Part 1 — Challenges of Climate Change in SSA
1. Introduction

1.1 Looming shadow of climate change across the SSA development agenda

Many Sub-Saharan Africa countries have made significant economic reforms in recent years — improving macroeconomic management, liberalizing markets and trade, and widening the space for private sector activity. Where these reforms have been sustained — and underpinned by civil peace — they have raised growth and incomes and reduced poverty. Even as parts of the region are making headlines with wars and natural disasters, other parts are making headway with rising interest from domestic and foreign businesses and higher levels of investment. Nevertheless, despite these gains in the second half of the 1990s, SSA entered the 21st century as home to many of the world’s poorest countries. Average income per capita is lower than at the end of the 1960s. Incomes, assets, and access to essential services are unequally distributed. One African in five lives in countries severely disrupted by conflict. Across these hopeful signs and development challenges, the shadow of a changing climate now looms.

2. Climate has always featured prominently in African development, and the continent’s populations have lived and adapted to a high degree of climate variability and its associated risks since time immemorial, moving from hunter-gatherer to pastoralists to more agriculture-based livelihood systems. Flood irrigation was widely practiced along many rivers and in the many wetlands that dot the continent, and is the precursor to modern irrigation systems. Yet, the accelerated changes in the climate during the last century — and the unanimous view that Africa is the most vulnerable and least able to cope with these changes — have brought into sharp focus both the threat and opportunities presented by climate change.

3. Sub-Saharan Africa (SSA) lies almost exclusively within tropical latitudes. Two-thirds of its land surface can be classified as fragile desert or dryland (UNEP, 2002). Away from the equator, average annual rainfall declines rapidly and is characterized by higher variability (Figure 3-1). This general picture is somewhat modulated by the influence of larger scale atmospheric circulation and topography. For example, the western equatorial regions are wetter than the eastern. The Ethiopian highlands experience a much cooler and wetter climate than the surrounding lowlands due to topographic effects.

4. The main challenge is that most African economies and most of the poor depend on climate sensitive sectors. Agriculture, which contributes some 30 percent of GDP and employs 70 percent of the population, is mainly rainfed — less than 5 percent of cultivated land is irrigated (Table 2-1) — and highly sensitive to droughts and floods. Africa has the lowest water storage capacity in the world. Malaria, which is already the...
biggest killer in Africa, is spreading to higher elevations in part due to climate change. Africa’s rapidly urbanizing population is vulnerable — poorly defined property rights, weak land-use planning, and informal settlements, frequently on land subject to erosion or flood plains, all contribute to vulnerability. Finally, armed conflicts, terms-of-trade shocks, and aid dependence add to the weight of these factors. Africa’s vulnerability could lead to “low human development traps” (UNDP, 2007) from ex ante losses in productivity, and erosion of assets (land productivity, livestock, water resources) and capabilities (health, nutrition, and education).

1.2 Challenges and opportunities of a changing climate

5. **Africa accounts for only 4 percent of global greenhouse gas (CO₂) emissions** that are driving climate change, which reflects the current low levels of income and energy consumption in SSA (Figure 2-2). Although climate change has been caused largely by the activities of industrialized countries, efforts to curb global greenhouse gas emissions may create pressure on African countries to curtail energy demands. If such demands slow economic growth, it would be particularly unfortunate because African countries are for the first time in 30 years experiencing sustained growth as fast as developing countries other than China and India (Figure 2-1). Moreover, with only 25 percent of the population with access to electricity, ensuring that energy access and consumption grow rapidly in Africa is a key development challenge.

6. **Alternatively, climate change presents an opportunity for Africa** to accelerate growth and reduce poverty. The opportunity cost of delaying much needed development programs in an increasingly climate-constrained world may be significantly higher in both socioeconomic and political terms. For example, one reason why such a small percentage of cultivated land is irrigated is that the cost of extending irrigation has exceeded the longer-term benefits. But the increased threat of climate change may, at the margin, tip the balance in favor of irrigation as a critical adaptation measure to improve food security and sustain agricultural growth. Similarly, with the prospect of the emergence and re-emergence of disease spreading conditions, malaria may rise in the priorities of policy makers, resulting in benefits for current and future victims. Finally, the benefits of building resiliency into ongoing development programs would far exceed the additional cost when compared to the cost of emergency relief, rehabilitation, and recovery associated with extreme events (Box 1-1).

7. **Even mitigating climate change could be a benefit for Africa.** With land and forest degradation accounting for more than 60 percent of CO₂ emissions in Africa, compared to about 30 percent in the developing world as a whole, Africa could help mitigate climate change by more sustainable management of natural resources, especially land. Most existing carbon trading mechanisms focus on reducing emissions from energy and industry and are currently not well adapted to Africa’s needs, but the potential is there.

8. **Africa has the world’s highest level of untapped hydropower resources.** One reason these remain untapped is that a large percentage of African rivers cross national boundaries so that hydropower development requires multilateral coordination and
cooperation. Inasmuch as mitigating climate change is a global public good, there is a better chance that the global community would be willing to facilitate the cooperation required for African countries to fully utilize their hydropower potential. However, it may also be necessary for the Clean Development Mechanism (CDM) to either adopt more flexible additionality requirements, or develop renewable energy funds that promote the development of hydropower and other renewables.

9. Therefore, the objective of the present World Bank strategy in the Africa region, Making Development Climate Resilient for Sub-Saharan Africa, (called the “CC-Strategy” throughout this report) is to provide a road map for the Bank to address climate variability and change in Sub-Saharan Africa, with the aim of helping its clients achieve climate-resilient growth. It is designed to be an integral part of the Region’s development strategy and business plan (the Africa Action Plan, AAP).

Box 1-1. Economic and social impacts of weather-related disasters is severe

Droughts and floods cause significant losses and negatively affect economic growth. The aggregate impact of drought on the economies of Africa can be large — 8 to 9 percent of GDP in Zimbabwe and Zambia in 1992, and 4 to 6 percent in Nigeria and Niger in 1984. Floods are among the most devastating natural hazards in Africa and flash floods are one of the greatest hazards arising from tropical cyclones and severe storms. Devastating floods have been reported in major cities across the region. The cost of the year 2000 floods in Mozambique was an estimated $550 million, with a reduction in the GDP growth rate of 1.5 percent (during the period 1994 to 2003 the annual average growth rate was 7.5 percent). The 1997/98 flood in Kenya destroyed $1.8 billion worth of infrastructure and property.


1.3 Key messages of the CC-Strategy

10. Four key messages underpin the CC-Strategy:

- **Reducing the risk of disaster and adapting to climate change need be managed as one integrated agenda.** While adapting to the climate requires preparing for long-term changes in average climatic conditions, from a development perspective, most impacts of climate change, especially in the short to medium term, will materialize through variability and extremes. These risks already occur, and therefore reducing disaster risk under the current climate is a “no-regrets” adaptation strategy. For most development planning and investment decisions, it provides a much more relevant entry point than a long-term scenario of changing average conditions, and yields positive economic and social returns even in the short term.

- **While adaptation is essentially a risk management strategy — with associated costs and benefits — for most African countries adaptation is fundamentally about sound, resilient development.** A changing climate adds urgency to the need to manage development in the face of increased climate variability, and to ensure that disaster risk reduction and adaptation are fully integrated into growth and poverty reduction strategies. Therefore, growth and poverty reduction should remain the main focus of Africa’s development agenda, despite the emergence of new challenges brought about by climate change.
• While African countries contribute little to global GHG emissions, mitigation should not be a new constraint to Africa’s access to energy and economic growth. Moreover, there are important synergies and benefits among adaptation and mitigation in key development areas such as energy access, transport, and land management.

• There is clearly a need for additional financing to build capacity and mainstream climate variability and change considerations into development planning. For most African countries, adaptation to climate variability and change will be integrated into sector policy dialogue and sector investment operations, hence, IDA will remain the principal financing instrument taking full advantage of new carbon finance and specialized instruments.

11. The CC-Strategy is grounded in Development and Climate Change: A Strategic Framework for the World Bank Group (World Bank, 2008f) — an overall guide to scaling-up of WBG actions — which itself builds on progress with the Clean Energy Investment Framework (World Bank, 2006a). In addition, the CC-Strategy has benefited from extensive internal and external consultations (both formal and informal) with Sub-Saharan African governments, members of civil society, the private sector, and development partners, as well as African institutions, and a special partnership with the Africa Development Bank (AfDB).

1.4 Four pillars of the strategy

12. This CC-Strategy document is divided in two parts. Part 1 focuses on the region’s development context (both from a macro and key sector perspectives), a climate profile, a summary of the main impacts of climate change, and concludes with a summary of key initiatives and activities already being undertaken by the countries themselves, the Bank, and key partners.

13. Part 2 presents the strategy in terms of these four pillars:

• Making adaptation and climate risk management a core component of development, with a focus on energy disaster risk reduction; increased agricultural productivity; sustainable land, water, and forest management; coastal and urban development; health; and social issues.

• Benefiting from mitigation opportunities through access to carbon finance to reduce emissions from deforestation and forest degradation (REDD), promoting carbon sequestration based on sustainable agricultural land and forest management, and promoting renewable energy, energy efficiency, cost-effective clean coal, reduced gas flaring, and efficient transport.

• Focusing on knowledge and capacity development by improving weather forecasting, water resources monitoring, land use information, disaster preparedness, appropriate technology development, and strengthening capacity for risk management, planning, and coordination.

• Scaling-up financing for climate risk management, using IDA15 and additional resources from existing sources (e.g., CDM and GEF), and new instruments, including
UNFCC’s Adaptation Fund, World Bank Group’s Climate Investment Funds (Pilot Program for Climate Resilience, Clean Technology Fund), the Forest Investment Fund, and new World Bank carbon finance instruments (the Forest Carbon Partnership Facility and the Carbon Partnership Facility).
2. Development Context

14. The CC-Strategy foresees adaptation to a changing climate and mitigation of greenhouse gases as an integral part of the development agenda in SSA. It is important to examine the development context and its relation to climate change, and to highlight both key vulnerabilities as well as opportunities to accelerate development in key sectors, including land management, water resources, urbanization, energy, agriculture, and disease control. Part 2 of this CC-Strategy outlines specific sector and country-level recommendations.

2.1 Macroeconomic context

15. After stagnating for decades, economic performance in Africa is markedly improving. In recent years, GDP growth in SSA has accelerated to about 6 percent per year, while inflation registered below a two-digit level, a recent low point. The much improved economic performance is confirmed by several recent assessments. For the first time in 30 years, SSA is experiencing sustained growth as fast as developing countries other than China and India, and average incomes have been rising in tandem with those in other regions (Figure 2-1). The top performers in Africa are doing very well compared with fast-growing countries in other regions.

16. During 2000 to 2006, about 26 SSA countries experienced GDP growth exceeding 4 percent per year, while as many as 14 countries exceeded 5.5 percent. Countries with at least 4 percent GDP growth are now a sizable portion of Sub-Saharan Africa — about 70 percent of the region’s total population and 80 percent of the region’s GDP. As a group, these countries have been growing consistently at nearly 7 percent per year, whether considered in the more recent period or a longer period extending from the mid-1990s.

17. The population of SSA is expected to exceed 1 billion people in 2030, the region is one of the world’s major net exporters of energy resources, but biomass resources provide over 80 percent of total domestic primary energy supply, and electricity contributes less than 3 percent of total final energy consumption (Box 2-1). Some 45 to 50 percent of electricity is generated from hydropower, with an equal amount from oil- and gas-fired thermal power plants. However, demand for electricity is expected to grow by 5 to 7 percent per year between now and 2050 (IEA, 2006).

Figure 2-1. Comparative per capita income

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2. Parts of this section draw on a paper presented at the AERC 20th Anniversary Conference Natural Resources Management and Climate Change (Bouzaher, A., S. Devarajan, and B. Ngo, 2008).

3. Arbache et al. (2007)

4. In fact, only seven countries are net energy exporters.
Box 2-1. Mix of primary energy supply in SSA. Biomass provides 80% of the total domestic primary energy supply in Africa

18. Despite very low levels (both in absolute terms and on a per capita basis), CO₂ emissions in SSA (excluding South Africa) reflect a heavy reliance on energy from
biomass and low levels of efficiency.\textsuperscript{5} Globally, however, CO\textsubscript{2} emissions are strongly linked via energy to development (World Bank, 2008d). In SSA the relationship between per capita income and per capita emissions is stronger for richer countries (more than $1,000 income per capita); for lower income countries there is significant variation in emissions at a similar level of income, reflecting differences in deforestation and energy efficiency (Figure 2-2). As energy supply and demand increase over time, development in SSA will generally be expected to produce higher emissions.

19. With an average 30 percent share of GDP and 70 to 80 percent of employment, agriculture continues to be the dominant sector in the 19 countries with an average annual GDP growth rate of 4.5 percent or more (over the period 2000 to 2006, Figure 2-3). Moreover, because agriculture is mainly rainfed and characterized by low productivity (only 3.6 percent of arable land is irrigated [Table 2-1]), these economies are constantly exposed to the risks of high climate variability (e.g., precipitation) and extreme climatic events, especially droughts and floods, and it is not uncommon to see swings in annual GDP that exceed 30 percent.

![Figure 2-2. CO\textsubscript{2} emissions and income, 2002](image)


### 2.2 Urban growth and development

20. Growth of cities and urban areas is a major strategic development issue. Africa is the fastest urbanizing continent, and is arguably the least prepared for the transition.\textsuperscript{6} This reflects what is currently underway in Asia and what took place in Latin

\textsuperscript{5} CO\textsubscript{2} emissions in SSA — 10 percent from electricity/heat; 15 percent from manufacturing and industry, transport, fugitive emissions, and waste; 10 percent from agriculture; and about 65 percent from land use change and forestry.

