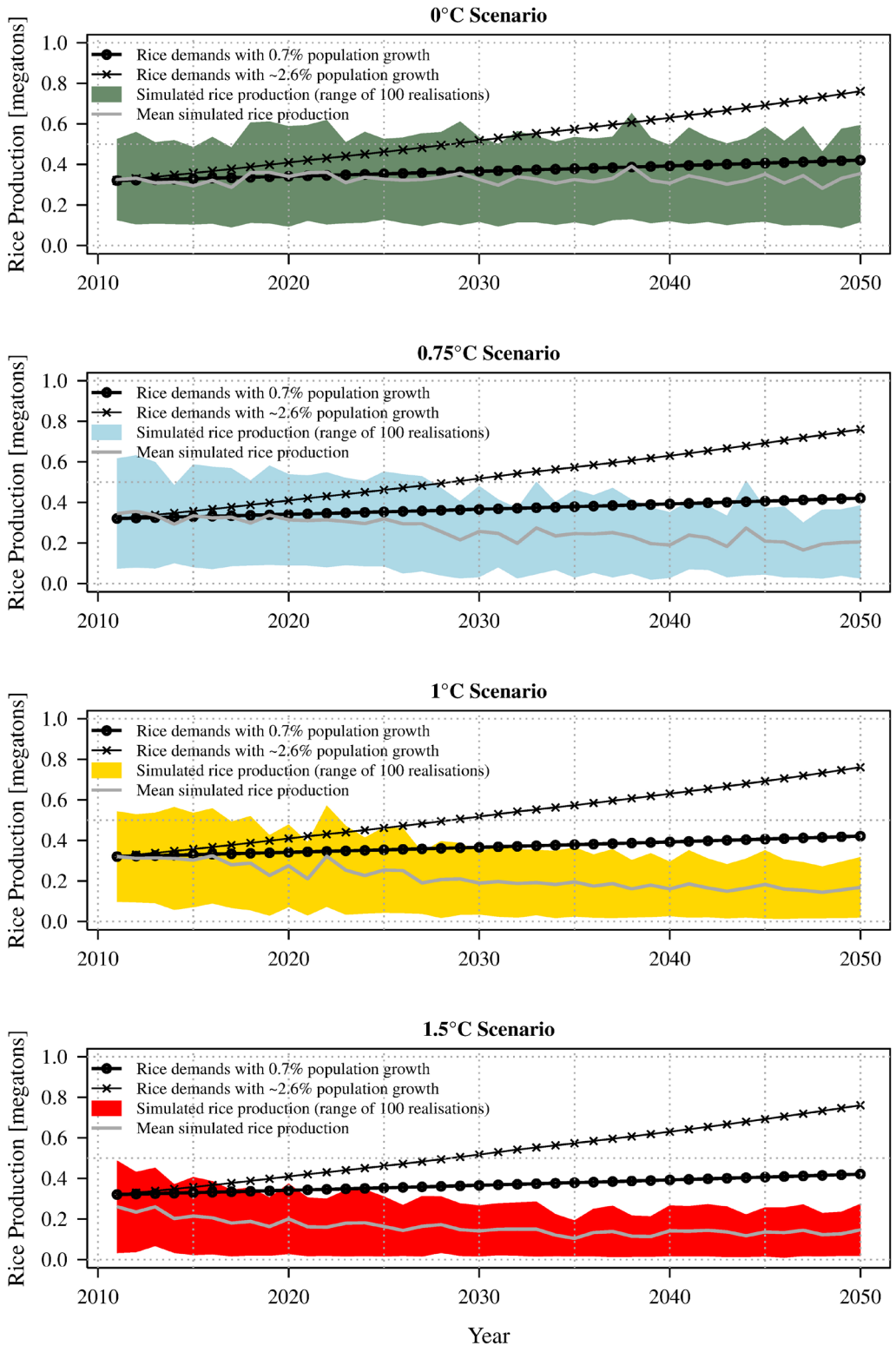
ADAPTING TO CLIMATE CHANGE IN AFRICA

African people face increasing threats to their health, their access to water, and their ability to produce enough food. FP 6 and FP 7 research projects are not only contributing to efforts to identify and understand these impacts, but also to provide solutions to adapt. There are a number of conceptual paradigms to consider in assessing Africa's ability to respond to the impacts of climate change, but all agree that Africa will need to raise its overall level of "adaptive capacity" in order to implement a suite of different adaptation measures, with the end goal of increasing Africa's overall "resilience" to climate change.

