Assessing the security implications of climate change for West Africa

Country case studies of Ghana and Burkina Faso

Oli Brown and Alec Crawford

iisd International Institute for Sustainable Development / Institut international du développement durable

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Foreword

There is an increasing realization within the international community that climate change is an issue with implications across the full sweep of government policy. No longer can we consider climate change as merely an environmental problem or an energy challenge. It is also a huge development challenge.

Climate change will redraw our coastlines, alter where we can grow food, change where we can find water, expose us to fiercer storms or more severe droughts and likely force large numbers of people to move from their homelands. Warming temperatures are already opening up new resources for exploitation, such as oil and gas supplies previously covered by the Arctic ice. Climate change will affect the economic and agricultural base of many countries, particularly vulnerable developing countries, and may undermine their comparative advantage on world markets. It will stress existing mechanisms for sharing resources like transboundary rivers and migratory fish stocks. It is clear that climate change holds the potential to exacerbate existing tensions and even trigger new ones.

Africa, with its history of resource, ethnic and inter-state conflict, is seen as particularly vulnerable. There is certainly irony in the fact that Africa, the continent least responsible for greenhouse gas emissions, may be the worst affected by climate change. Broad climate change projections paint a disturbing picture of increasingly scarce water, collapsing agricultural yields, encroaching desert and damaged coastal infrastructure. These challenges threaten to undermine the "carrying capacity" of large parts of Africa, causing destabilizing population movements and raising tensions over dwindling strategic resources. Climate change could be one more factor that tips fragile states towards failure.

Denmark has long-standing relationships with the two countries described in this report. Official development cooperation between Ghana and Denmark stretches back 50 years with Ghana and 35 years with Burkina Faso. This report also forms part of a larger process of the Danish Ministry of Foreign Affairs to "climate proof" its development cooperation programs. This means that climate change will be taken into account to ensure climate-friendly development, design projects that are resilient to future climate change, and help local communities adapt to the specific challenges they face.

We hope that this publication will be of use to academics, journalists and development practitioners trying to address the interaction between climate change and security.

Ib Petersen
State Secretary, Ambassador
Ministry of Foreign Affairs
Denmark

Preface

Since its creation in 1990, the International Institute for Sustainable Development (IISD) has been working to raise awareness of climate change, to develop ways to mitigate greenhouse gas emissions and to help communities adapt to the impacts of climate change. For more than 10 years, IISD has been investigating the ways in which environmental change and natural resources interact with the causes, conduct and resolution of violent conflict.

These once-distinct areas of research are now coming together. Climate change represents the latest of a series of environmental drivers of human conflict that have been identified over the past decades: drought, desertification, land degradation, failing water supplies, deforestation and fisheries depletion. Given that climate change could exacerbate the negative impacts of many of these factors it is perhaps no surprise that climate change is being cast as the "mother of all environmental security problems."

It is encouraging to see increasing interest in the security implications of climate change. It is an important area that requires increased understanding. But too often this story is told by Northern academics and Northern politicians without much in the way of consultation or discussion with people in the countries supposedly affected.

The challenge now is to understand how climate change could affect political and economic stability and to develop effective ways to address those problems. Drawing on field visits, workshops and interviews with local experts, this research project analyzes the prospects of two neighbouring, contrasting countries in West Africa (Ghana and Burkina Faso) under different climate change scenarios. It attempts to cut through the occasionally shrill doomsday scenarios with a clear analysis of where the areas of concern lie and hopes to add nuance, texture and detail to the debate on the security implications of climate change.

I would like to thank the IISD team for their work—in particular Oli Brown and Alec Crawford. I would also like to thank the Ministry of Foreign Affairs of Denmark who funded this project. The publication is the latest in a series we have produced in cooperation with the Ministry examining some of the major challenges facing sustainable development. The earlier titles—*Global Environmental Governance: A reform agenda* and

Climate Change and Foreign Policy: An exploration of options for greater integration—are available for download at http://www.iisd.org/publications. We hope you will find them of interest and value.