\textsuperscript{6} Some countries that have lower levels of urbanization are now experiencing rapid annual urbanization growth (e.g., 9.3 percent in Rwanda, 6.66 percent in Burundi, and 5.2 percent in Burkina Faso). (E. Ouayoro, State of AFTU2 FY07 Note).
America over the past five decades. By 2030, it is expected that one in two Africans will live in an urban area. However, urban growth in Africa is not only being driven by rural-urban movement, but is increasingly being fueled by growth from within the towns and cities themselves. Urban centers play a key role in fighting poverty and sustaining economic growth — over the past decade, industry and services (located mainly in urban areas) have contributed to 79 percent of total GDP growth in Sub-Saharan Africa (Kessides, 2006).

### Table 2-1. Agriculture continues to face many challenges

<table>
<thead>
<tr>
<th>Region</th>
<th>Irrigated area (% of cropland) 1989-91</th>
<th>2001-03</th>
<th>Fertilizer consumption (kg/ha of arable land) 1989-91</th>
<th>2001-03</th>
<th>Cereal yield(^a) (metric tonnes/ha) 1989-91</th>
<th>2001-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSA(^b)</td>
<td>3.6</td>
<td>3.6</td>
<td>14.2</td>
<td>12.3</td>
<td>1.04</td>
<td>1.09</td>
</tr>
<tr>
<td>Latin America</td>
<td>11.1</td>
<td>11.4</td>
<td>60.02</td>
<td>89.5</td>
<td>2.20</td>
<td>3.16</td>
</tr>
<tr>
<td>South Asia</td>
<td>33</td>
<td>39</td>
<td>75.4</td>
<td>106.6</td>
<td>2.13</td>
<td>2.51</td>
</tr>
</tbody>
</table>

\(a\). Cereals include wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, mixed grains

\(b\). Sub-Saharan Africa includes South Africa

*Source: World Bank IEG Database (2008)*

### Figure 2-3. Agriculture continues to make a major contribution to high-performing economies

*Source: Based on data from Arbache et al. (2007) and World Development Indicators 2006*

21. **The problem is not just population growth.** Two aspects of the urban growth phenomena in SSA highlight the nature of this strategic problem — SSA has the highest urbanization rate and the highest worldwide rate of informal settlements, which will clearly affect the links between urban development and climate change in the Region.
• **Urban population growth rates in Africa of an annual 4.5 percent** have been and will continue to be the highest in the world. City-based populations are growing faster than their counterparts in Asia. These higher growth rates are expected to continue well into the next two decades. Consequently, how SSA cities develop will be one of the main influences on future greenhouse gas emissions.

• **In SSA urban and peri-urban areas, slum dwellers are 72 percent** of the total urban population (compared to 50 percent worldwide). The current rate of slum growth substantially exceeds the impact of any attempts at urban development. Over the next 25 years, there will be an additional 300 million urban residents in Africa, and the vast majority will have no alternative but to move to the slums. Much of this housing is vulnerable to the impacts of natural hazards. A large portion of housing stock in SSA is built through the informal sector, not meeting minimum safety standards.

22. **Cities and urban areas are particularly vulnerable to climate change.** Urban conglomerations are particularly vulnerable to disruptions from natural hazards (including those related to climate change), especially in SSA countries where the combination of structural poverty, decaying and sub-standard infrastructure, high population densities, and the concentration of economic assets and commercial and industrial activities magnify the problems of unplanned and uncontrolled growth (World Bank, 2003). Because many of the most important cities in SSA are located in or near the coast, the rise in sea level and associated problems are a fundamental challenge that urban settlements face from global warming.

23. **Floods are also among the most devastating natural hazards in Africa** and disproportionately effect cities. Rising sea levels combined with tropical cyclones and the accompanying intense rainfall cause severe and more rapid onset of flooding. Flash floods, which often stem from higher rainfall intensity, are becoming increasingly important hazards. Devastating floods have been reported in major cities across the region. The cost of the year 2000 floods in Mozambique was an estimated $550 million, lowering the country’s GDP by 1.5 percent (during the period of 1994 to 2003 the annual average growth rate was 7.5 percent) (World Bank, 2005).

24. **Urban areas face a double threat.** Africa’s urban areas and cities face twin risks from climate variability and change. Domestic and industrial water supplies are vulnerable to drought and seasonal stream flow variations and availability of groundwater, while urban services (including housing, transport, health and safety, drainage, and wastewater) are vulnerable to floods and restricted drainage, compounded in coastal areas by sea level rise (Box 2-2). In the housing sector alone, current trends suggest that the rate of slum growth substantially exceeds the impact of any attempts at urban upgrading. The vast majority of new urban residents will have no alternative but to move to the slums. In such rapidly urbanizing areas, the combination of structural poverty, decaying and sub-standard infrastructure, high population densities, and the concentration of economic assets and commercial and industrial activities magnifies these problems (World Bank, 2003).

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7. Sea level rise, and the surge that accompanies large storms such as cyclones, can impede drainage and affect the extent and magnitude of flooding for considerable distances inland depending on the coastal topography.
25. **Despite rapid urbanization, the majority of the African population** is strongly dependent on land resources. More than two-thirds of Africa’s poorest households are rural. In most African countries agriculture is the major source of employment and contributes significantly to the aggregate GDP.

26. **In the face of population growth,** local development pressure, and global environmental change, maintaining a healthy natural resource base is a major challenge in many rural areas. Food productivity per capita has remained stagnant in many parts of Africa. Population growth has already overtaken agricultural GDP growth in much of Sub-Saharan Africa. Increases in agricultural output are largely from expansion of crop land into increasingly marginal areas. Forests and wood lands are being cleared even though they are not suited for permanent agriculture. In addition, land productivity is constrained, by among other factors, insufficient nutrient inputs, lack of erosion control, and pressure from overgrazing.

### 2.3 Land management

27. **The lack of effective land, forest, and watershed management** has led to widespread land degradation across the African continent. This erosion of the natural asset base, which is a primary foundation of rural livelihoods, undermines food security and constrains economic development. These problems have resulted in the loss of land productivity (World Resources Institute, 2005), declines in forest cover and biodiversity, and decreases in the quality and quantity of water resources. Estimates on the extent of land degradation vary depending on methodology. Some Africa-wide estimates have suggested that about 67 percent of the total area of Sub-Saharan Africa is affected by some form of land degradation, i.e., about 16 million square kilometers, of which about one-fourth is rated severe to very severe (FAO, 2000). Other estimates based on remote sensing data paint a less severe picture, suggesting that about 10 percent of agriculture and mix cropping area is affected by land degradation (Vlek et al., 2008). The extent of land degradation varies considerably across the region and is further influenced by data availability and the method of aggregation.

**Box 2-2. Impact of sea level rise on the city of Mombasa**

Mombasa (700,000 inhabitants) is already affected by climate-related disasters, especially floods, droughts, and strong winds (El Nino in 1997, frequent floods, tsunami in 2006, drought in 2005/06). These disasters are projected to increase in frequency and intensity with long-term climate change. Sea level rise and frequent flooding damage existing infrastructure (transport, telecommunications), and thus negatively affect economic and commercial activities in the city. The IPCC has estimated that if the emission of greenhouse gases continues at the current rate, the sea level will rise by an additional 8 to 20 centimeters by 2030, and 21 to 71 centimeters by 2070 (IPCC, 2001). It is estimated that about 17 percent of Mombasa, or 4,600 hectares will be submerged with a sea level rise of only 0.3 meters. There will be also large areas rendered uninhabitable due to flooding or water logging or agriculturally unsuitable due to salt.
28. **Land degradation processes may be exacerbated by climate change.** More intense rainfall promotes soil erosion. Increasing temperatures increase evapotranspiration rates, reducing soil moisture and in conjunction with shifting rainfall patterns will affect vegetation patterns and the length of the growing period for crops. Prolonged dry spells and erratic climatic conditions may result in short-term coping strategies such as deforestation. This may help to mitigate the immediate impact of a climatic event, but will prove to be mal-adaptive in the long-term by having adverse consequences for watersheds, biodiversity, and provision of important ecosystem services.

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**Box 2-3. Land degradation and climate change are closely linked**

**Land degradation** can increase vulnerabilities to climate variability and affect GHG emissions through:
- Reduced land productivity
- Increased erosion and run-off
- Reduced land cover and soil carbon
- Water logging and soil compaction
- Changes to microclimates due to changes in land cover

**Climate change** will add to existing stress and accelerate land degradation processes through:
- Heavy precipitation that causes soil loss
- Changes in vegetative cover due to shifting climatic conditions
- Climatic extremes triggering short-term coping responses that erode the natural resource base
29. **Land degradation increases the vulnerability of rural livelihoods** to climate variability and change. Declining land productivity and ecosystem services make rural livelihoods more vulnerable to climatic variations and affects their capacity to recover from climatic shocks such as prolonged dry spells. Forest degradation and other changes in land cover may also increase exposure to floods because the capacity of water to infiltrate is reduced and surface run-off increases.

30. **Aside from affecting land productivity and ecosystem services**, land-use changes and land degradation also contribute to greenhouse gas emissions and affect local climatic conditions. Emissions from land use, land-use change, and deforestation are the single largest source of emissions in Sub-Saharan Africa (Figure 2-4). Where land-use changes reduce above-ground organic carbon, soil carbon usually declines. This decline in organic matter is accompanied by adverse effects on several physical, chemical, and biological properties of the soil, which affect land productivity as well as biodiversity and ecological functions. Land cover changes can also lead to changes in local climatic conditions as a result of changes in surface reflectivity and water transpiration. Consequently, sustainable land management approaches are required that focus on improving food security and development prospects today, while maintaining a healthy natural resource base for the challenges of tomorrow.

2.4 **Key role for agriculture**

31. **Changing climate and agriculture.** The recent food crisis has highlighted the important notion that climate change may multiply threats; thus the urgency for policy makers to decisively move the agricultural agenda forward. In addition to warming, changes in rainfall, increased flooding, extreme heat events, pests, and loss of irrigation water, climate changes may affect yields. Despite the dire predictions, the continent is endowed with a significant undeveloped resource base; about one-third of potential cropland is currently used for cultivation and only a tiny fraction is irrigated (Figure 2-5).

32. **Most studies predict that impacts will vary by region**, but will be more pronounced in Africa. There is a strong consensus about the severe consequences for agricultural production in SSA, assuming a limited adaptive capacity of smallholder farmers. For example, Cline (2007) estimates that without carbon fertilization, agricultural output would be reduced by 21 percent in developing countries while industrial countries would experience a more modest decrease of 9 percent by 2080. Among the developing countries, the losses would be most severe in SSA, with an average reduction of agricultural output by 28 percent.

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8. Sources of greenhouse gas emissions and relative contribution to total emissions. In Africa the majority of greenhouse gases are released from land-use changes and deforestation (World Bank).
33. **Key climate change factors will impact agriculture.** Climate change is expected to further exacerbate the already high vulnerability of agricultural producers in SSA. Scientific evidence about the seriousness of the climate threat to agriculture in Africa is unambiguous. Climate change will have far-reaching consequences for the agricultural sector that will disproportionately affect the poor in SSA. Five main factors will have a direct impact on agricultural productivity — changes in temperature and precipitation, climate variability, water availability (or surface run-off), and carbon
dioxide fertilization. Crop failures and livestock deaths are already imposing significant economic losses and are undermining food security. These impacts are most likely becoming more severe as global warming continues.

34. **Current low level of agricultural development.** The agriculture sector is a unique instrument for sustainable development in Sub-Saharan Africa. The sector is key for economic growth, poverty reduction, and environmental sustainability in the region as highlighted by the *World Development Report 2008*. Agriculture contributes some 30 percent of GDP and employs 70 percent of the labor force, while 82 percent of the SSA population lives in rural areas. Despite its potential, the agriculture sector has been vastly underused for development (Figure 2-5). Public spending on agriculture is particularly low in SSA. According to the *World Development Report 2008*, in agriculture-based countries public spending for agriculture as share of their agricultural GDP is 4 percent compared to 10 percent in successful transforming countries in 1980 (at a time when they still had a high share of agriculture in GDP). Under-investment in the sector is one important cause of poor agricultural performance in Africa. In SSA, growth per capita of the agricultural population — which is a crude measure for agricultural income — has been only 0.9 percent, less than one-half that in any other region.

35. **Vulnerability of smallholders and the rural poor.** The neglect of the agriculture sector contributed to unfavorable socioeconomic and ecological conditions for the rural poor in Africa, leaving them particularly vulnerable to climate variability and change. The rural poor in SSA increased over the last decade to more than 200 million. They have very little access to services and infrastructure such as technologies, advisory services, input and output markets, credit, water and sanitation, and roads. The agricultural productivity of smallholder farmers is also affected by severe degradation of the natural resource base and low water availability, which are being exacerbated by climate change. Agriculture is mainly rainfed, with only 7 percent of cultivated area under irrigation. In addition to the need for soil moisture management in farming, of particular concern are soil erosion and nutrient depletion. About 75 percent of Africa’s farmland is affected by severe mining of soil nutrients. The International Fertilizer Development Center reports that the average rate of soil nutrient extraction is 52 kilograms of nitrogen-phosphorus-potassium per hectare per year, five times the average application per hectare of nutrients through fertilizer.