According to the IPCC, the term "adaptive capacity" represents "the ability of a (human) system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."[16] In the EU, the development of robust early warning systems, efficient disaster relief, the development of national adaptation strategies and the implementation of adaptation measures, are all indicators of higher levels of adaptive capacity. In Africa, the limited availability of comprehensive and implementable adaptation policies at the national level prevent government bodies from responding in a similar way, and therefore reduce their adaptive capacity. However, research shows that there are effective ways for Africa to increase its adaptive capacity and that these measure will help the continent to respond to the impacts of climate change, as highlighted by the WETwin project in the box below. DG Research projects are investigating the specific adaptive measures that African countries can take, such as integrated management policies, early warning systems and better information gathering, in order to respond to the impacts of climate change in the region.

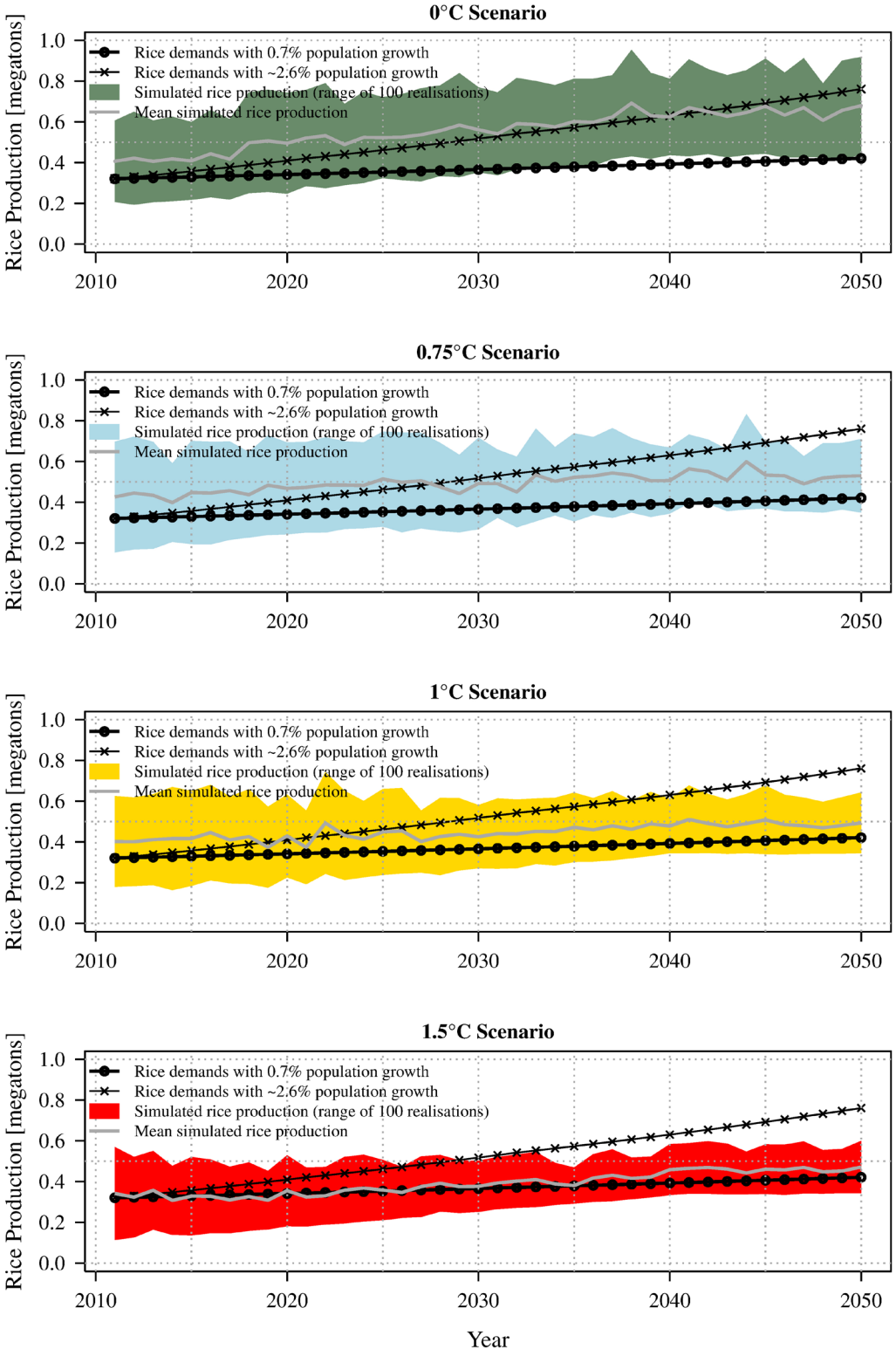
The WETwin project downscaled projected impacts of climate change to river basins and consequently assessed, based on storylines, the impact of climate change (combined with endemic poverty and population growth) on important ecosystem services such as food production, flood regulation and ecosystem integrity for wetlands/river basins in Uganda, Mali and South Africa. In the Inner Niger Delta, increasing temperature and decreasing rainfalls have very large and negative impacts on food production, especially if we consider the estimated population growth and consequent increased demand for food. Figure 5.1 indicates the impact of increasing temperatures on the mean production of rice. The main conclusion to be drawn from this data is that, without adaptive measures to balance out the effect of climate change on a growing population, food production will not be sufficient. Figure 5.2, however, shows how adaptive measures, such as water management, can have a positive impact on mean rice production, even with increased temperatures. The difference between business as usual and adaptive measures to counteract the effects of climate change on population growth and food production is juxtaposed in Figure 5.3. The recently started AFROMAISON project will continue along these lines and will develop adaptation strategies for integrated natural resources management in a broad variety of eco-regions in Africa (Ethiopia, Mali, Uganda, South Africa and Tunisia). DG Research projects are investigating the specific adaptation measures that African countries can take, such as integrated management policies, early warning systems and better information gathering, in order to respond to the impacts of climate change in the region.