David Runnalls
President and Chief Executive Officer
International Institute for Sustainable Development

Summary

Over the past decades, the way we talk about climate change has evolved. Traditionally seen as an environmental and an energy issue, climate change is now also being cast as a threat to international peace and security. Analysts argue that climate change exacerbates existing tensions and triggers new conflicts by redrawing the maps of water availability, food security, disease prevalence, coastal boundaries and population distribution. Africa, though the least responsible for greenhouse gas emissions, is seen as the continent most likely to suffer its worst consequences—a function of the continent's reliance on climate-dependent sectors (such as rain-fed agriculture) and its history of resource, ethnic and political conflict.

The security implications of climate change have become the subject of unprecedented international attention; in 2007 the focus of a Security Council debate and the Nobel Peace prize. There have been some attempts to construct scenarios of the security implications of climate change at a global scale. But the country-level security impacts of climate change have been lost in the midst of the political rhetoric. Local experts in the subject countries are rarely consulted. This paper is a modest effort to address this research gap and to test the links that have been hypothesized to see to what extent they reflect a realistic future for two different countries in West Africa as the impacts of climate change gather pace.

We presented three scenarios (a best case, a medium case and a worst case) to local experts from a variety of different sectors. The scenarios were drawn from the emissions scenarios of the Intergovernmental Panel on Climate Change (IPCC) and elaborated using additional information from the IPCC's Fourth Assessment Report (2007) and the Stern Review (2006). Each describes a future climate scenario. Using these three scenarios as a basis for discussion, we asked our participants to discuss the implications of each scenario across six different sectors: (1) agriculture and food security; (2) productive systems and exports; (3) water; (4) natural disasters and risk management; (5) migration; and (6) health.

The predicted impact of climate change on societies is, of course, one step *more uncertain* than the projected climate change itself, being a projection based on a projection. Talking about "security," itself a loaded and loose concept, complicates the question further. Consequently, we made a conscious decision to frame our discussions in terms of the impact of climate change on *economic* and *political stability*, rather than on outright violent conflict. We then followed up specific themes and issues in a series of individual meetings and consultations in each country. We aggregated this information with the available literature to arrive at seven broad findings:

1. Ghana and Burkina Faso already face considerable development challenges from existing economic, population and environmental stresses. The two countries share many development challenges. They have rapidly growing and urbanizing populations and high rates of poverty. They are vulnerable to changes in temperature and rainfall. They have also been affected by episodes of violent conflict domestically and in neighbouring countries.

2. Climate change is not new to West Africa. West Africa in general and the Sahelian region in particular are characterized by some of the most variable climates on the planet. Climate variability seems to have become particularly pronounced in the twentieth century. A period of unusually high rainfall from the 1930s to the 1950s was followed by extended drought for the next three decades. Mean annual rainfall and runoff dropped by as much as 30 per cent—with devastating effects on local populations and livelihoods. An estimated 500,000 people died across the Sahel and as many as one million people left Burkina Faso.

3. Future climate change will likely make many current development challenges more complex and urgent. Both the Ghanaian and Burkinabe governments have worked hard to identify sectors and regions that might be vulnerable to climate change. Ghana's national communication on climate change identified water, agricultural crops and coastal zones as sectors and areas particularly vulnerable. Burkina Faso's National Adaptation Programme of Action (NAPA) identified water, agriculture, stockbreeding and forestry/fisheries as the most vulnerable sectors.

4. There are links between climate change and security in the region. There is anecdotal evidence that climate change has already been associated with conflict in West Africa. However, there is little research that has managed to construct an *empirical* link between climate change and conflict in the region (or, for that matter, anywhere else). That is not to say that such a link might not appear in future, but the drivers of conflict and instability are complex.

5. Climate change could exacerbate existing, latent tensions in Ghana and Burkina Faso. Our research in Ghana identified five main areas where climate change could challenge political and economic stability: managing the north-south divide; the division of water between energy in the south and agriculture in the north; the management of regional water sources; instability on Ghana's border; and economic stability if cocoa production ceases to be viable. Four main challenges face Burkina Faso: food security; the availability of water; relations between pastoral and agricultural communities; and the management of migration (both to urban areas and regionally).