36. **Modalities to expand irrigated agriculture.** We illustrate the potential to expand irrigated agriculture by using the Zambezi River basin as an example (Box 2-4). Current hydrologic risks are characterized by erratic and unreliable rainfall over much of the region, with a very low percentage of run-off occurring during the dry season. Agriculture, which is the source of livelihood for 80 percent of the Zambezi basin’s rural population, is very risky (World Bank, 2008a). The average maize yield (70 percent of cereal area) is 1.06 tonnes per hectare, a fraction of the potential irrigated yield of 7.5 tonnes per hectare. In addition, the average rice yield is about 1.1 tonnes per hectare, compared to potential irrigated yields of 4 to 5 tonnes per hectare. Because of climate variability and low productivity, the Zambezi basin countries tend to be chronically short of food, requiring large food imports and donor food assistance. FAO studies have projected that the value of net agricultural trade in Southern Africa between 1997 and
2030 will worsen for cereal crops (expected to constitute about one-half of agricultural production) (Bruinsma, 2003; Westlake and Riddell, 2005). To achieve a cereal requirement of 163 kilograms per person per year (equivalent to self-sufficiency), it is estimated that tripling the area under irrigation (from a base of about 200,000 hectares), at a rate of 32,000 hectares per year across the basin, would require about 7 percent of the water available in the Zambezi annually, and would benefit 30 percent of the rural population in the basin.

37. **Imperative to increase productivity and production.** The trend toward drier rainy seasons in Southern Africa has also been observed for parts of Eastern Africa, which directly impacts agricultural productivity. Findings from a recent simulation study (Funk et al., 2008) concluded that if current trends in declining rainfall and agricultural capacity continue unabated, by 2030 the number of undernourished people in eastern Africa will increase by more than 50 percent. At the same time, a mere 15 percent increase in yields per decade would approach achieving the MDG of halving the number of undernourished people by 2030. Thus, there is very large scope for increased production and food availability if water is available for timely irrigation and farmers have better water control and modern inputs. At the same time, because climate projections for Southern Africa indicate a drying trend over large parts of the region, with intensifying occurrence of floods and droughts, irrigation investments will also serve as a buffer against increased climate variability in the future. Irrigation development needs to be part of a package of technology and institutional reforms (Box 2-4).

2.5 **Need to rapidly increase access to electricity**

38. **The Bank’s ongoing strategy for the energy sector in SSA is designed** to address key constraints (including long-term under-investment, weak utilities, failed privatization, on-and-off reforms, and capacity constraints), and significantly contribute to: (i) increasing generation and transmission capacity, including regional trade; (ii) accelerating energy access through increasing electrification and promoting sustainable household fuels; (iii) strengthening power utilities and increasing supply-side efficiency; and (iv) improving demand-side efficiency.

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**Box 2-4. Importance of irrigation to grow the agriculture sector and reduce poverty — the case of the Zambezi River basin**

Both land and water resources are ample at the basin level,* although water is not always in the right place at the right time, and there are a number of important factors and problems that strongly influence the profitability of smallholder irrigated agriculture. A major scaling-up of irrigated agriculture in the Zambezi River basin is possible based on new models and approaches already emerging in the region.

**Potential benefits**

- A high-growth scenario triples the current estimated rate at which the riparian countries could expand irrigated area, and the irrigated area in the basin would rise to about 551,000 hectares and about 6
percent of the rural population in 2020 would have access to improved irrigated land and direct increases in income.

- Indirectly, an additional 6 to 12 percent of the rural population would benefit through employment (on- and off-farm), lower food prices, increased food availability, and the general rise in rural economic activity induced by the expansion of profitable irrigated agriculture. Hence, a total of about 12 to 18 percent of the basin’s rural population in 2020 would directly or indirectly benefit.

- About 80 percent of the rural population is not directly or indirectly reached by this investment in irrigated agriculture. If irrigation expansion takes place as a part of comprehensive water-for-agriculture strategy to improve agriculture productivity, then a wider impact on rural poverty and food security could be achieved through the introduction of conservation farming and water harvesting to improve rainfed farming supported by strong extension services and improved inputs.

**Key lessons from existing models**

- Programs should address the issues that undermine smallholder profitability at each step of the value chain, and to do this the existing and potential private sector actors must be brought into the program by providing incentives such as favorable policy reforms and access to financing.

- Program financing mechanisms should be structured to impose high appraisal standards and commercial discipline on sub-project sponsors to ensure that the programs remain demand driven, and do not creep steadily toward traditional bureaucratic, government supply-driven approaches.

- Cost minimization and cost-effectiveness are paramount to ensure that sub-projects are financially and economically sound.

- Government desires are high and their capacities to administer and manage a scaled-up water-for-agriculture program are extremely limited. Hence, it will be essential for governments to outsource the essential technical and social services needed to implement accelerated programs.

- Government capacities to coordinate, manage, and supervise the programs must be strengthened. Decentralization remains crucial for the sector in order to locate the most important strategic expertise — such as irrigation and rainfed agriculture advisory services strongly linked to a revitalized research system — as close as possible to the rapidly expanding number of new smallholder farmer groups.

- Continuing training of farmers and farmer groups in skills ranging from leading and managing their own businesses and organizations, to cropping systems and water management, is critical for long-term success.

- A key part of the enabling environment — which will improve capacity to attract investment financing — involves improved planning and upgrades to monitoring networks and information systems.

- Continuing training of farmers and farmer groups in topics ranging from how to lead, manage, and operate their new organizations to water management and new crops and cropping practices, has been well demonstrated to be crucial for long-term success.

- Programs must be targeted to maximize the opportunity for early success and demonstration. This will depend in large part on upgrading monitoring networks and information systems and improved planning. The current deteriorated state of the hydrologic monitoring networks and the lack of planning has resulted in very limited and poorly documented investment portfolios, further limiting the ability to attract investment financing.

* It is estimated that annual availability of water resources in the Zambezi is about 110 cubic kilometers, of which 3 percent is used for agriculture, human consumption, and industry; 13 percent is used for hydropower production; and 85 percent is discharged to the Indian Ocean. With expected lower run-off due to climate change, an integrated approach to managing the Zambezi will be needed to balance the various socioeconomic needs in the basin and the sustainability of the critically important delta ecosystem.

Source: World Bank (2008a)

39. **Unmet demand for electricity.** The lack of access to electricity, or its unreliable supply, is a major impediment to the growth and competitiveness of African economies, particularly exports. Not only is electricity important for growth, access to electricity also helps power other MDGs and meet the population’s basic needs. Underlying the low level of access are the exceptionally low levels of installed generation capacity in Sub-Saharan Africa of which 60 percent is in South Africa alone. The mismatch between electricity demand and supply has grown. Twenty-eight countries are or have been affected by the energy crisis in the past two years, an unprecedented situation. With more
than 550 million Africans without access to electricity, energy production and consumption are expected to soar in the future.

40. **Effects of climate variability and change on the electricity sector.** Climate change presents additional challenges to African electricity sectors, which have already been hit hard by high oil prices. More erratic rainfall has severely affected hydropower dams in both East (Tanzania and Uganda) and West (Ghana) Africa, forcing these countries to spend their limited resources to add emergency generation capacity, most of which relies on coal- or oil-based systems, thus aggravating greenhouse gases emissions.

41. **Developing new sources of electricity.** Africa has large, unexplored potential for hydropower, solar, wind power, and other renewable resources. Of its huge hydroelectric power potential, only 7 percent is currently utilized, compared, for example, to over 30 percent in Latin America (Figure 2-6). A recent UNEP-funded study identified 2,000 megawatts of wind power potential in Ghana. A geothermal potential of 7,000 megawatts has been estimated mainly in the Rift Valley in East Africa. Faced with the need to increase access to modern energy and the opportunity offered by Africa’s vast potential in renewable energy, particularly hydropower, the African Ministerial Conference on Hydropower and Sustainable development agreed on a plan of action for developing the huge untapped hydropower potential on the continent. It called for: (i) development of a holistic Africa Energy Vision (2025) combining water and energy sectors under the auspices of the African Union; (ii) establishing a permanent secretariat in collaboration with the International Hydropower Association; (iii) developing, in association with UN-Energy Africa, a regular monitoring and reporting system on Africa’s hydropower, and devising a strategy to assist member countries with technical expertise; and (iv) integrating energy and water sector ministries for holistic development of water resources. Building on the Ministerial Conferences on Hydropower, efforts are being made to directly engage the private sector — financiers, investors, manufacturers, engineers and environmentalists — with governments for hydropower development.

42. **Opportunities that arise from GHG mitigation.** Sub-Saharan Africa has an unprecedented opportunity. By choosing a cleaner development pathway (World Bank, 2008h) through low-carbon alternatives that can reduce greenhouse gas (GHG) emissions, this region can meet its future energy needs, and at the same time receive support from carbon finance schemes9 and the Clean Development Mechanism (CDM) of the Kyoto Protocol (Box 8-1). For 44 SSA countries using 22 technologies that have been approved by the CDM Executive Board, the report estimated a technical potential of more than 3,200 low-carbon energy projects. If fully implemented, this estimated pool of potential projects could provide more than 170 gigawatts of additional power-generation capacity, more than twice the continent’s current installed capacity. It is estimated that the achievable avoidance of future GHG emissions would total about 740 million tonnes.

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9. The carbon market is the most tangible result of efforts to mitigate climate change. By creating a market for emission reductions, in effect paying people and businesses to reduce GHG emissions, the carbon market provides a financial incentive to invest in clean energy projects, energy efficiency, fuel switching, waste management and forestry.
of carbon dioxide equivalent per year. A conservative estimate of the total capital cost for these potential low carbon energy projects is about $150 billion, although detailed economic analyses of the potential investments remain to be done. To unlock this potential would require important reforms such as filling the regulatory gaps needed to allow the sale of renewable energy to national electricity grids — most of which are managed in monopolistic arrangements — as well as the collection and transport of renewable energy and dissemination of clean energy technologies, among others.

Figure 2-6. SSA and world hydropower potential


2.6 Challenges of integrated water resource management

43. Importance of water in the Sub-Saharan Africa development agenda. Water is a vital component in the development of nearly every sector in Sub-Saharan Africa. Lack of a reliable supply of water of adequate quality undermines public health, restricts industrial growth, limits energy production from hydropower (and possibly thermal sources as well), constrains agricultural productivity and food production, and threatens and may eliminate important environmental services, including fisheries. Until now, the pursuit of water resources to meet these increasing needs and demands has been undertaken city-by-city, sector-by-sector, and project-by-project. Externalities, including increased costs and diminished water availability, are already apparent and will become an increasing burden with the growth of cities and the development of rivers for

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10. While there is no basis to value the GHG emissions reductions, the current price of a ton of “certified emission reduction” in the European Union carbon market currently ranges from 20 to 25 euros.
hydropower and other uses. But water is a unitary resource — i.e., water use in one part of the system (watershed or drainage basin) alters the resource base and affects water availability and water users in other parts of the basin or watershed — and it is not always where and when it is needed. In a great many cases in Sub-Saharan Africa, water is scarce and this scarcity is exacerbated by unfettered competition for this vital resource.

44. **Unitary and scarce water resources should be managed.** In the face of scarcity and rising demand, the development challenge is to effectively manage water resources to ensure that water use is balanced across the various demands and sectors and that the economic benefits from productive uses of water are maximized. Water allocation needs to be both equitable and efficient, and water resources need to be proactively protected and monitored — the fundamental functions of water management. The lack of a policy and institutional framework for such management, and more importantly, the lack of a knowledge base and human resources to carry out these functions, has been a constraint to timely and accelerated development to support sector development in SSA. For example, the vast potential for irrigation remains largely underutilized, which has significant implications for agriculture growth, food security and rural poverty. Similarly, only a small fraction of the available hydropower potential has been developed even though access to energy is extremely low. Access to other services, such as domestic water supply and sanitation, also remains low. Harnessing water in key economic sectors has to be balanced by the demand to preserve biodiversity and the environment, essential to sustaining marginal livelihoods in Africa.

45. **Importance of water storage to overcome high climate variability.** In most of Sub-Saharan Africa, precipitation occurs in just one season of 4 to 6 months, and the seasonal and inter-annual variation in the timing and volume of precipitation is high. As a consequence, seasonal and inter-annual variations in accessible surface and groundwater are also high. Hence, water storage is vital to ensure that water is available where and when it is needed. Water storage in a watershed or river basin occurs naturally in the groundwater aquifers and the soil, but these processes can be greatly disrupted by poor land management and land degradation, and in many cases can be readily over-exploited. However, with few exceptions, in Sub-Saharan Africa surface water in the streams and rivers of a watershed or basin is the largest volume of water that can potentially be stored for use by multiple sectors when it is needed, particularly in the dry season. Sub-Saharan Africa (excluding South Africa) has the world’s lowest surface water storage capacity at around 43 cubic meters per person per year and has developed less than 7 percent of its hydropower potential. In contrast (Figure 2-7), North America has a water storage capacity of 6150 cubic meters per person per year and has developed 60 percent of its hydropower potential. Using the present water storage capacity of South Africa (750 cubic meters per person per year) as an indicator of where other African countries might want to be, the World Bank estimates, for example, that Nigeria and Ethiopia alone have storage investment requirements of $67 billion and $46 billion, respectively.

| Figure 2-7. Water storage in selected SSA countries and the world (cubic meters per capita) |
46. **Water resources in Sub-Saharan Africa are primarily transboundary.** Although Africa has no dearth of water resources, most of its river basins cross country borders. Africa is endowed with generous water resources, with estimated annual renewable surface water resources of about 4,590 billion cubic meters per year. Three-quarters of these resources are concentrated in eight large transboundary river basins — Congo, Niger, Ogdugne (Gabon), Zambezi, Nile, Sanga, Chari-Lagone, and Volta. The total number is 63 transboundary river basins, which together account for 90 percent of surface water resources and cover 64 percent of the SSA surface area. In addition to rivers, there are more than 160 lakes larger than 27 square kilometers, primarily in the equatorial region and the East African highlands. Developments in the context of the Nile River basin (in eastern and northern Africa), the Senegal River basin (in West Africa) and the beginning of a similar process in the Zambezi River basin (in Southern Africa) highlight the benefits of these regional agreements (Box 2-4). In addition to the direct benefits from improved agricultural and power production, there is potential from transboundary water projects for improved ecosystem sustainability, broader economic benefits from regional cooperation, and integration and political benefits through a shift from the competition for a scarce resource to cooperation and development.