Figure 5.1: Vulnerability of rice production in the Inner Niger Delta to water resources management under climate variability and change



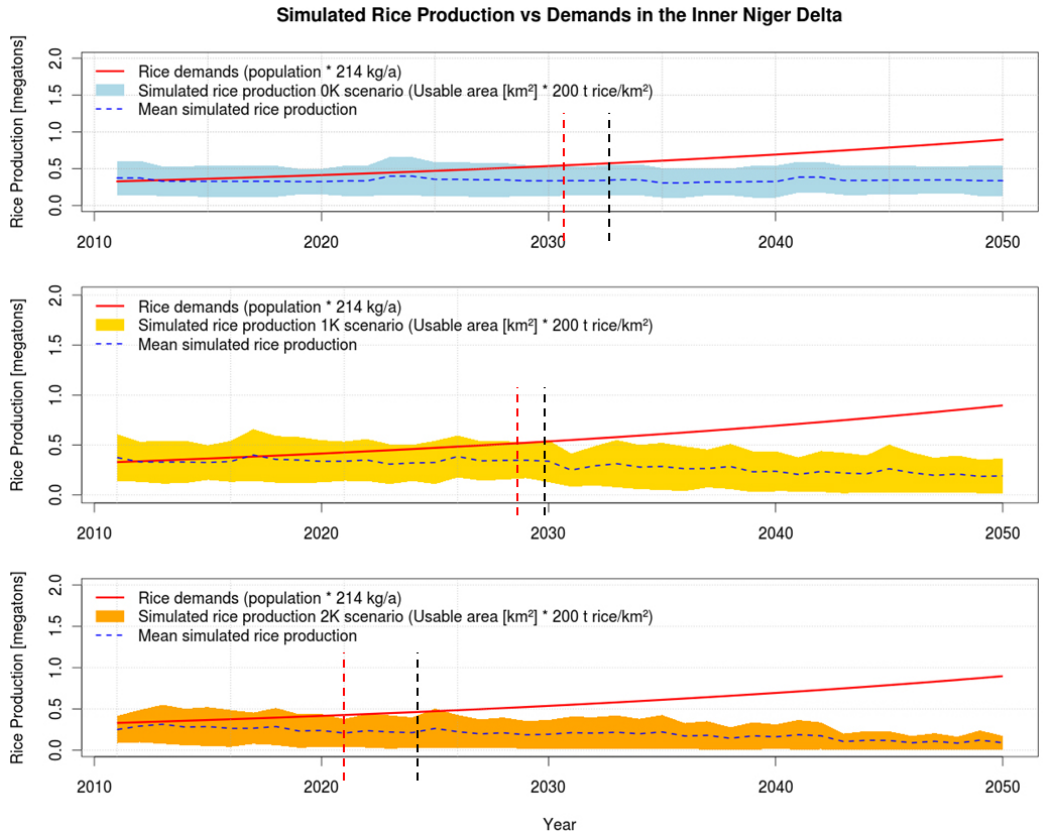
Source: S. Liersch, J. Cools, B. Kone, H. Koch, M. Diallo, V. Aich, S.Fournet, F.F. Hattermann (2012). Submitted to Environmental Science & Policy.