6. But only in the extreme scenarios does climate change begin to present a determining factor in future economic and political instability. Climate change in the region is clearly one of many serious development issues. It is easy to see how climate change might be a (somewhat amorphous) *contributory* factor that exacerbates a number of existing problems. Under specific external conditions (poor governance, recession, ethnic tensions and so on) these problems could undermine economic and political stability. But, generally, it was not until the worst case scenarios that the experts in our workshops and interviews felt that impacts of climate change could themselves present *deterministic* factors in serious future economic and political instability, or indeed in violent conflict.

7. Adaptation needs to focus on the full range of development problems affecting countries. Adaptation to climate change clearly needs to be integrated within wider plans for development assistance, and the additional costs for that adaptation need to be funded with "new money" so as not to undercut development priorities elsewhere. If designed and implemented carefully, adaptation could then help to address some of the key natural resource issues that could become contentious as a result of climate change (food security, water allocation and so on).

   However, we are concerned that some key development concerns might be forgotten in the donor rush to "do something" about climate change adaptation. Ghana and Burkina Faso are faced with a number of pressing challenges that are only tangentially related to climate change, if at all: growing population; rapid urbanization; and the need to adjust to a swiftly globalizing world. The projected impact of climate change has to be examined within the context of other factors within the region.

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Acronyms

CIFOR	Centre for International Forestry Research
CILSS	Comite Permanent Inter-états de lutte contre la sécheresse au Sahel
CFA	colonies françaises d'Afrique (West African franc)
GDP	gross domestic product
GEF	Global Environment Facility
HDI	Human Development Index
IPCC	Intergovernmental Panel on Climate Change
LDC	least developed countries
NAPA	National Adaptation Programme of Action
PANA	programme d'action national d'adaptation
PPP	purchasing power parity
SST	sea surface temperature
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VBA	Volta Basin Authority

Section 1
Introduction: Climate change as the "new" security threat

"Recent scientific evidence has... given us a picture of the physical impacts on our world that we can expect as our climate changes. And those impacts go far beyond the environmental. Their consequences reach to the very heart of the security agenda."

Margaret Beckett, U.K. Foreign Secretary
UN Security Council debate, New York, 17 April 2007

Over the past decades the way we talk about climate change has evolved. When scientists began to uncover worrying evidence of human-induced climate change in the 1970s and 1980s, the emerging problem of "global warming" was seen by policy-makers, when not ignored altogether, as an environmental issue of peripheral concern. By the 1990s, as climate modelling became more sophisticated, it became clear that reducing greenhouse gas emissions would have dramatic impacts on the way we produce power and transport ourselves. Given that doing so would necessitate drastic changes in our use of fossil fuels, climate change became an economic and energy policy issue.

More recently, analysts and campaigners have begun to view climate change as a major threat to international security. They argue that climate change, by redrawing the maps of water availability, food security, disease prevalence, coastal boundaries and population distribution, could exacerbate existing tensions and trigger new conflicts. Africa, though the least responsible for per capita greenhouse gas emissions, is seen as the continent most likely to suffer its worst consequences—a function of the continent's reliance on climate-dependent sectors (such as rain-fed agriculture) and its history of resource, ethnic and political conflict.

The security threat posed by climate change has become the subject of unprecedented international attention. In 2007, it was the focus of a dedicated UN Security Council debate and the grounds for the Nobel Peace Prize shared between Al Gore and the scientists of the Intergovernmental Panel on Climate Change (IPCC). Meanwhile the climate debate has taken on the language of a military threat assessment. At an African Union debate in early

2007, President Yoweri Museveni of Uganda called greenhouse gas emissions an "act of aggression" by the developed world against the developing world. In April 2007, a group of retired U.S. generals released a widely-circulated report arguing that climate change will act as a "threat multiplier" that will make existing concerns such as water scarcity and food insecurity more intractable (NPR, 2007). At the April 2007 Security Council debate, the Namibian representative Kaire Mbuende called greenhouse gas emissions tantamount to "low intensity biological or chemical warfare" (UNSCDPI, 2007).