47. **Governance is a core development issue for water resources management.** With so much of Africa’s natural resources shared among countries, effective institutions that help to ensure shared benefits are important. Only a few basin organizations (Nile
Basin Initiative, Niger Basin, and Senegal Basin) are currently implementing transboundary water resource management (TWRM). These basins are preparing investment plans with similar plans in the pipeline for the Gambia and Volta basins. SADC is helping the Zambezi basin countries to finalize a Watercourse Agreement that will among other things establish such an institutional framework and prepare a Strategic Development Plan for the basin. Many other river basins still suffer from lack of financial resources, management tools, and above all, governance issues such as ongoing conflicts and the primacy of national agendas at the expense of cooperation.

48. **Effects of a changing climate on water resources.** Climate change will manifest itself primarily through changes in average temperature and precipitation, and increases in the magnitude and frequency of related extreme events such as floods and droughts. Temperature and precipitation are important drivers of the water cycle and hence the seasonal occurrence and volume of water. This adds a new dimension to the already high variability of precipitation and the water cycle because it suggests that in the future the historical climate and hydrologic record may not be an appropriate predictor of conditions. This presents a huge challenge, not only to water resources development planners and managers, but also to the sector authorities responsible for deciding on the conditions and criteria for which their systems will be planned and designed. For example, if floods are more frequent, then what transport planners would have estimated from the historical record as a 100-year flood (say for the design of river crossings or cross drainage) may in the future be a 25- or 50-year flood. Similarly, water supply utilities would have to consider new drought or low flow design criteria, and power utilities may find that water available for hydropower generation is different than what they might have estimated based on historical records.

49. **Effects of a changing climate on the hydro economy.** The challenge brought about by climate change on the hydro economy of most countries in Africa is not just a problem of finding enough water at the right time for all economic sectors and the environment. Most countries also must struggle to reduce the destructive and sometimes cumulative impacts of water-related natural calamities such as floods and droughts (e.g., floods in Mozambique caused average growth to drop from 7.5 percent a year during the period 1994 to 2003 to 1.5 percent in 2000. Kenya suffered an 11 percent and 16 percent drop in GDP due to the El Niño floods and the La Niña drought between 1997 and 2000. The very large investments required to develop multi-purpose and single-purpose water resource development infrastructure will necessarily require a more thorough analysis of the returns to investment that explicitly account for hydrologic risks. The need to give greater consideration to these risks has important implications for the way in which we assess the cost-effectiveness of early investments in water resources infrastructure. Without taking into consideration the impact of climate change in the form of increased hydrologic risk, current low-yielding agricultural practices combined with the high investment costs of irrigation partly justify the severe inadequacy in irrigation investments in most of Africa. However, preparing Ethiopia’s water resources assistance strategy highlights the fact that the returns to irrigation and drainage are significantly higher if the enormous costs of hydrologic viability — caused by severe droughts and floods — are considered. If the larger and more frequent damages and losses forecast to
occur with changing climate regimes are considered, they could help to justify larger infrastructure projects to help manage the impact of extreme natural events.

### Box 2-5. Senegal River Basin

The four riparian countries of the Senegal River basin — Guinea, Mali, Mauritania and Senegal — rank among the 25 poorest countries in the world. All riparian countries are facing energy shortages and growing water constraints, which hampers their economies. The basin’s hydropower potential is estimated at 1,200 megawatts, of which less than 25 percent is currently exploited. Similarly, potential irrigable area is estimated at 320,000 hectares, of which less than 32 percent are currently developed. Although the Senegal River Basin Organization (OMVS) has existed since 1972, the structure has not been fully inclusive because upstream riparian Guinea has not been involved. This has limited the development opportunities and shared benefits that could arise from cooperative and integrated management of the entire basin.

With support by development partners, the four riparian countries have worked to enhance regional integration of the Senegal River basin for multi-purpose water resources development that supports joint ownership of water infrastructure and fosters growth. The focus is placed on three activities to reach this objective: (i) regional institutional development for water resources; (ii) local level multi-purpose water resources development to promote income generation activities and create tangible basin-wide benefits at the ground level; and (iii) regional multi-purpose and multi-sector master planning.

Integrated river basin management, coupled with the development of multi-purpose water resources infrastructure, is expected to yield expanded opportunities for growth, reduced immigration and poverty, and improved health and livelihoods for the population while also preserving the environment. The multi-purpose approach will also broaden the scope of potential investments, generate a wider range of direct and indirect benefits (e.g., the development of a least-cost energy market in the context of the West Africa Power Pool), and enhance the participation of local communities in water management.

Source: IDA at Work: Water Resources

50. **Importance of multi-purpose and integrated water development.** Future development efforts will have to include unlocking the hydropower, water supply, irrigation, regulation for flood and drought management, navigation, environmental, and other economically and socially important water uses. The close connection between the urgent need to increase access to modern energy and rewards from GHG mitigation through clean energy presents Africa with an opportunity to take a bolder approach to water resources. A multi-purpose water resource development approach would involve complementary water security infrastructure to manage hydrological variability — storage, containment, ecological balances, water conservation, flood management, drought mitigation — hydropower development, and water for industry, domestic use, navigation, and irrigation. This multi-purpose and integrated approach (which follows directly from the unitary character of water resources) has the clear potential not only to help countries build economic resilience to climate change, but more importantly to diversify their economies. Such diversification would include sustainable intensification of agriculture based on irrigation and other technologies and practices, and development and/or deepening of new economic activities made possible by the availability of a larger and more stable supply of electricity (Figure 2-8). While multi-purpose water resource development has the potential to offer significant potential benefits to the countries of Africa, infrastructure alone is not a panacea without the development of appropriate water institutions and improved governance, as well as managing the complex dynamics of multi-country development (Box 2-3). Badly managed water resources and water infrastructure will not support growth.
2.7 Public health — malaria

51. **The menace of malaria.** Despite remarkable improvements in global health, Sub-Saharan Africa continues to face significant challenges in controlling communicable diseases and improving the health of its population. Malaria infects millions of people each year and impedes economic growth (Box 2-6). The World Health Organization (WHO, 2007) indicates that there are 500 million newly infected cases annually. The Centers for Control Disease (CDC) estimates that 700,000 to 2.7 million people die of malaria each year and 75 percent of those are African children. In recent years, there has been a resurgence of malaria in areas where the disease was once eliminated or under control. Following the 1997/98 El Niño event, malaria, Rift Valley fever, and cholera outbreaks were recorded in many countries in East Africa (UNEP, 2000).

52. **Increased risk in a changing climate.** Projections indicate that climate change will cause varying shifts in ecosystems that will affect insects, animals, and plants, which will be forced to shift, expand, and adapt to new environments. As temperature increases, some regions in Sub-Saharan Africa, once hyper-arid or semi-arid, will receive higher precipitation or become more humid. These areas may provide hospitable environments for new emerging vectors or the expansion of known infectious disease vectors. A warmer and higher precipitation environment may open up new areas for malaria; altered temperature and rainfall patterns could also increase the incidence of yellow fever and dengue fever.

53. **Climate may affect disease incidence.** Any extreme climate event or prolonged climate stress is likely to have an effect on the prevalence of infectious diseases, especially in the regions of SSA with a high prevalence HIV/AIDS, tuberculosis, and

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11. Although the strategy deliberately focuses on malaria, the potential impacts of climate change also include nutrition, diarrheal disease and other conditions linked to lack of safe water and sanitation, injuries from flooding, heat stress, and various other illnesses (Confalonieri et al., 2007)
malaria. People with HIV/AIDS, with their pre-existing vulnerabilities, may become one of the most susceptible and vulnerable populations and are likely to suffer higher rates of morbidity and mortality. Furthermore, climate-related population displacement could create the conditions for increased transmission of HIV infection, tuberculosis, and malaria. Extreme climate events can impair health care infrastructure, health care services, delivery systems, human resources, and trigger mass migrations among affected populations, exposing them to insecurity and conflict. Climate change has the potential to bring further devastation to populations that are already dealing with infectious diseases.

54. **Projected trends.** Climate change is likely exacerbate the incidence and impact of infectious diseases. A lower disease burden would offer the best resilience, thus providing an opportunity for African countries to strengthen their health systems and scale-up investment to expand prevention and treatment programs for these diseases while focusing on human resources, monitoring and evaluation, and surveillance systems, particularly at the sub-regional and regional levels.

### Box 2.6. Public health and economic burden of malaria

Projections and modeling of climate change effects on malaria indicate with high confidence that malaria will surge in Southern Africa and the East African highlands, and that the global population affected by malaria will increase by an extra 260 to 320 million people by the 2080s (IPCC FAR, 2007). Research also shows that malaria not only imposes significant burdens on population health, but also impedes economic growth. Using cross-country data from 1965 to 1990, Gallup and Sachs (2001) show that in countries where malaria has been eliminated, economic growth has usually been substantially higher than in neighboring countries. The same study shows that by controlling for initial poverty, economic policy, tropical location, and life expectancy, countries with intensive malaria grew 1.3 percent less per person per year, and a 10 percent reduction in malaria was associated with 0.3 percent higher growth. Micro-level studies also indicate that malaria is associated with reduced household socioeconomic status.

*Source: Somi et al. (2007)*

### 2.8 Promoting price signals and environmental markets

55. **Regulatory frameworks and growth.** An important source of increasing growth and reducing poverty is improving the regulatory frameworks for natural resources, specifically in water, mining, rural land, fisheries, and forestry. Over-exploitation and mismanagement of these resources have many causes, but ill-defined rules about property rights and the absence of proper valuation of natural resources are generally at the core of the problems.

56. **Climate change and market regulation.** Climate change will add to the pressure to address these issues, be it for water pricing payments or ecosystems. Work done in Madagascar and Mozambique on the proper costing of different environmental resources shows that it would not only ensure sustainable exploitation of natural resources, but also generate additional fiscal resources to cover the public sector role in helping to ensure their sustainable management.

57. **Establishing better incentives.** Stronger regulatory frameworks and improved pricing of resources will help to establish the incentives for stronger public-private partnerships for climate change adaptation. The majority of adaptation practices, with the
exception of large infrastructure investments, are managed directly by private actors. Given the very large costs of climate adaptation (as per existing estimates), contributions by the private sector play an important role. Private operators are generally better suited than their public counterparts to deal with the additional risk brought about by climate change (analysis and mitigation).
3. Climate Profile of Sub-Saharan Africa

3.1 Characteristics of the climate in Sub-Saharan Africa

58. Two-thirds of Africa’s land surface can be classified as dryland (UNEP, 2002). Africa is the only continent that resides almost exclusively within tropical latitudes. Moving south or north from the equator, there is a steep decline in average annual rainfall, accompanied by an increase in variability (Figure 3-1). Large parts of the continent are already exposed to a high degree of climate variability on an annual and inter-annual basis. Climate also depends on circulation and topography; for example, the western equatorial regions are wetter than the eastern, and the Ethiopian highlands experience a cooler and wetter climate than the surrounding lowlands due to topographic effects. These conditions are development constraints as well as opportunities that need to be integrated into the dialogue about development policy and investment operations.

59. **Rainfall variability is high in Sub-Saharan Africa.** The historical climate and hydrologic record in Sub-Saharan Africa is marked by great variations in inter-annual and intra-annual precipitation, with frequent droughts of varying length. The worst droughts were those of the 1910s, which affected East and West Africa alike. They were generally followed by higher rainfall amounts, but negative trends were observed again from 1950 onward, culminating in the droughts of the early 1970s and mid-1980s. In 1973 (but less so in 1984), almost all African countries suffered, north and south alike. In contrast, the
1992 Southern African drought was relatively limited in space because the Sahel received relatively high rainfall.

60. **Regional variation in climate characteristics.** Based on general climate characteristics, Sub-Saharan Africa can be broadly divided into five main regions as described in Table 3-1 — West Africa (including the Guinea coast and the Sahel), Horn of Africa, East Africa, Central Africa, and Southern Africa (further differentiated into eastern and western sub-regions). The classification of the Sub-Saharan African climate suggested in this report is based on annual rainfall totals, characteristics of the rainy season, inter-annual climate variability, and the influence of teleconnections\(^\text{12}\) such as El Nino.

61. **Climate characteristics.** The basic climate of the homogenous climate regions is set out in Table 3-2. The regions have been established for several decades as identifiable elements of the African climate. Many of the regions also map closely to agro-ecological zones, and some have emerged from ecological studies rather than climate studies (e.g., the Sahel and Guinea coast). In many cases, countries are split into more than one region or sub-region (e.g., Nigeria, South Africa, Mali).