Figure 5.2: Vulnerability of rice production in the Inner Niger Delta to water resources management under climate variability and change



Source: S. Liersch, J. Cools, B. Kone, H. Koch, M. Diallo, V. Aich, S.Fournet, F.F. Hattermann (2012). Submitted to Environmental Science & Policy.

Figure 5.3: Vulnerability of rice production in the Inner Niger Delta to water resources management under climate variability and change



Source: S. Liersch, J. Cools, B. Kone, H. Koch, M. Diallo, V. Aich, S.Fournet, F.F. Hattermann (2012). Submitted to Environmental Science & Policy.

Integrated Management

The number of DG Research projects that have been undertaken to assess the range of climate change impacts throughout Africa, and the appropriate response measures, contributes to an enhancement of Africa's adaptive capacity. Carefully designed management systems are shown to be effective in responding to these impacts. A variety of different solutions will be required to address the variability of impacts in the different regions, particularly given the potential for the impacts of climate change to affect a number of different sectors. For example, the WETwin project, in cooperation with the Twin2go project, has developed a methodology to quantify the adaptive and institutional capacity in the context of wetland and river basin management. The methodology allows experts to evaluate the current state of the environment, the impact of solutions and to provide a monitoring strategy for these management policies.

In addition to considering the impacts of climate change, the CIRCE project has explored the complexity of water management in the context of a changing climate.[17] Given the importance of agriculture to all countries and the need for water resources, climate change and water scarcity may lead to a greater stress on water resources, with increasing competition for water among parties in other sectors such as energy and tourism. This work underlines the importance of bridging the gap between existing understandings of business as usual water management practises, and the potential for adaptive measures to respond to the impacts of climate change. Reducing this knowledge gap will require the following actions: expanding the scope of stakeholder engagement; increasing levels of finance; undertaking the appropriate knowledge transfer between stakeholders; strengthening the knowledge base of decision makers; and improving water metering techniques to monitor changes in water usage. In essence, it requires improving the level of adaptive capacity.

The NeWater project, promotes the "Adaptive Integrated Water Resources Management (AWM)" tool. Water scarcity and the implementation of adaptation measures are reviewed in the context of river basin management and the applicable socio-economic considerations among many project partners from Europe, Africa and Central Asia. The project highlights the need for integrated water management with shared river basins that cross national boundaries. This issue is reviewed in the context of a number of different regional case studies including the Orange River Basin, which flows through South Africa, Lesotho, Namibia and Botswana. This illustrates the complexity of managing potential water scarcity given the underlying characteristics of the watershed. From an economic standpoint, the river basin is located within a major "economic hub" for South Africa, leading to increasing demands for water resources from the river.[18] This case study underlines the fact that anticipated water scarcity associated with climate change is likely to be further exacerbated by a lack of appropriate tariffs and infrastructure for water metering. Both the NeWater and Circe projects illustrate integrated natural resources management systems but stress the need for on-going financial assistance to guarantee the successful implementation of adaptation measures.

Information Gathering and Early Warning Systems

Addressing research and operational capacity in regional modelling of climate change, using decadal and seasonal modelling, is crucial to build adaptive capacity in Africa. Clear data is used for science-based policies and effective management strategies. This is the underlying rationale of the CLIMAFRICA project that is currently working on improving both the decadal and seasonal modelling for drought events (particularly in Sub-Saharan Africa) and for precipitation patterns more generally. The outcome of this project, will serve to provide policy makers with improved decision making tools enabling a better understanding of the indirect impacts on the livelihoods of African citizens.

The AGRICAB project, which started in October 2011, will explore adaptation challenges in the agricultural and forestry sectors and the potential to implement the appropriate measures to respond to those challenges with a particular focus on water management, and improved earth observation techniques. DevCoCast increases access to environmental information by overcoming telecommunication limitations in developing countries. Both the AGRICAB and the DevCoCast projects serve to enhance Africa's adaptive capacity through the development of improved earth observation techniques and the provision of more accurate data related to both land use and the corresponding impacts of climate change.

Successful information gathering and earth observation techniques are not only useful for creating management strategies. They are also important for the development of early warning systems which will become more valuable as climate change will increase the likelihood of extreme weather events. For example, despite the monsoonal rains occurring from May to September, West Africa's agricultural base is still vulnerable to drought with implications for food security. With support from the World Climate Research program (WCRP) and the International Geosphere-Biosphere Programme (IGBP), the AMMA project has sought to upgrade the accuracy of forecasts for inter-annual precipitation levels.