Climate change may already play a role in existing conflicts. A June 2007 report by the United Nations Environment Programme (UNEP) suggested that the conflict in Darfur has been in part driven by climate change and environmental degradation (UNEP, 2007). Over the past 40 years, rainfall in the region has decreased by 30 per cent and the Sahara has advanced by more than a mile every year. The report argues that the resulting tension between farmers and herders over disappearing pasture and declining water-holes partly explains the Darfur conflict (UNEP, 2007). The UNEP report warned of a succession of new wars across Africa unless more is done to contain the damage of climate change, concluding that "Darfur… holds grim lessons for other countries at risk."

In short, the security implications of climate change have caught the political imagination, generating a perceptible shift in the way decision-makers discuss the subject. There are perhaps two reasons for this. The first is self-evident: it is becoming increasingly clear that future climate change threatens to undermine development and to exacerbate existing drivers of conflict. Analysts have outlined five main dimensions of the link between climate change and conflict (Dupont and Pearman, 2006):

- volatile weather patterns, coupled with changes in rainfall and temperature, have the capacity to reshape the productive landscape of entire regions and exacerbate food, water and energy scarcities;
- more frequent and intense natural disasters coupled with a greater burden of diseases such as malaria could stretch the coping capacity of developing countries. This could, in turn, tip poor countries into fragile states and fragile states into failed states;
- natural disasters and a changing landscape could contribute to destabilising and unregulated population movements (so called "climate refugees"). This would bring previously separate groups in competition for the same dwindling resources;
- receding sea and land ice could enable access to previously inaccessible resources such as oil and gas supplies in the Arctic and transit routes like

the North-West Passage, triggering dispute over their ownership and control; and

- salinization, rising sea levels and mega droughts could make entire areas uninhabitable. In the case of some small island states this presents perhaps the ultimate security threat, jeopardizing the very existence of small low-lying countries.

A second reason for the "securitization" of the climate change debate is more political; it is part of a clear move by some campaigners to invest the climate negotiations with a greater sense of urgency, to raise climate change to the realm of high politics and to create the political space for serious concessions on greenhouse gas emissions. Advocates hope it will help unite countries towards strong action on future mitigation and adaptation. As Jon Barnett pointed out in 2001, "security communicates a certain gravitas that is arguably necessary in climate change policy. In that climate change is a security problem for certain groups, identifying it as such suggests that it is an issue that warrants a policy response commensurate in effort if not in kind with war" (Barnett, 2001).

In this approach, Africa is often portrayed as the "canary in the mine" of climate security, the first continent to fully feel the effects of climate change on political and economic stability. As the IPCC notes in its Fourth Assessment Report, "Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of 'multiple stresses', occurring at various levels, and low adaptive capacity" (IPCC, 2007a:13).

Whether or not sub-Saharan countries sign-up to a post-Kyoto deal will have little impact on global emissions. The average Ghanaian produces a third of a tonne of CO_2 per year and a Burkinabe one third of that (just one hundred kilograms). This compares to the average Dane's emissions of 9.8 tonnes and the North American's 20.6 tonnes (UNDP, 2007). However, cases such as Darfur are being held up as cautionary tales for the potential impact of climate change everywhere. In other words, African nations are not the *intended audience* of the post-Kyoto debate, but they are part of the *evidence* being used to make it.

The scientific basis for climate change is increasingly well established and there is considerable evidence of the physical impacts of climate change in terms of raised sea levels, altered precipitation patterns and more frequent and fierce storms. However, there is comparatively little research on the empirical links between climate change and conflict.

There have been some attempts made to construct scenarios of the security implications of climate change at a global scale (CSIS, 2007). But the country-

level security impacts of climate change seem to have been lost in the midst of the political rhetoric. Much of the literature written on the subject has been desk-based research from researchers in the North, hypothesising on the general links between climate change and security by extrapolating from particular anecdotal case studies. Local experts in the subject countries are rarely consulted. Our research was an effort to address this research gap, to test the links that have been hypothesized to see the extent to which they reflect a realistic future for different countries as the impacts of climate change gather pace.