62. **El Nino and climate variation.** The variations in the Indian Ocean sea-surface temperature caused by El Nino Southern Oscillation (ENSO) exert a strong influence on the inter-annual climate variability of parts of the continent. This applies in particular to Eastern Africa (Box 3-1) where the challenge of changing climatic conditions has been underscored in the frequent occurrence of climate-related disasters.

3.2 **Global climate trends**

63. **Unmistakable trends caused by the emission of greenhouse gases.** There can be no more doubt that the Earth’s climate is changing (Figure 3-2) and the main causes are human induced. The Fourth IPCC Report (2007) offers a dauntingly clear warning — “change of the climate system is now unequivocal.” Eleven of the last 12 years (1995 to 2006) rank among the 11 warmest years in the instrumental record of global surface temperatures (since 1850).\(^\text{13}\) Scientists also agree on looming prospects for more extreme

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\(^{12}\) Teleconnections refer to climate anomalies that are driven by climate variations in other geographic locations. For example, changes in atmospheric pressure and sea-surface temperatures in the Pacific, which are associated with El Nino events, influence the rainfall patterns over Eastern Africa.

\(^{13}\) The datasets on which the global warming trends were calculated have been developed in conjunction with Hadley Centre of the UK Met Office Stations and the Climate Research Unit (CRU) at East Anglia.

“*Why are the temperatures expressed as anomalies from 1961-90?* Stations on land are at different elevations, and different countries estimate average monthly temperatures using different methods and formulae. To avoid biases that could result from these problems, monthly average temperatures are reduced to anomalies from the period with best coverage (1961-90). For stations to be used, an estimate of the base period average must be calculated. Because many stations do not have complete records for the 1961-90 period several methods have been developed to estimate 1961-90 averages from neighbouring records or using other sources of data. Over the oceans, where observations are generally made from mobile platforms, it is impossible to assemble long series of actual temperatures for fixed points. However it is possible to interpolate historical data to create spatially complete reference climatologies (averages for 1961-90) so that individual observations can be compared with a
weather patterns. This is underpinned by massive research and data analysis. The causes of these trends include burning fossil fuels (mainly in developed countries) which produces some 6 billion tonnes of CO₂ annually, to which are added another 1.6 billion tonnes from deforestation (mainly in developing countries). Agricultural activities are also responsible for significant amounts of other greenhouse gases, mainly methane and nitrous oxide.

### Table 3-1. Regional and country climate variations in Sub-Saharan Africa

<table>
<thead>
<tr>
<th>Region</th>
<th>Sub-region</th>
<th>Countries</th>
<th>Key climatic features</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Africa</td>
<td></td>
<td>Mauritania, Senegal, Mali, Burkina Faso, Niger, Chad, western Sudan, Guinea, Sierra Leone, Liberia, Côte d’Ivoire, Ghana, Togo, Benin, Nigeria</td>
<td>The region can further be subdivided into: (i) Sahel: Rainy season occurs from July to September. Region is characterized by large inter-decadal climate variability and prolonged drought periods; (ii) Sudan: Region below the Sahel, characterized by a wetter rainfall regime, and (iii) Guinea coast: Bi-modal rainfall regime, no prolonged drought periods, wettest region of West Africa.</td>
</tr>
<tr>
<td>Horn of Africa</td>
<td></td>
<td>Ethiopia, eastern Sudan, Eritrea, Somalia</td>
<td>Different timing of rainy season than in East Africa.</td>
</tr>
<tr>
<td>Central Africa</td>
<td></td>
<td>Cameroon, Central African Republic, Gabon, Equatorial Guinea, Congo, DRC, northern Angola</td>
<td>Central Africa: Largely defined by annual total rainfall. Wettest region on the continent. Bi-modal rainy seasons: October to December and March to May. No known ENSO teleconnections, instead inter-annual climate variability is influenced by Atlantic modes.</td>
</tr>
<tr>
<td>East Africa</td>
<td></td>
<td>Kenya, Uganda, Burundi, Ruanda, Tanzania</td>
<td>East Africa: Bi-modal rainy seasons October to December (short rains) and March to May (long rains). Inter-annual climate variability is strongly influenced by Pacific and Indian Ocean teleconnections.</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>Western Southern Africa</td>
<td>Western South Africa, western Botswana, Namibia, southern Angola</td>
<td>Rainfall peaks between January to March. Inter-annual climate variability by ENSO and Indian Ocean teleconnections.</td>
</tr>
<tr>
<td></td>
<td>Eastern &amp; Central Southern Africa</td>
<td>Eastern and central South Africa, Lesotho, Swaziland, Mozambique, Zimbabwe, Zambia, Malawi</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3-2. Regional climates of Sub-Saharan Africa

<table>
<thead>
<tr>
<th>Region/sub-region</th>
<th>Rainfall seasonality</th>
<th>Approximate seasonal</th>
<th>Approximate mean</th>
</tr>
</thead>
</table>

“local normal for the given day of the year” (Brohan et al., 2006). See also http://www.cru.uea.ac.uk/cru/data/temperature/#datter)
### Table 1. Rainfall and Temperature in Various Regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Rainfall (mm)</th>
<th>Annual Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sahel</td>
<td>July-September</td>
<td>100-400</td>
</tr>
<tr>
<td>Sudan</td>
<td>July-September</td>
<td>400-1200</td>
</tr>
<tr>
<td>Guinea coast</td>
<td>May-October</td>
<td>&gt;1200</td>
</tr>
<tr>
<td>Horn of Africa</td>
<td>July-September</td>
<td>200-1200</td>
</tr>
<tr>
<td>Central Africa</td>
<td>Bi-modal transition seasons</td>
<td>&gt;1300</td>
</tr>
<tr>
<td>East Africa</td>
<td>Bi-modal transition seasons March to May (long rains), October to December (short rains)</td>
<td>500-1200</td>
</tr>
<tr>
<td>Western Southern Africa</td>
<td>January to March</td>
<td>10-450</td>
</tr>
<tr>
<td>Eastern &amp; Central Southern Africa</td>
<td>December to February</td>
<td>450-&gt;1500</td>
</tr>
</tbody>
</table>

### Box 3-1. Influence of ENSO in Kenya

During the warm phase of El Nino (ENSO), Kenya experiences a substantial increase in precipitation. While the relative water gains from rainfall are substantial, in particular in the drylands where vegetative cover and productivity both increase, these gains are not always utilized due to lack of adaptive capacity. Floods wash away top soils and outbreaks of water- and vector-borne diseases, such as rift valley fever and malaria, affect both livestock and human health. By contrast, the cold phase of ENSO, La Nina, which often follows an El Nino episode, leads to prolonged below-normal rainfall or drought conditions. Hence, people in the drylands of Kenya have to cope with a broad spectrum of climate variations.

Source: World Bank staff (based on literature review)

### Figure 3-2. Global Warming Trends (°C)

Source: Brohan et al. (2006). See also http://www.cru.uea.ac.uk/cru/data/temperature/#datter.

64. **IPCC projections of global climate change.** Considerable uncertainty is associated with projections of the level or magnitude of changes in climate parameters
such as temperature and precipitation, as well as the onset, extent, and severity of the impacts. Projections of climate parameters are derived from Global Climate Model (GCM) runs that are based on specific scenarios of the future. The scenarios include basic assumptions about economic growth and structure, population trends, and the extent of reliance on fossil fuels. The IPCC projections are summarized in Table 3-3 for several different scenarios. Depending on the rate of GHG emissions, IPCC projections indicate that temperature would increase in the range of 1.1 to 6.4 ºC by 2100. A rise of the global average temperature beyond 2 ºC is generally considered as having devastating effects on people, and food- and fiber-supporting ecosystems. The higher the degree of global warming the greater the likelihood of consequences for human livelihoods and development processes.

Table 3-3. IPCC scenario forecasts of temperature change in 2080 (change in average global temperature)

<table>
<thead>
<tr>
<th>IPCC scenarios</th>
<th>Relative to pre-industrial temperature (ºC)</th>
<th>Relative to 1980 to 1999 average temperature (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant year 2000</td>
<td>+0.6 (0.3-0.9º)</td>
<td>+ 1.1</td>
</tr>
<tr>
<td>B1</td>
<td>+ 1.8 (1.1.- 2.9)</td>
<td>+ 2.3</td>
</tr>
<tr>
<td>A1T</td>
<td>+ 2.4 (1.4-3.8)</td>
<td>+ 2.9</td>
</tr>
<tr>
<td>B2</td>
<td>+ 2.4 (1.4-3.8)</td>
<td>+ 2.9</td>
</tr>
<tr>
<td>A1B</td>
<td>+ 2.8 (1.7-4.4)</td>
<td>+ 3.3</td>
</tr>
<tr>
<td>A2</td>
<td>+ 3.4 (2.0-5.4)</td>
<td>+ 3.9</td>
</tr>
<tr>
<td>A1F1</td>
<td>+4.0 (2.4 -4.6)</td>
<td>+ 4.5</td>
</tr>
</tbody>
</table>

Scenario A1: Rapid economic and population growth, (i) combined with reliance on fossil fuels (A1F1), and (ii) non fossil energy (A1T).
Scenario A2: Lower economic growth, less globalization, and continued high population growth.
Scenario A1B: Rapid economic and population growth with a balanced mix of technologies and supply sources, with technology improvements.
Scenarios B1 and B2: Some mitigation of emissions through increased resource efficiency and technology improvement.

*Source: IPCC (2007)*

65. Potential adverse impacts of climate change. There are many projected adverse consequences of climate change, including:

- Decreased water availability in many water-scarce regions, especially in arid and semi-arid lands in the sub-tropics;
- Reduction in agricultural productivity in the tropics and sub-tropics for almost any warming, and in mid-latitudes for warming more than a few degrees changes in productivity and composition of ecological systems, with coral reefs and boreal forests most vulnerable with increased risk of extinction of some vulnerable species;
- Increased risk of floods, potentially displacing tens of millions of people due to sea level rise and heavy rainfall, especially in small island states and low-lying deltaic areas; and
- Increased incidence of heat stress mortality and the number of people exposed to vector-borne diseases, such as malaria and dengue, and water-borne diseases such as cholera, especially in the tropics and sub-tropics

3.3 Projected climate changes for Sub-Saharan Africa

66. **Climate projections in Africa are hindered by limited data.** While there is growing evidence that climate change is already underway, regional and local trends are often masked by the high annual and inter-annual variability in climatic conditions. The sparse meteorological data networks, spurious data records, and/or difficult data access in many parts of the continent represent an additional constraint to detecting climatic changes. The resolution and quality of available climate information vary considerably across the continent. Notwithstanding these issues, a large number of Global Climate Model (GCM) simulations for a range of scenarios are available and are being used to assess the potential changes that SSA may experience (Table 3-4).

**Table 3-4. Overview of climate changes projected for Africa**

<table>
<thead>
<tr>
<th>Change</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average conditions</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature increase</td>
<td>Entire continent (median projected increase in annual average temperature: 3 to 4 ºC (end of century to present)</td>
</tr>
<tr>
<td>Decrease in rainfall</td>
<td>West coast of Africa as far south as 15º N</td>
</tr>
<tr>
<td>Southern Africa</td>
<td></td>
</tr>
<tr>
<td>Increase in rainfall</td>
<td>Northern parts of East Africa</td>
</tr>
<tr>
<td>Uncertain projections for rainfall</td>
<td>Sahel (already high variability)</td>
</tr>
<tr>
<td>Guinean coast</td>
<td></td>
</tr>
<tr>
<td>Southern Sahara</td>
<td></td>
</tr>
<tr>
<td>Sea level rise</td>
<td>Low lying islands and coastal zones</td>
</tr>
<tr>
<td></td>
<td>Delta regions</td>
</tr>
<tr>
<td><strong>Extremes</strong></td>
<td></td>
</tr>
<tr>
<td>Increase in intense precipitation events</td>
<td>Entire continent (this applies also in regions of mean drying because there is a proportionally larger decrease in the number of rain days)</td>
</tr>
<tr>
<td><strong>Cyclones</strong></td>
<td>Uncertain — changes in magnitude and frequency, and shifts in cyclone tracks possible</td>
</tr>
</tbody>
</table>

Source: Based on IPCC (2007)

67. **The region will have to plan on:** (i) increased temperatures that will stress agricultural and natural ecosystems; (ii) increased water shortages and regional differences in water availability; (iii) shorter growing periods for parts of Sub-Saharan
Africa; and (iv) intensified precipitation events that may increase the magnitude and frequency of flooding.

68. **Projected temperature changes.** On the whole, the African continent has warmed by about 0.5 °C over the last century. Based on climate simulations available to date, the median projected additional increase in average annual temperature is likely to reach 3 to 4 °C by the end of this century.

69. **Climate projections for precipitation.** The existing precipitation gradient, from the tropics to the sub-tropics, could be further exacerbated in the future. As global warming progresses, it is generally expected that dry areas are becoming drier and wet areas are becoming wetter. Areas that already receive substantial amounts of rainfall are expected to receive more rainfall in the future. Areas receiving only sparse rainfall today are likely to experience even less rain over time, which poses an additional challenge to livelihoods and economic activities that depend on natural resources. Increases in temperature will increase evaporation from the soil and water bodies and increase transpiration by plants, but the overall change in run-off (and hence stream flow) and groundwater recharge depends on the level of change in precipitation. Projected changes in annual average precipitation are indicative of overall wetting and drying of the annual climate. It is these variations in the timing and magnitude of monthly rainfall, when combined with changes in temperature and other conditions (development including infrastructure, land management, etc), that result in changes in run-off and groundwater recharge. Considerable research is ongoing to utilize the GCM simulation results to simulate changes in the hydrologic cycle and to model river basins to assess changes in stream flow that provide a basis to assess climate risk.