In West-Africa, the monsoon season accounts for most of the total annual rainfall within a few months. Sub-Saharan African crop yields, water resources and livestock farming, which are strongly rainfall dependent, can therefore be greatly affected by the timing and the intensity of monsoon irregularities. In the framework of the AMMA project, and using available multi-year datasets, a broader understanding of intra-seasonal variability in the African monsoon has been achieved, although a comprehensive view is still lacking.[19] The project has shown that prediction and decision-support systems which provide better and more relevant information to stakeholders are possible today. In view of the large variability of the African climate at all scales, and the high vulnerability of the populations, strong and effective environmental decision-support systems are needed. To produce these climate services, West Africa needs denser observing networks and long-term monitoring of the environment.[20]

The DG Research projects reviewed for this briefing also indicate that information and communications technologies comprise potential adaptation measures by improving temperature forecasting, impacts mapping, and early warning systems used in the event of extreme weather. Research has previously been undertaken as part of the AIDA project (from 2008-2010) investigating the potential for such technologies in developing early warning systems in response to extreme weather events.

MITIGATION AND CARBON SEQUESTRATION

On a global level, the Clean Development Mechanism (CDM) established by the Kyoto Protocol is a market-based tool that promotes investments in low-carbon technologies and sustainable development in developing countries. The CDM promotes cost-effective emissions reductions in non-Annex 1 countries, financed by industrialised countries that can count 'certified emission reductions' credits against their Kyoto targets or EU Emissions Trading Scheme caps. In Africa, however, the CDM has had a relatively low profile compared to other regions, especially China (in 2009, credits from African CDM projects accounted for 7% of the market whereas China accounted for 72%), reflecting investment barriers in less developed areas.[21] Notwithstanding, the lack of CDM projects in Africa is also a factor of the nature of its economic development, with the CDM market favouring more cost effective reductions from larger infrastructure projects. The EU's decision to restrict CDM credits' validity in the Emissions Trading System (ETS) after the end of 2012 to those generated in least developed countries will give greater market share to Africa (33 out of 48 are in Africa).[22]

Complementing the CDM, financial support for low carbon technology transfer can be important for Africa. For example, the Africa-Europe Energy Partnership (AEEP) provides substantial support for African renewable energy capacity, thus contributing to the AEEP's goal of bringing modern and sustainable energy services to 100 million people by 2020.[23] Because nearly 50% of Africa's emissions come from the energy sector, support for low carbon energy alternatives could make a substantial impact.[24]

Compared to the global average, Africa's emissions profile is skewed towards emissions from agriculture and land use change. At the same time, a number of FP6 and FP7 projects consider the possibility that Africa may have underestimated the ability of the region to act as a global carbon 'sink'. The CarboAfrica project studied the carbon cycle and other greenhouse gases in Sub-Saharan Africa, evaluated the region's potential as a global carbon 'sink', and contributed to the development of local capacity for carbon monitoring. The project's results showed a higher than expected potential for carbon sequestration in the continent. Nevertheless, more research is needed to reduce the uncertainties in the estimates underpinning this conclusion. Additional efforts have been made to examine the role of climate in African ecosystems as part of the AFRICA-GHG project, which investigated the impact of African tropical forests on the global greenhouse gas balance.

Given the potential for the African continent to act as a carbon sink, the on-going negotiations on Reducing Emissions from Deforestation and Forest Degradation (REDD) could have great significance for African states. As a result, improved earth observation systems and other research developed through FP6 and FP7 projects can add scientific input to the political debate and will provide the evidence base necessary to underpin the integrity and permanence of potential REDD projects.

POLICY IMPLICATIONS AND CONCLUSIONS

The research projects reviewed in this briefing indicate that the impacts of climate change felt throughout Africa are extremely varied but all have the noted potential to exacerbate existing exposure of local populations to health issues, malnutrition and water scarcity. The key messages from the projects examining potential response measures indicate that there is significant scope to implement a number of adaptation measures, including improved water management, information and communications technologies, climate resilient agricultural practises, and early warning systems. From a mitigation perspective, there is potential to harness opportunities for low carbon development, and to explore the potential for carbon sequestration as part of avoided deforestation. However, while DG Research funding will help improve existing knowledge of climate

change impacts in Africa, thus highlighting areas in need of Official Development Assistance or humanitarian assistance, the results of a number of DG Research projects suggest the need for more systematic capacity building. The CIRCE project indicates that existing water management practises could help countries to cope with the impacts of climate change but that additional capacity building and technical assistance are required. Improving Africa's "adaptive capacity" will be crucial in order to develop and implement the appropriate response measures.