Section 2
Testing the links: The research methodology

The purpose of this research, which was financially supported by the Foreign Ministry of Denmark, was to investigate the links between climate change and security in the case of two countries in West Africa: Ghana and Burkina Faso. Three questions drove the research:

1. What do we know about the way that climate change is going to interact with existing tensions and create new ones?
2. Do we know enough to use climate change projections to predict future conflict?
3. And to what extent will adaptation to climate change ward off instability and conflict?

The rationale for choosing Ghana and Burkina Faso as the subjects of our research was three-fold. Firstly, Ghana and Burkina Faso provide a study in contrast in the West African region. Anglophone, coastal Ghana is one of West Africa's wealthier countries (relatively speaking). Meanwhile, francophone, land-locked Burkina Faso is one of the world's poorest (176 of 177 on the 2007/2008 Human Development Index). Secondly, despite their differences, Ghana and Burkina Faso share many development challenges: a reliance on rain-fed agriculture; vulnerability to drought; and some unpredictable neighbours. They also have to contend with significant cross-border issues, principally the allocation of the waters of the Volta River basin, growing economic integration and cross-border migration. But in a region that has witnessed half a dozen civil wars over the last 15 years both countries are notable for their relative stability. Finally, they are both program countries for Danida (the overseas development arm of the Danish foreign ministry), which is currently considering how best to support adaptation to the impacts of climate change in the region.

Both countries have worked hard to identify sectors and regions that might be vulnerable to climate change. In 2000, Ghana produced its first national communication on climate change, which identified several key vulnerable sectors (see the Ghana case study). In 2007, Burkina Faso produced its first National Adaptation Programme of Action (NAPA), which detailed the current and future climate vulnerabilities facing the country (see the Burkina Faso case

study).[1] Our objective in this project was not to repeat the excellent work already done, or on-going, in either country. Rather it was to see whether and at what point these vulnerabilities jump from being a matter of *development* concern to becoming a *security* issue.

We did not set out to either prove or disprove the link between climate change and violent conflict. Rather our aim was to understand better the prospect of climate change for the political and economic stability of Ghana and Burkina Faso, and through that to add some nuance to the wider debate on climate change as a security threat. In particular, we sought to identify geographic areas or sectors of the economy that might be particularly affected under three different scenarios for climate change (a best case, medium case and worst case scenario: see Annex 1).

To do so, we arranged scenario planning workshops in both countries, supplemented by individual meetings and consultations. We invited a wide range of local experts to each meeting: agronomists, hydrologists, development specialists, security analysts and so on. The purpose of each workshop was to facilitate a process with local experts to identify specific vulnerabilities and "hot spots" and to understand how domestic adaptation policies can tackle anticipated problems (such as water allocation, disaster risk management, etc.).

We presented three scenarios, each of which described a different climate path for West Africa by 2100. These scenarios were drawn from the emissions scenarios of the IPCC and were expanded using additional information from the IPCC's fourth assessment report and the Stern Review (see Annex 1). The scenarios are highly speculative, but all fall within the meteorological bounds described by the IPCC. Each describes a future climate scenario, the likelihood of which depends on the complex interplay of factors such as total greenhouse gas emissions, the meteorological evolution of climate change, global population growth, energy use and international cooperation on mitigation and adaptation.

The projected impact of climate change on societies is, of course, one step *more uncertain* than the projected climate change itself, being a projection based on a projection. In addition, for West Africa as elsewhere, "the discourse is further complicated by the near impossibility of disaggregating climatic from anthropogenic influences, as a whole range of variables other than climatic ones (e.g., demographic, political, economic, technical) are influencing land-use change throughout the Region" (CIFOR, 2005:12). Nevertheless, to have any meaningful discussion of the social impacts of climate change, one has to define a starting point, albeit with sizeable built-in assumptions.

1 The NAPA report was written in 2006, endorsed by the President in November 2007 and is currently awaiting wider distribution.