70. **Projected changes in the length of growing (LGP) period.** While the magnitude of change differs depending on the type of model and scenario used, the general picture of how growing periods may change across the region (Figure 3-3) suggests that the decline in the length of growing period is most pronounced in areas where climatic conditions are already a constraining factor to agriculture-based livelihoods. Declining LGPs are also observed in some areas with projected increases in rainfall due to enhanced evaporation under global warming. However, just as important may be changes in monthly and seasonal precipitation, especially the early or late onset or cessation of rainfall.

**Figure 3-3. Relative change in length of growing period (LGP) by 2050 compared to present**
Source: Thornton et al. (2006)
4. Climate Change Impacts

4.1 Prospective changes to climate and country exposure to climatic risks

71. More climatic extremes. As described in Chapter 3, temperatures are rising and rainfall is becoming more unpredictable, but generally dry areas will become drier and wet areas will become wetter. Africa experienced important shifts in climate over the past millennia, but likely changes in the next few decades may present some of the greatest challenges. Along with rising temperatures, there is also likely to be increased rainfall variability leading to more precipitation extremes and growing water stress. Growing seasons will be affected. More intense and unpredictable weather events are likely in countries such as Kenya, Ethiopia, Malawi, Mozambique, and Madagascar (Figure 4-1). The six warmest years on record in Africa have occurred within the last 20 years and the average temperature rose approximately 0.5 °C during the 20th century. In addition, the continent has seen a decrease in rainfall over large parts of the Sahel and Southern Africa, and an increase in parts of East and Central Africa. The number of weather-related disasters, droughts and floods, has doubled in Africa over the last 25 years, and Africa has higher mortality rates from droughts than any other region.

72. Nature and level of climatic changes. The initial problem for policy makers and sector development authorities is to determine the nature and level of potential climatic changes. In Figures 4-1 and 4-2 we have mapped IPCC projections (available for a global 0.5° × 0.5° grid that ranges in size from 250 to 600 kilometers) to each SSA country. We then assessed the level of risk using assumed risk threshold parameters that differentiate the degree of predicted change (e.g., change in precipitation greater than 10 percent is assigned a high risk). In addition to monthly changes in wet- and dry-season precipitation, to determine flood and drought risk we also used predictions of changes in maximum short-duration rainfall (5 days), number of consecutive dry days, and change in run-off based on hydrologic modeling of IPCC projections of temperature and precipitation change.

73. Relative risks. Table 4-1 and Figure 4-1 are meant to be indicative of relative risk or exposure and hence to help establish priorities. Countries with a high risk of exposure need to begin developing the capacity and knowledge base to determine specific manifestations for these projections, and formulate medium- and long-term plans to adapt and adjust. For example, hydrologic modeling of increased temperature and rainy season precipitation indicates that these changes are generally amplified as increased run-off. Increased rainy season precipitation accompanied by increased short-duration rainfall (increased intensity) would indicate increased flooding risks (increased magnitude and frequency). On the other hand, increased precipitation may mainly increase water basin yield and offer opportunities to improve hydropower and irrigation potential and as well as the reliability of domestic and industrial water supplies.

Table 4-1. Indicative country exposure to climate change risks

<table>
<thead>
<tr>
<th>Potential change</th>
<th>Floods (wetter with higher run-off)</th>
<th>Droughts (drier and lower run-off)</th>
<th>Sea level rise</th>
<th>Cyclone</th>
</tr>
</thead>
</table>

14. These results are based on data from 11 GCMs for the A1B scenario (Table 3-3) for precipitation, and eight GCMs for temperature. Data available for the GCM global 0.5° × 0.5° grid were mapped within country boundaries. Because of systematic biases and other model differences, all the GCM model results do not agree in some regions. Overall, about two out of three of the 11 models agree on the sign of precipitation change.
<table>
<thead>
<tr>
<th>Higher</th>
<th>Kenya</th>
<th>Botswana</th>
<th>Gambia</th>
<th>Mozambique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eritrea</td>
<td>Namibia</td>
<td>Senegal</td>
<td>Guinea-Bissau</td>
<td>Madagascar</td>
</tr>
<tr>
<td>Sudan (eastern)</td>
<td>Lesotho</td>
<td>Ghana</td>
<td>Senegal</td>
<td>Mauritius</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Angola (southern)</td>
<td>Zambia</td>
<td>Sierra Leone</td>
<td></td>
</tr>
<tr>
<td>Angola (northern)</td>
<td>Zimbabwe</td>
<td>Liberia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senegal*</td>
<td>Senegal*</td>
<td>Senegal*</td>
<td>Benin</td>
<td></td>
</tr>
<tr>
<td>Burkina Faso*</td>
<td>Burkina Faso*</td>
<td>Mali*</td>
<td>Togo</td>
<td></td>
</tr>
<tr>
<td>Mali*</td>
<td>Niger*</td>
<td>Niger*</td>
<td>Cote d'Ivoire</td>
<td></td>
</tr>
<tr>
<td>Niger*</td>
<td>Chad*</td>
<td>Chad*</td>
<td>Cameroon</td>
<td></td>
</tr>
<tr>
<td>Mauritania*</td>
<td>Mauritania*</td>
<td>Mauritania*</td>
<td>Cape Verde</td>
<td></td>
</tr>
<tr>
<td>Sudan (western)*</td>
<td>Sudan*</td>
<td>Sao Tome &amp; Principe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gambia*</td>
<td>Gambia*</td>
<td>Gambia*</td>
<td>Comoros</td>
<td></td>
</tr>
<tr>
<td>Guinée</td>
<td>Guinea-Bissau</td>
<td>Mauritius</td>
<td>Tanzania</td>
<td></td>
</tr>
<tr>
<td>Gabon</td>
<td>South Africa (western)</td>
<td>Madagascar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congo</td>
<td>Mozambique</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burundi</td>
<td>Eritrea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rwanda</td>
<td>Somalia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uganda</td>
<td>Kenya</td>
<td></td>
<td></td>
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<tr>
<td>Tanzania</td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mozambique</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malawi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa (eastern)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central African Rep</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congo, Dem Rep</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Projections of future rainfall are highly uncertain in the countries of the Sahel region because of the precipitation gradient between the wetter and dryer parts of the countries.

An asterisk (*) indicates large uncertainties in the simulations. A drying trend is presumed to be worse than a wetting trend. Where large uncertainties in the projections persist, drying trends are highlighted in bold. No asterisk indicates which scenario predominates for a particular country and/or good agreement in the direction of the projections. This is a medium-term outlook (next 50 years). If warming trends continue any precipitation gains are likely to be offset by increased evaporation rates. The table does not capture climatic differences within a given country and is intended only as a general overview.

4.2 Effects of climate change on economic growth

74. **Improved economic performance.** After stagnating for several decades, economic performance in Africa has been improving. In recent years GDP growth has been accelerating to about 6 percent per year while inflation registered below a two-digit level, a recent low point (Arbache et al., 2007). The current growth performance has lasted more than a decade, and average incomes in Africa have been rising in tandem with those in other regions (Figure 4-2).

**Figure 4-2. Economic performance by main climatic regions in SSA**

Source: Data from Arbache et al. (2007), Table 1

75. **Recent economic performance** exhibits a similar pattern across climatic zones. The distribution among countries between high and low performers is similar across the main climate zones in SSA (Figure 4-2). While average GDP growth between 2000 and 2006 was highest in Central Africa (6.6 percent), closely followed by western Southern Africa (6.1 percent), the Sahel (6 percent), and the Guinea coast (5.0 percent), it was lowest in the Horn of Africa (4.9 percent), East Africa (4.6 percent), and eastern Southern Africa (4.2 percent). Interestingly, in the Sahel region — where further drying conditions are projected along with large uncertainties and shortening of the main growing period — has seen solid economic performance of late predictions (IPCC, 2007; Washington, 2008).
76. **Sub-Saharan African economies have a degree of built-in climate resilience.** Some measure of resilience to climate variability is clearly already built into African economies, despite their many vulnerabilities. Present development strategies and models already include important adjustments and adaptations to weather, climate, and hydrologic risks. This includes investments in water storage, flood control and drainage infrastructure, crop varieties and practices, irrigation infrastructure, diversification of water supply sources, coastal defenses, health systems, etc.

77. **Climate change introduces new risks.** While an even greater degree of adaptation to climate variability needs to be built into SSA economies, climate change introduces a new set of risks and challenges. Past variations and patterns are an incomplete guide to what might be expected in the future. Extremes such as droughts, floods, and cyclones are predicted to increase in frequency and magnitude (Figure 4-3); sea levels are expected to rise, adversely affecting not only coastal zones but drainage far inland in many cases; and seasonal patterns of rainfall intensity and magnitude are predicted to change, increasing in some sub-regions and seasons and decreasing in others. Parts of Sub-Saharan Africa have already experienced an increase in temperature, and this important change is predicted to increase and affect larger areas.

**Figure 4-3.** Number of reported hydro-meteorological disasters in SSA (1985-2007) and increasing trend

![Graph showing the number of reported hydro-meteorological disasters in SSA (1985-2007) and increasing trend.](source: EM-DAT)
78. **Agriculture is most vulnerable sector.** While all of Africa’s major economic sectors are vulnerable to climatic change, agriculture is the most vulnerable. In most African countries, due to a lack of economic diversification and the importance of rainfed agriculture, there is a close association between GDP growth and rainfall. The persistent correlation between rainfall and GDP growth in Ethiopia (Figure 4-4) is striking; this is not the case in countries with higher incomes and highly diversified economies such as China or India, or African countries with low dependence on agriculture (e.g., Botswana, Namibia, Mauritius). Moreover, long-term projections forecast that Africa’s agricultural output could be reduced more than any other region of the world.\(^{15}\)

![Figure 4-4. Links between rainfall and GDP growth (Ethiopia)](source: World Bank (2006c))

79. **High cost of natural disasters.** Droughts and floods cause significant economic and social losses (Figure 4-5). Country-level studies over the past 30 years suggest that the impacts of hydrology and rainfall variability on economic development are significant, estimated at 8 to 9 percent of GDP in Zimbabwe and Zambia in 1992, and 4 to 6 percent in Nigeria and Niger in 1984. In Ethiopia, it was estimated that droughts and floods reduced economic growth by more than one-third. Annual damages in Kenya due to flooding and drought from 1998 to 2000 range from 10 to 16 percent of GDP (the 1997/98 flood alone destroyed $1.8 billion worth of infrastructure and property). The Mozambique 2000 floods cost the country $550 million (1.5

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\(^{15}\) A recent global study by IIASA (2002.) concludes that climate change will have a significant negative impact on cereal production in Africa. This will be due to the increase in areas where the length of the growing period will fall below 120 days per year (thus more land area would become arid). Some 180 million Africans will potentially be threatened by famine.
percent reduction GDP growth rate). In addition to direct and immediate impacts, floods and droughts can also have persistent effects through destruction of productive capital and/or, in the absence of safety nets, disposal of productive capital for survival (for example, the sale of livestock by poor households).

80. **Energy scarcity is a drag on SSA economies.** Climate change also affects the availability and reliability of energy. Lower annual rainfall in some parts of the continent has sharply reduced the power generation capacity of hydroelectric dams. Meanwhile, because of a combination of factors (including low investment, inadequate management, and international prices), 28 countries in Africa have been affected by power crises in the past two years. This energy scarcity, compounded by high fuel prices, has raised the cost of transport, industrial, and commercial sector operations in most African countries.

### Figure 4.5. Change in agricultural output potential (2080 as % of 2000)

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>-16.7</td>
</tr>
<tr>
<td>Latin America</td>
<td>-12.9</td>
</tr>
<tr>
<td>ME &amp; North Africa</td>
<td>-9.4</td>
</tr>
<tr>
<td>Asia</td>
<td>-7.2</td>
</tr>
<tr>
<td>Developing Ctries</td>
<td>-7.7</td>
</tr>
<tr>
<td>World</td>
<td>-3.2</td>
</tr>
<tr>
<td>USA</td>
<td>8.2</td>
</tr>
<tr>
<td>Europe</td>
<td>4.1</td>
</tr>
<tr>
<td>Industrial Countries</td>
<td>7.7</td>
</tr>
</tbody>
</table>

*Source: Cline (2007)*

81. **Climate change is a development issue.** Climate change poses a threat to sustainable development and may unravel progress that has been made toward achieving the Millennium Development Goals (MDGs) by 2015 and beyond unless measures to mitigate risk are taken. This was the message of a report on poverty and climate change written by the World Bank and nine other multilateral and bilateral organizations (AfDB et al., 2003), highlighting the importance of recognizing climate change as a development issue. This message was echoed by reports from civil society organizations (e.g., IIED, 2007) and other stakeholder groups.

82. **Conceptual links between climate change and the MDGs.** These reports generally describe the conceptual links between climate change and the objectives of different MDGs, examining how climate change will challenge the processes required to achieve the MDGs. For
the MDGs concerned with income levels and hunger, human health, and access to water and sanitation, there is insufficient momentum to meet the targets by 2015 across wide areas of Africa. The MDGs most susceptible to direct climate change impacts are MDG 7, particularly increased access to potable water, MDG 1, progress on food security, and MDG 6, prevalence and death rates associated with malaria. A search of the literature revealed that there is currently a lack of systematic, quantitative assessments of the impacts of climate variability and change on the sectors (social and economic) that are central to achieving and sustaining the MDGs across African countries.