With respect to broader development assistance, interventions made on the part of the EU in Africa will respond to the impacts of climate change in two ways: ad hoc humanitarian assistance that responds to immediate climate-related crises, and on-going interventions that help to increase Africa's level of adaptive capacity over the long term. In the short term, the failure to address African exposure to climate change through the implementation of the appropriate responses may exacerbate existing health risks and food scarcity, thus requiring on-going humanitarian aid on behalf of the international community. Research completed by the Overseas Development Institute as part of their Africa Climate Change Resilience Alliance in 2010, suggests that failing to address African vulnerability to climate change may have indirect impacts on emigration and human security, possibly increasing the risk of regional conflict.[25]

Capacity Building

Adapting to and mitigating the impacts of climate change in Africa requires a long-term strategy which encompasses all of the key solutions listed in the main part of this briefing. This also involves developing the capacities of African scientific institutions, local governments, stakeholders, and civil society to help them understand the implications of climate change on droughts and water scarcity, flooding, food scarcity and health; this will give them the tools to cope with these impacts through adaptation and mitigation techniques such as advanced warning systems and integrated management strategies. Promoting cross-sectoral cooperation, sharing of experiences, and policies that facilitate integrated management strategies are all important aspects of capacity building. AfriCan CLIMATE, CLUVA, and AMMA are just some of the FP6 and FP7 projects that speak to the value of this approach and give concrete examples of what can be done.

AfriCAN CLIMATE, for instance, is developing a web-based knowledge platform where users from governments, institutions, and other organisations can find results from climate-related research implemented in Africa, and share their lessons learned and best practices. This platform acts as a long-term mechanism for capacity building by facilitating knowledge sharing among key stakeholders and policy makers.

After seven years of research in West Africa, the AMMA project has outlined a number of key areas where capacity building is needed in order to build decision-support systems as a response to monsoons in the region. To begin with, there is a need to train personnel to transform research results into operational tools, and for agencies that perform research and develop application models to be more involved in operational activities. Furthermore, because university programmes in environmental science are relatively weak, a sufficient number of students cannot be trained to the PhD level. AMMA concludes that research and technical communities should be expanded in universities and environmental agencies, and that an investment in research and educational programmes, and their application in West Africa, will greatly increase the adaptation potential of the region.[26]

These approaches all focus on capacity building and can thus be adjusted for use on different scales, regions, and impacts. The CLUVA project, for example, emphasises the need to improve the capacity of governments, institutions and civil society in order to effectively design and implement adaptation strategies to make cities facing the impacts of climate change more resilient. It uses specific case studies of selected cities in Africa to investigate the potential to use integrated interdisciplinary approaches to manage the impacts of climate change on urban areas such as sea rise level, erosion, flooding, drought, and desertification.

To conclude, FP6 and FP7 projects show that capacity building is an important medium- to long-term strategy that will help to operationalise what has been outlined by the research, and is also an effective tool for adaptation and mitigation. Initiatives such as these should continue to benefit from the support of both African countries and the EU as a way to increase adaptive capacity in the face of climate change.

RECOMMENDATIONS FOR FUTURE ACTION

Africa faces significant challenges from a change to the global climate. While international agreements to limit the drivers of future climate change will benefit Africa, the continent also has to take measures to adapt to likely future climate challenges. To do this, it is necessary to understand what future changes to the climate are likely to be – including regional variation, the direct and indirect impacts of these changes and the appropriate adaptation responses to these impacts. Each of these elements of a coherent adaptation strategy requires sound research. Projects funded through the EU's Research Framework Programmes, as well as other sources, are contributing to this understanding and are helping to improve the capacity of institutions to make informed decisions for future climate adaptation. However, uncertainties and gaps remain and further support will be needed in the future to enhance Africa's adaptive capacity by building on the foundation already established under the Research Framework Programmes and other global programmes.

The underlying theme for the majority of FP6 and FP7 projects discussed here is the need for more data collection and analysis. While a number of projects are looking at the possibility for improved methods, these projects are in the early stages, and have not yet provided the solutions necessary to implement early warning systems for example. Improved knowledge of the spatial distribution of the impacts of climate change would provide decision makers with the necessary data for the implementation of potential adaptation measures. With respect to future climate events, there is a need to develop suitable response mechanisms by applying better modelling and facilitating the use of more sophisticated satellite imagery. This will improve African institutions' adaptive capacity.