Our scenarios stretched from a conservative "best case" to a conservative "worst case." The best case scenario builds on the B1 "storyline" of the Special Report on Emission Scenarios (SRES), which describes a world whose population peaks mid-century at around nine billion and declines thereafter towards seven billion. States move rapidly towards service and information economics, and there is a reduction in the material intensity of economic growth and an introduction of clean and resource-efficient technologies (IPCC, 2001). Atmospheric concentrations of CO_2 stabilize at around 600 ppm by the end of the century, leading to a global temperature rise of around 1.8˚C and a sea level rise of 18 to 38 cm over the next 100 years. The temperature rise would lead to a 20–30 per cent decrease in water availability in some vulnerable regions of the world. Crop yields would decline across tropical regions and would fall by five to 10 per cent in Africa. Further diverging from the SRES scenarios, which do not factor in the impact of international action, this scenario imagines that there is widespread international support for climate change adaptation.

Our medium case scenario uses the SRES A1B storyline as its starting point. A1B envisages the same population curve as B1 and predicts a world of rapid economic growth with the swift up-take of new and more efficient technologies. In contrast with our "best case" scenario, the world's energy is sourced from a balance between fossil-intensive and non-fossil energy sources (IPCC, 2001). By 2100, atmospheric concentrations of CO_2 grow to 850 ppm; three times pre-industrial levels. As a result, temperatures increase over the same period by approximately 2.4˚C (within a range of 1.7˚C to 4.4˚C). Sea level rise would be between 21 and 48 cm and the resultant coastal flooding would affect between 11 and 170 million additional people every year. Precipitation in sub-tropical areas would fall by up to 20 per cent. Internationally, some effort and funds are invested in adaptation, but not a great deal.

Our worst case scenario is built around the A1F1 storyline. This SRES scenario differs from the A1B scenario in that it forecasts a continued dependence on fossil fuels for the world's energy needs—a "business as usual" scenario. Following this trend, atmospheric concentrations of CO_2 would be 1,550 ppm by 2100, five times pre-industrial levels and four times current levels. This concentration would result in a global temperature increase of 4.0˚C (with a likely range from 2.4˚C to 6.4˚C) and a corresponding sea level rise of between 29 and 59 cm. According to the Stern Review, a warming of 4.0˚C would result in a 30 to 50 per cent decrease in water availability in southern Africa and a decrease of 15 to 35 per cent in agricultural yields across the continent (Stern, 2006). With high climate sensitivity, the number of people exposed to flooding per year could be as many as 160 million by the 2050s and 420 million by the 2100s. Under this final scenario no serious support is given to climate change adaptation.

The terms "security" and "conflict" are loaded and loose concepts, open to misinterpretation. Consequently we made a conscious decision to frame our discussions in terms of the impact of climate change on *economic* and *political stability*, rather than outright violent conflict. This provided more scope for debate, enabling discussion across the spectrum of possible impacts of climate change. Using these three scenarios as a basis for discussion, we asked our participants to discuss the implications of each scenario across six different sectors: (1) agriculture and food security; (2) productive systems and exports; (3) water; (4) natural disasters and risk management; (5) migration; and (6) health. For each scenario, we asked the group to identify the negative consequences and positive opportunities for political and economic stability in each country. Scenario planning, by its very nature, becomes less precise the longer you project into the future. Consequently, the discussions were limited to impacts on economic and political stability between the present day and 2050.

We then followed up specific themes and issues in a series of individual meetings and consultations in each country. We aggregated this information with the available literature to come to seven broad findings on the future impact of climate change on political and economic stability in both countries. These findings are the subject of the next section. More detailed case studies on each country and subsidiary information can be found beginning on page 21.