83. **MDGs: goals, targets, and current status.** Table 4-2 lists the Millennium Development Goals, some associated targets, and their current status in Sub-Saharan Africa.

<table>
<thead>
<tr>
<th>MDG and measure of achievement</th>
<th>1990</th>
<th>2004</th>
<th>2015 target</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDG 1: People living on $1 (PPP) as % of population</td>
<td>44.6</td>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>MDG 2: Net primary enrollment rate (%)</td>
<td>53</td>
<td>64</td>
<td>100</td>
</tr>
<tr>
<td>MDG 3: Promote gender equality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of girls who completed primary education</td>
<td>51</td>
<td>61</td>
<td>100</td>
</tr>
<tr>
<td>Percent of illiterate women in the 15 to 24 age group</td>
<td>80</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td>MDG 4: Under-5 mortality per 1,000 births</td>
<td>185</td>
<td>168</td>
<td>62</td>
</tr>
<tr>
<td>MDG 5: Deliveries attended by skilled health workers (%)</td>
<td>42</td>
<td>46</td>
<td>100</td>
</tr>
<tr>
<td>MDG 6: Combat malaria, tuberculosis, HIV/AIDS and other diseases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult HIV/AIDS prevalence (percent of adult population)</td>
<td>2.7</td>
<td>5.8</td>
<td>Stop increase</td>
</tr>
<tr>
<td>Tuberculosis prevalence (cases per 100,000 excluding HIV infected)</td>
<td>337</td>
<td>492</td>
<td>Stop increase</td>
</tr>
<tr>
<td>MDG 7: Ensure environmental sustainability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to improved water source (% of population)</td>
<td>49</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>Access to improved sanitation (% of population)</td>
<td>32</td>
<td>37</td>
<td>66</td>
</tr>
<tr>
<td>MDG 8: Develop a global partnership for development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of ODA flows (% of donor GNI)</td>
<td>0.33</td>
<td>0.22</td>
<td>0.7</td>
</tr>
</tbody>
</table>

*Source: World Bank: Millennium Development Goals*

84. **Evidence of climate change effects.** Table 4-3 shows the different ways that current climate variability and climate change will continue to affect sectors that are central to achieving and sustaining the MDGs across Africa. It is important to note that no studies were encountered in the review of literature that assessed how climate change will affect MDGs across Africa. Some general assertions have been made by UNDP and UNFCCC about the likely impacts of climate and climate change on the MDGs, but these have not been followed up with empirical
4.4 Costs of adapting to climate change

Estimating the cost of adaptation to future climate change is problematic. First, climate change affects all sectors, making it difficult to separate adaptation from general development. Second, it is increasingly difficult to extrapolate future impacts of climate change from historical climate and hydrologic patterns — making any estimate of the costs of adaptation highly speculative. For example, if Ethiopia improves its flood management forecasting and information system, what proportion of this is an adaptation to past (and current) variability versus that for future climate changes? With these important caveats, there have been several attempts to provide approximate estimates of the financing required for adaptation. Most have focused on “climate-proofing,” that is, they looked principally at the cost of adapting current investments and infrastructure to protect them against climate change risks.

Table 4-3. Evidence of the ways that climate change will affect the achievement and sustainability of the MDGs across Africa

<table>
<thead>
<tr>
<th>Climate impacts</th>
<th>Sector</th>
<th>Information from climate projection research work</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDG 1: Eradicate extreme poverty and hunger</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. The UNFCCC (the Convention) divides countries into three main groups according to differing commitments:

Annex I Parties include the industrialized countries that were members of the OECD in 1992, plus countries with economies in transition (EIT), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

Annex II Parties include the OECD members of Annex I, but not the EIT Parties. They are required to provide financial resources to enable developing countries to undertake emissions reduction activities under the Convention, and help them adapt to adverse effects of climate change, as well as “take all practicable steps” to promote the development and transfer of environmentally friendly technologies to EIT Parties and developing countries.

Non-Annex I Parties are mostly developing countries. Certain groups of developing countries are recognized by the Convention as being especially vulnerable to the adverse impacts of climate change. The 49 Parties classified as least-developed countries (LDCs) by the United Nations are given special consideration under the Convention because of their limited capacity to respond to climate change and adapt to its adverse effects. Parties are urged to take full account of the special situation of LDCs when considering funding and technology-transfer activities (Out of 49 countries classified as LDCs, 33 are from Sub-Saharan Africa) (http://unfccc.int/essential_background/convention/items/2627.php).
Productivity declines in terms of crop yields, animal product off-take reduces household incomes and/or worsens food security.

**Crops**
- Productivity of mixed rainfed and semi-arid systems, particularly in the Sahel, expected to decline.
- Agricultural GDP losses range from 2 to 4% with some model estimates.
- Food security, already a humanitarian crisis in southern Africa, is likely to be further aggravated.
- Wheat production likely to disappear from Africa by the 2080s.
- Southern Africa likely to experience notable reductions in maize production under possible increased ENSO conditions.

**Livestock**
- Changes in disease distribution, range, prevalence, incidence, and seasonality can all be expected. However, there is low certainty about the degree of change.

**Fisheries**
- Fisheries productivity may or may not decline due to change in water temperature, salinity, acidity, and other fluctuations; however, the emergence of new water bodies, improved low-flow availability, or more extensive flooded areas where rainfall will increase may create new opportunities.
- Rainfall changes might affect water levels in freshwater bodies which can therefore change fish habitat (including breeding habitat), salinity, and acidity. In the marine environment, currents might change and coastal erosion might be more pronounced, both potentially affecting fish habitat, breeding, and migrations.

**Nutrition**
- Nutrition (as measured by underweight) is likely to be affected by reduced food production and availability.

**MDG 2: Ensure that all children remain in school and receive a high-quality education**

Loss of livelihood assets (natural, health, financial, and physical capital) may reduce opportunities for full-time education in numerous ways.

**Food security**
- Experience in several African countries (Ethiopia, Ghana, Niger) shows that children aged 5 and under are more likely to be stunted if they were born during a drought year.
- In Kenya, being born in a drought year increases the likelihood of children being malnourished by 50 percent.

**MDG 3: Promote gender equality and empower women**

Climate change affects women more than men, exacerbating gender inequalities.

**Agriculture**
- Rural women in developing countries are the primary producers of staple foods, a sector that is highly exposed to the risks that come with drought and uncertain rainfall.

**Women and girls have to cope with fewer resources and a greater workload**

**Water**
- Climate change means that women and young girls have to walk further to collect water, especially in the dry season.

**MDG 4: Reduce child mortality & MDG 5: Improve maternal health**

Children and pregnant women are particularly susceptible to vector-borne diseases.

**Health**
- Some 800,000 children under age 5 in sub-Saharan Africa die as a result of malaria each year, making it the third largest killer of children worldwide. Rainfall, temperature, and humidity are three variables that most influence transmission of malaria — and climate change will affect all three.
- In eastern Africa, flooding in 2007 created new breeding sites for disease vectors such as mosquitoes, triggering epidemics of Rift Valley Fever and increasing levels of malaria.

Table 4-3. Evidence of the ways that climate change will affect the achievement and sustainability of the MDGs across Africa (continued)

<table>
<thead>
<tr>
<th>Climate impacts</th>
<th>Sector</th>
<th>Information from climate projection research work</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDG 6: Combat malaria, tuberculosis, HIV/AIDS, and other diseases</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Water stress and warmer conditions encourage disease

**MDG 7: Ensure environmental sustainability**

- The highlands of Eastern Africa and areas of Southern Africa are likely to become more suitable for malaria transmission.

**Altering and possible irreversible damage in the quality and productivity of ecosystems and natural resources**

- Increase in number of people who could experience water stress by 2055 in northern and Southern Africa. In contrast, more people in Eastern and western Africa will be likely to experience a reduction rather than an increase in water stress.
- Parts of Southern Africa are projected to experience significant losses of run-off, with some areas being particularly affected (e.g., parts of South Africa).
- Increasing difficulty in maintaining wetlands and aquatic ecosystems and environmental flows.
- There is no clear indication of how flow in key river basins (e.g., Nile, Zambezi, Niger, Senegal) will be affected by climate change because of the uncertainty about rainfall patterns in the basins and the influence of complex water management and water governance structures.

**MDG 8: Develop a global partnership for development**

- Developed countries have fallen short of targets they have set for themselves to achieve wide-reaching development objectives.
- Climate change challenges will require significant additional resources.

**Funding for development and adaptation must be greatly increased to meet the needs of the poor**

- Developed countries have fallen short of targets they have set for themselves to achieve wide-reaching development objectives.
- Climate change challenges will require significant additional resources.

**Source:** IIED (2007), see also AfDB et al. (2003)

86. **World Bank/UNDP approach.** The first estimate is based on preliminary calculations by the World Bank of the additional cost of adapting or climate-proofing new investments financed each year by development aid, domestic resources, and foreign direct investments. Of the $3 trillion per year of investments in the developing world, the majority of which are domestic investments, and assuming that the percentage of these investments that are sensitive to climate risk varies between 5 and 20 percent, total yearly adaptation costs are estimated to range from $4 to 37 billion. A recent update by UNDP (2007) using 2005 as a base year put the mid-range of the costs of adaptation at about $37 billion a year (Table 4-4). 17.

87. **Oxfam’s NAPA-based estimate.** Extrapolating from the project cost of some 13 national adaptation action plans (NAPA), Oxfam puts the financing needed for immediate climate-proofing at between $1.1 billion and $2.2 billion for the least-developed countries, rising to $7.7 to $33 billion for all developing countries (Table 4-5). Using a different approach, Oxfam attempted to estimate the broad financing requirements for community-based adaptation. Drawing upon a range of project-based per capita estimates, it reached an indicative figure of around $7.5 billion in adaptation financing requirements for people living on less than $2 per day.

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17. A new global study, *The Economics of Adaptation to Climate Change* (World Bank Environment Department), is a multi-year multi-country study designed to help developing country decision makers to better design climate change adaptation strategies through an improved understanding and assessment of the risks posed by climate change, the adaptation measures that can be taken to reduce risks and/or adverse impacts, and the costs and benefits of such measures. The study results from a partnership between the World Bank which is leading the technical aspects of the study and the governments of the United Kingdom, Netherlands, and Switzerland which are funding the study. The study will be initially focus on seven case study countries — Ethiopia, Mozambique, Ghana, Bangladesh, Vietnam, Bolivia and a small East Pacific island country (being identified at present).
88. **UNFCCC sectoral adaptation estimates.** The third estimate comes from an analysis by the UNFCCC\(^\text{18}\) to estimate additional investments needed for adaptation in 2030 in selected sectors (Table 4-6). Due to the difficulties of estimating the adaptation costs to climate change in sectors such as ecosystems, these estimates may be low because the adaptation needs of some sectors were not included. Estimates are based on climate modeling assumptions. For the world as a whole, it was estimated that additional investments needed for adaptation in 2030 could be as high as $170 billion per year, a large share of which is accounted for by infrastructure (representing some 0.2 percent of an $80 trillion global economy). The costs for developing countries are estimated at $57 billion and could be as high as $100 billion per year several decades from now.

<table>
<thead>
<tr>
<th>Type of investment</th>
<th>Developing countries (billion $)</th>
<th>Estimated portion sensitive to climate change (%)</th>
<th>Estimated cost of climate adaptation (%)</th>
<th>Estimated cost (billion $)</th>
<th>Mid-range of estimated cost (billion $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic investment</td>
<td>2,724</td>
<td>2-10</td>
<td>5-20</td>
<td>3-54</td>
<td>30</td>
</tr>
<tr>
<td>Foreign direct investment</td>
<td>281</td>
<td>10</td>
<td>5-20</td>
<td>1-6</td>
<td>3</td>
</tr>
<tr>
<td>Net official development assistance</td>
<td>107</td>
<td>17-33</td>
<td>5-20</td>
<td>1-7</td>
<td>4</td>
</tr>
</tbody>
</table>

*Source: UNDP (2007) using broad estimates from various sources and assumptions on climate sensitivity and cost from Stern (2006)*

89. **Two studies also identified possible sources** of funding (UNFCCC 2007, 2008). In agriculture, forestry, and fisheries, a large share of additional investment will be in production\(^\text{19}\) and processing and thus will likely be covered by private sector agents. But public resources will likely be needed for research and development, extension, and direct support to small-scale farmers. For water resources, 80 percent of the estimated need will be in developing countries and the majority of financing will come from the public sector, both domestic and foreign. The totality of the additional investment needs in human health will be in developing countries with most of the cost to be shouldered by the families of those affected. But external support is expected to play an important role. For coastal zones, about one-half of the adaptation needs will be in developing countries with the large coastal deltas in Asia and Africa and small island states as most affected. Additional sources of external development assistance will likely be needed. In infrastructure, the very wide range of the estimate reflects the significant uncertainty of the climate impacts.

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\(^{18}\) UNFCCC (2007, 2008). Estimates of financial flows and investment needs for adaptation have not changed from the 2007 report, and remain in the tens of billions, possibly hundreds of billions dollars of per year. The update reflects efforts to assess adaptation needs through regional and national bottom-up assessments as compared to global top-down estimates.