The primary recommendation for further research would be to investigate more thoroughly what data and monitoring equipment may be required at the local level in order to provide more robust predictions of extreme weather events. Similarly, African countries should have access to remote sensing data in order to respond to extreme weather events. Further research efforts could involve an assessment of local training and education needs required to interpret seasonal and decadal predictions, and to determine what infrastructure may be required to distribute this information to other interested stakeholders.

ANNEX: LIST OF SELECTED EU FP6 AND FP7 PROJECTS

- **AFRICA-GHG**: (ends March 2014) The role of African tropical forests on the Greenhouse Gases balance of the atmosphere: http://www.cmcc.it/research/research-projects/africa-ghg?set_language=en
- **The AfriCAN CLIMATE project:** (ends September 2014) The AfriCAN CLIMATE project will be developing an information sharing platform that will allow stakeholders to share information related to the implementation of FP7 projects in Africa: http://www.paueducation.com/en/content/african-climate
- **Afromaison**: (ends February 2014) will use sustainable, integrated natural resources management strategies to help communities and authorities in Africa adapt to the consequences of climate change: http://www.afromaison.net/
- **The AGRICAB project:** (ends March 2015) Developing a framework for enhancing earth observation capacity to support agriculture and forestry management in Africa: http://www.agricab.info/Pages/home.aspx
- **The AIDA project**: (project completed) Unlocking the potentialities of Agriculture In Africa's Drylands for fighting hunger: http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=9642387
- **The AMMA project:** (project completed) The Africa Monsoon Multidisciplinary Analysis project, see: http://www.ecmwf.int/research/EU_projects/AMMA/index.html
- **The CarboAfrica project:** (project completed) Quantification, understanding and prediction of carbon cycle, and other GHG gases, in Sub-Saharan Africa, see: www.carboafrica.net
- **The CIRCE project:** (project completed) Climate change and impacts in the Mediterranean: http://www.circeproject.eu/
- **The CLICO project**: (ends December 2012) Climate Change Hydro Conflicts and Human Security http://www.clico.org/
- **The CLIMAFRICA project:** (ends September 2014) Investigating the potential to project climate change impacts in Sub-Saharan Africa: http://www.cmcc.it/research/research-projects/climafrica?set_language=en
- **The CLIMB project:** (ends December 2013) Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modelling System: http://www.climb-fp7.eu/home/home.php
- **The CLUVA project:** (ends November 2013) investigating CLimate change and Urban Vulnerability in Africa: http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=11651157
- **The DevCoCast project**: (project completed) Improved Global Earth Observation Systems (more indirect relevance for Africa): www.devcocast.eu
- **The DEWFORA project**: (ends December 2013) Early warning and forecasting systems to predict climate related drought vulnerability and risks in Africa: http://www.dewfora.net/english/About
- **The EAU4Food project:** (ends June 2015) European Union and African Union cooperative research to increase Food production in irrigated farming systems in Africa: http://www.eau4food.info/
- **EDEN**: (project completed) Emerging Diseases in a Changing European Environment: http://www.eden-fp6project.net/
- **The HEALTHY FUTURES project:** (ends December 2014) The HEALTHY FUTURES project is motivated by the concern for these impacts. It aims to respond to this concern through construction of a disease risk mapping system for three water-related, high-impact VBDs (malaria, Rift Valley fever and schistosomiasis) in eastern Africa, taking into account environmental/climatic trends and changes in socio-economic conditions to predict future risk: http://www.healthyfutures.eu/
- **The NeWater project:** (project completed) New Approaches to Adaptive Water Management under Uncertainty: http://www.newater.info/

- **QWECI:** (ends July 2013) Quantifying WEather and Climate Impacts on Developing Countries: http://www.liv.ac.uk/qweci/#

- **SUSTAINMED**: (ends February 2013) Assessing the impact of EU and national policies to deliver Sustainable agri-food systems and rural development in the Mediterranean Partner Countries: http://sustainmed.iamm.fr/index.php/project-presentation

- **Twin2go**: (project completed) reviewed, assessed, and synthesized research projects on integrated water resources management in basins around the world. The project has analysed this information and consolidated it into a collection of policy briefing papers, best practices and guidelines on adaptive water governance systems: Twin2go.eu

- **The WAHARA project**: (ends February 2016) Water Harvesting for Rainfed Africa: http://www.wahara.eu/

- **The WASSERMED project**: (ends December 2012) Water Availability and Security in Southern EuRope and the Mediterranean: http://www.wassermed.eu/

- **WETwin**: (project completed) enhancing the role of wetlands in water resources management for river basins in the EU, Africa, and South-America: http://www.wetwin.net/

- **WHaTeR**: (ends December 2014) contributing to the development of water harvesting technologies in Sub-Saharan Africa: http://cordis.europa.eu/projects/index.cfm?fuseaction=app.details&TXT=WHaTeR&FRM=1&STP=10&SIC=&PGA=&CCY=&PCY=&SRC=&LNG=en&REF=99027

References

1. Fankhauser, S. & Ward, J. (2010) 'Regional implications of the AGF recommendations: Africa', Climate & Development Knowledge Network, Special Issue, November 2010.
2. The 2010 UNFCCC Cancun agreements commit to a maximum temperature rise of 2 degrees.
3. World Bank (2010), *Economics of Adaptation to Climate Change: Synthesis Report*, Washington DC.
4. OECD DAC, "Development Aid Reaches an Historic High in 2010", accessed at http://www.oecd.org/document/35/0,3746,en_2649_34447_47515235_1_1_1_1,00.html July 7, 2011.
5. Frankhauser, Sam, and Schmidt-Traub, Guido, From adaptation to climate-resilient development: The costs of climate proofing the Millenium Development Goals in Africa, February 2010, Grantham Research Institute
6. The Contonou Agreement is based on the principle that poverty is incompatible with global trade, stating that all members of the ACP need to be incorporated in to the world economy on the basis of sustainable development through Economic Partnership Agreements.
7. Scientific and technological Cooperation between Africa and the European Union: http://ec.europa.eu/research/iscp/pdf/eu-africa.pdf
8. FP7 AFRICA Call 2010: http://ec.europa.eu/research/participants/portal/page/cooperation?callIdentifier=FP7-AFRICA-2010
9. Managing the Risks and Disasters of Extreme Events to Climate Change Adaptation, Summary for Policy Makers, Intergovernmental Panel on Climate Change, February, 2012
10. The full report is to be released in March of 2012.
11. Conway, G. (2009) "The science of climate change in Africa: impacts and adaptation", Grantham Institute for Climate Change, Discussion paper number 1, October 2009.
12. IFPRI Discussion Paper 01042, "Climate Change Impacts on Food Security in Sub-Saharan Africa Insights from Comprehensive Climate Change Scenarios", December 2010
13. Food and Agriculture Organisation of the United Nations (2007), "Adaptation to climate change in agriculture, forestry and fisheries: Perspective framework and priorities", Interdepartmental Working group on Climate Change, ftp://ftp.fao.org/docrep/fao/009/j9271e/j9271e.pdf

[14] World Health Organisation (2009), "Protecting Health from Climate Change: Connecting Science, Policy and People", http://whqlibdoc.who.int/publications/2009/9789241598880_eng.pdf

[15] Iglesias, Ana; Garrote, Luis; Diz, Augustin; Schlickenrieder, Jeremy; Martin-Carrasco, Franciso; "Re-thinking water policy priorities in the Mediterranean region in view of climate change", Environmental Science and Policy 14 (2011) 744-757, March 2011

[16] Intergovernmental Panel on Climate Change, (2001)"Third Assessment Report" Annex B, p. 365, http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf

[17] Ibid.

[18] See:NeWater, http://www.newater.info/

[19] Janicot, S., et al., (2011), "Intraseasonal variability of the West African monsoon", in *Atmospheric Science Letters*, Wiley Online Library, p. 65.

[20] Polcher, J., et al., (2011) "AMMA's contribution to the evolution of prediction and deision-making systems for West Africa", in *Atmospheric Science Letters*, Wiley Online Library, p. 5.

[21] Kossoy, A. & Ambrosi, P., *State and Trends of the Carbon Market 2010,* The World Bank, Washington DC, May 2010.

[22] UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, 'Least Developed Countries: About LDCs', http://www.unohrlls.org/en/ldc/25/, October 2011.

[23] Africa and Europe in Partnership, 'Energy', http://www.africa-eu-partnership.org/node/68/.

[24] Fankhauser, S. & Ward, J. (2010) 'Regional implications of the AGF recommendations: Africa', Climate & Development Knowledge Network, Special Issue, November 2010.

[25] Jones. L., et al., (2010) "Responding to a changing climate: Exploring how disaster risk reduction, social protection and livelihoods approaches promote features of adaptive capacity" (Working Paper 319), Overseas Development Institute, London, p. 1, http://community.eldis.org/.59d669a7/ODIWP.pdf,

[26] Polcher, J., et al., (2011) "AMMA's contribution to the evolution of prediction and decision-making systems for West Africa" in *Atmospheric Science Letters*, Wiley Online Library, p. 5.

SEVENTH FRAMEWORK PROGRAMME

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