\(^{19}\) Most wild fisheries are already at maximum production capacity and processing plants throughout the world tend to operate at 50 percent capacity or less. Production will increase through aquaculture, but not through wild capture fisheries.
Table 4-5. NAPA-based estimates

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Population (millions)</th>
<th>GDP (billion)</th>
<th>Land use (sq. km.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAPA 13, submitted</td>
<td>218</td>
<td>83</td>
<td>349</td>
</tr>
<tr>
<td>All LDCs</td>
<td>741</td>
<td>257</td>
<td>2,262</td>
</tr>
<tr>
<td>All developing countries</td>
<td>5,094</td>
<td>8,347</td>
<td>15,178</td>
</tr>
<tr>
<td>Scaling-up from NAPA budgets</td>
<td>$1.1 billion</td>
<td>$1.0 billion</td>
<td>$2.2 billion</td>
</tr>
<tr>
<td>Scaling-up for all LDCs</td>
<td>$7.7 billion</td>
<td>$33.1 billion</td>
<td>$14.4 billion</td>
</tr>
</tbody>
</table>

Source: Oxfam (2007)

Table 4-6. UNFCCC estimates of adaptation investment needs in 2030

<table>
<thead>
<tr>
<th>Sector</th>
<th>Global (billion $)</th>
<th>Share of developing countries (%)</th>
<th>Source of funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry, and fisheries</td>
<td>14</td>
<td>50</td>
<td>Private sector</td>
</tr>
<tr>
<td>Water supply</td>
<td>11</td>
<td>80</td>
<td>Public sector</td>
</tr>
<tr>
<td>Human health</td>
<td>5</td>
<td>100</td>
<td>Families</td>
</tr>
<tr>
<td>Coastal zones</td>
<td>11</td>
<td>40</td>
<td>Public sector</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>8-130</td>
<td>25</td>
<td>Public sector</td>
</tr>
</tbody>
</table>

Source: UNFCCC 2007 and 2008

5. Primary Ongoing Initiatives and Programs

5.1 Introduction

This section briefly reviews key programs that are either underway or at an advanced stage of preparation, and which have direct relevance to the Bank strategy. The main focus is on initiatives with strong country and/or African institution ownership.

5.2 World Bank Group Africa Action Plan

Platform for climate-resilient development. The Africa Action Plan (AAP) is the World Bank Group’s strategy, in partnership with others, to help each African country reach as many of the MDGs as possible (World Bank, 2006). The AAP provides a results-oriented framework to support critical policy and public actions by African countries, with a focus on building honest and capable states through governance reforms; raising the rate of growth; enabling the poor and women to participate in, and benefit from, growth; building partnerships at
the country, regional, and global levels; greater country and sector selectivity in the design and targeting of interventions; better harmonization and alignment of development partner actions to support country-led strategies; and the establishment of sound monitoring and evaluation systems. Moreover, the Africa Region is focusing on the results agenda through IDA 15, which requires reporting at mid-term on progress with incorporating climate change into IDA 15 overall results.

92. **Strengthening the drivers of growth, and leaving no one behind.** The AAP underlines that the poor and marginalized must benefit from a shared growth agenda. It contains 25 initiatives and over 100 suggested actions, focusing on three broad areas:

- Build capable states and improving government.
- Strengthen the drivers of growth — a vibrant private sector, expanded exports, infrastructure investment, increased agricultural productivity, as well as investments in education, health, and access to economic opportunity for the poor.
- Increase the impact of partnerships among governments and development partners/agencies with a special focus on agriculture as a driver of growth (Box 5-1).

93. **AAP focus areas.** African country Poverty Reduction Strategy Papers and the growth agenda they support form the foundation for the AAP. The Plan makes specific commitments, such as increased financial support for free primary education in 15 countries and more funding for roads, power, and other infrastructure. It also proposes an expansion of the Bank’s Malaria Booster Program by 150 percent in 17 countries, and expects to scale-up lending support for HIV/AIDS programs in 10 countries, as well as greater investment toward achieving the Millennium Development Goals. In addition, the Africa Action Plan supports the African Infrastructure Consortium in mobilizing resources for country and cross-border regional infrastructure projects.

**Box 5-1. Scaling-up support for African agriculture**

For many African countries, a push for agricultural exports will be the means by which they kick-start sustainable growth and open markets to African products. Many countries have the climatic conditions to compete in a world market, for example, the cut flower industry in Kenya and Ethiopia and horticultural products in Senegal. More important, 70 percent of Africans find employment and livelihood in agriculture.

The AAP sees agriculture as a driver of growth, and calls for the World Bank Group to help governments design, cost, and mobilize the resources needed to implement comprehensive programs of agricultural development, and to work with the New Partnership for Africa’s Development (NEPAD) and development partners to scale-up coordinated support.

*Source: World Bank*

**5.3 World Bank carbon finance program**

94. **Catalytic role of carbon finance.** Because carbon finance provides a means to leverage new private and public investment in projects that reduce greenhouse gas emissions over the past decade — thereby mitigating climate change while contributing to sustainable development — the World Bank has pioneered a number of carbon finance mechanisms, using funds contributed by governments and companies in OECD countries to purchase project-based greenhouse gas
emission reductions in developing countries and countries with economies in transition. The emission reductions are purchased through one of the 10 carbon funds on behalf of the contributor, and within the framework of the Kyoto Protocol Clean Development Mechanism (CDM) or Joint Implementation (JI).

95. **Carbon finance can help reduce poverty.** The World Bank carbon finance initiatives are an integral part of the Bank’s programs to reduce poverty through its environment and energy strategies. Carbon finance has served as a catalyst in bringing climate issues to bear in projects relating to rural electrification, renewable energy, energy efficiency, urban infrastructure, waste management, pollution abatement, forestry, and water resource management.

96. **Building the capacity to access carbon finance.** Because African countries lack supportive national CDM approval systems and have significantly higher transaction costs and risks, they are largely bypassed in favor of larger transactions in middle-income countries (So far, only about 3 percent of CDM projects are being implemented in SSA.) Therefore, a specific strategy for Africa is being implemented to ensure an equitable share of the benefits of carbon finance.

97. **New partnerships with African countries.** Under the Africa-Assist window of the global Carbon Fund-Assist program, new partnerships between selected African countries, regional and international organizations, donors, and civil society are being fostered to support critical “learning-by-doing” capacity building opportunities in about a dozen SSA countries. The World Bank and the Government of France, through its Agence Française de Développement/FFEM are supporting the development of a new Africa-focused carbon finance partnership. This initiative covers a six-month preparation phase, followed by a five-year active implementation phase, with a core focus on facilitating CDM project development, and a special focus on North, West, and Central Africa.

98. **Climate Investment Funds (CIFs) are new instruments** established by the Bank jointly with the regional development banks (AfDB, AsDB, EBRD, and IDB) to promote international cooperation on climate change and support progress toward the future of the climate change regime. The CIFs seek to mobilize new and additional resources at significant scale. The CIFs have the objective of providing experience and lessons in responding to the challenges of climate change through learning-by-doing. These new funds build on the experience gained from the World Bank’s Clean Energy Investment Framework (CEIF), which identified the need for increased financial resources and instruments to fill the financing gap to scale-up clean energy investments and integrate climate resilience into development assistance.

99. **The CIFs include** the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The CTF is designed to promote scaled-up demonstration, deployment, and transfer of low-carbon technologies in the power sector, transportation, and energy efficiency in buildings, industry, and agriculture. The CTF is already operational, and (as of December 2008) its steering committee has approved the first three proposed programs (Turkey, Egypt, and Mexico). Programs for Nigeria and South Africa are under preparation. The SCF will provide financing to pilot new development approaches or to scale-up activities aimed at a specific climate change challenge through targeted programs. The first program to be included in the SCF — the Pilot Program on Climate Resilience (PPCR) — is already piloting national-level actions to enhance
climate resilience in a few highly vulnerable countries, including three in Africa: Niger, Mozambique, and Zambia. The PPCR is also operational with a fund of $500 million, and is expected to support four or five programs in Sub-Saharan Africa. Another program under the SCF, the Forest Investment Fund, is expected to be operational by the end of the second quarter of 2010. Other programs under consideration include support for energy efficient and renewable energy technologies to increase access to “green” energy in low income countries; and investments to reduce emissions from deforestation and forest degradation through sustainable forest management (World Bank, www.worldbank.org/cif).

5.4 Country-driven National Adaptation Plan of Action (NAPA) process

Helping LDCs with climate change. Realizing the limited ability of the LDCs to adapt to the adverse impacts of the effects of climate change, in 2001 the UNFCC established a process to help poor countries prepare NAPAs. This process was aimed at identifying priority activities that respond to their urgent and immediate needs to adapt to climate change. “The NAPA takes into account existing coping strategies at the grassroots level, and builds upon that to identify priority activities, rather than focusing on scenario-based modeling to assess future vulnerability and long-term policy at state level. In the NAPA process, prominence is given to community-level input as an important source of information, recognizing that grassroots communities are the main stakeholders.”

With support from the Least Developing Countries Funds through the GEF and its main implementing agencies (UNEP, UNDP, and the World Bank), 28 African countries have so far prepared NAPAs (Table 5-1). The main focus areas were wide ranging, including capacity building and awareness raising, agriculture and natural resource management, livelihood enhancement, disaster management, and health. Besides an initial summary and overview in 1997 by UNITAR (United Nations Institute for Training and Research), no systematic assessment of the NAPAs has been undertaken.

<table>
<thead>
<tr>
<th>Table 5-1. Sub-Saharan African countries with complete NAPAs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
</tr>
<tr>
<td>Benin, Central African Republic, Ethiopia, Gambia, Guinea-Bissau, Liberia, Mozambique, Sierra Leone</td>
</tr>
<tr>
<td>Burkina Faso, Burundi, Cape Verde, Guinee, Lesotho, Mali, Rwanda, Sao Tome and Principle, Sudan, Tanzania, Uganda, Zambia</td>
</tr>
<tr>
<td>Comoros, Madagascar, Malawi, Niger, DRC, Senegal, Mauritania</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Building on NAPAs. Overall, however, by striking a balance between a quick response — to identify a number of projects and activities, generally at the local and community levels

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20. Out of 49 countries classified as LDCs, 35 are in Sub-Saharan Africa.
23. The World Bank supported preparation of only two of these (Sao Tome and Madagascar)
through an extensive participatory process — and a review of key vulnerabilities and risks, the NAPAs provide a good basis to build upon. As more refined climate projections and downscaling make more detailed assessments possible, efforts are expanded to embed adaptation requirements into development plans, programs, and budgets.

103. **Implementation faces challenges.** In addition, while most NAPAs identify activities that are incremental to what is already built into a number of existing development efforts that may address climate change adaptation, their early implementation would help build a body of experience and knowledge to prepare more comprehensive adaptation strategies. But it is important to note that implementation faces many challenges, including lack of coordination mechanisms with other national initiatives and programs, and availability of funds.

### 5.5 ClimDev for Africa initiative

104. **Joint initiative with strong support.** The ClimDev-Africa program is a joint initiative of the African Union Commission (AUC), the United National Economic Commission for Africa (UNECA), and the African Development Bank. The program enjoys strong political support from African heads of government, as well as by Africa’s ministers of finance, planning, and environment.

105. **Building policy capacity.** ClimDev supports Africa’s response to climate variability and change by building regional, sub-regional, and national policy capacity. It will improve the quality and availability of information and analysis to decision makers. Its immediate beneficiaries will be the institutions that seek to manage the response to climate change in Africa. Through these bodies, the program seeks to increase the resilience of Africa’s population to climate change, enabling effective adaptation activities.

106. **Three main focus areas.** ClimDev will be implemented by the African Climate Policy Center (ACPC) based in UNECA (newly established), and financial management of the ClimDev Trust Fund will be provided by the AfDB. Political leadership of ClimDev will be provided by the AUC. The program’s first four-year provisional budget is estimated to be $134 million, expected to be disbursed on a demand-driven basis through a blend of programmatic and Trust Fund modalities. The program includes three main focus areas:

- **Making climate information widely available,** organized into nine groups of products, and aimed at ensuring that policy makers across Africa, policy support organizations, and the population at large have access to comprehensive and understood climate information.

- **Providing analytical tools and technical support,** organized into 10 groups of products, and aimed at enhancing the scientific capacity of local and regional institutions to produce effective and quality policy-supporting analyses and best practices.

- **Increasing awareness and advocacy for enhanced decision making,** organized into seven groups of products, and aimed at strengthening the capacity of African policy makers to make use of best available information and policy and practice recommendations in response to climate change.
5.6 UNDP Adaptation Program for Africa

107. **Incorporating climate change risk into development.** Under a three-year $92 million program “Supporting Integrated and Comprehensive Approaches to Climate Change Adaptation in Africa,” supported by the Government of Japan, UNDP will help 21 countries across the African continent to incorporate climate change risks and opportunities into national development processes to secure development gains under a changing climate. The program will help countries establish an enabling environment and develop the capacity required at local and national levels to enable them to design, finance, implement, monitor, and adjust long-term, integrated, and cost-effective adaptation policies and plans that are robust within a wide range of possible changes in climate conditions. The program aims to support achievement of country-level outcomes, including: (i) introduction of long-term planning mechanisms for dealing with climate risk; (ii) development of institutional frameworks for managing climate risk at the local and national levels; (iii) implementation of climate-resilient policies in priority sectors; (iv) expansion of financing options; and (v) generation and sharing of climate risk-related knowledge.

5.7 Other initiatives and programs

108. **In addition to the above programs,** a number of bilateral programs are being developed and implemented, including:

- Japan’s “Cool Earth Partnership” program which has earmarked $10 billion over the next several years to support: (i) mitigation policies, (ii) adaptation policies for developing countries vulnerable to climate change, and (iii) improving access to clean energy; and

- The European Commission’s Global Change Alliance (GCCA) aims to provide substantial resources for adaptation and disaster risk reduction for the most vulnerable countries (€50 million to the GCCA over the period 2008 to 2010).