Section 3
Main findings

Key Point 1
Ghana and Burkina Faso already face considerable development challenges from existing economic, population and environmental stresses

Burkina Faso is one of the poorest countries in the world, occupying the second lowest spot on the 2007 Human Development Index (176 of 177). Ghana, by contrast, is categorized as a country of "medium human development" by the UNDP (position 135). Per capita GDP is higher in Ghana (US$485 in 2005) than Burkina Faso (US$391), but foreign aid still constitutes more than a tenth of GDP in both countries.[2]

The two countries share many development challenges. They have rapidly growing populations: Ghana's population is 22.5 million and rising at a rate of 1.9 per cent a year; Burkina Faso's is 13.9 million and rising even faster (at 2.8 per cent). Their urban populations are growing at a tremendous pace (4.2 per cent in Ghana and 4.8 per cent in Burkina Faso), stretching the capacity of government to provide basic urban services (UNDP, 2007).

Ghana and Burkina Faso are also vulnerable to changes in temperature and rainfall. Both are reliant on rain-fed agriculture for their food security and for their agricultural exports (particularly cocoa in Ghana and cotton in Burkina Faso). Consequently drought is the top natural disaster risk in both countries (EM-DAT, 2008a/b). Fifty-five per cent of the Ghanaian labour force works in agriculture which, in 2006, accounted for 35.8 per cent of GDP (RoG, 2006). Land degradation and deforestation are serious problems in both countries (MECV and SP/CONEDD, 2006).

Both countries have been affected by episodes of violent conflict domestically and in neighbouring countries in West Africa. According to the UN Office for the Coordination of Humanitarian Affairs (OCHA) the civil war and anti-foreigner policies in Côte d'Ivoire have led to the return of at least 365,000 Burkinabes since 1998. Others argue this estimate might be too low. According to the former UN Resident Coordinator in Burkina Faso, George Charpentier, over one million have been forced to return since 1998, placing considerable

2 In 2005, it was equivalent to 10.4 per cent and 12.8 per cent of Ghanaian and Burkinabe GDP. UNDP (2007).

stress on jobs, livelihoods and public services (Kress, 2006). Northern Ghana, meanwhile, saw episodic large-scale ethnic violence between 1980 and 2002, culminating in the 1994–95 conflict that cost several thousand lives and displaced many thousands more (Jönsson, 2007:2).

Key Point 2
Climatic change is not new to West Africa

A changing climate has been a feature of life in West Africa for thousands of years. Just 10,000 years ago the Sahara was a landscape of lakes, savannah and open woodland. After a period of generally drier conditions, the monsoon collapsed across much of what is now the Sahara. Pastoral cattle herding emerged in the region as an adaptive response to the more unpredictable climate.

West Africa in general and the Sahelian region in particular are still characterized by some of the most variable climates on the planet, and this variability increases as one moves north through the sub-humid and semi-arid zones (CIFOR, 2005:7). Ghanaians and Burkinabes have not been passive recipients of climate change in the past and have developed many ingenious ways of adapting to their climate. Some analysts suggest that the inherent adaptability of the Sahelian peoples is one of their greatest assets. Nevertheless, this adaptability has been severely tested in the last few decades.

Climate variability seems to have become particularly pronounced in the twentieth century. There was a period of unusually high rainfall from the 1930s to the 1950s. At the same time, many African nations were transitioning to independence (Ghana in 1957 and Burkina Faso in 1960). Nick Brooks suggests that "the coincidence of this period of political and economic transitions, when considerations of environmental variability and sustainability were minimal, with increased rainfall, resulted in the northward expansion of agriculture in the Sahel into historically marginal areas, with profound implications for the vulnerability of agriculturalists and pastoralists alike" (Brooks, 2006).

This boom was followed by an extended drought for much of the latter half of the twentieth century. Over a 30 year period from the 1960s to 1990s, temperatures rose by around 1˚C (EPA, 2000:5). Mean annual rainfall and runoff dropped by as much as 30 per cent with devastating effects on local populations and livelihoods, resulting in what Hulme (2001) refers to as the "most dramatic example of multi-decadal climate variability that has been quantitatively and directly measured." An estimated 500,000 people died across the Sahel (CIFOR, 2005:10) and as many as one million left Burkina Faso during the droughts, most of them settling in the urban areas of other West African countries, principally Côte d'Ivoire (Niamir-Fuller and Mann, 2007:4).

Annual rainfall has since partly recovered and has contributed to the recent "greening" of the Sahel: vegetation cover across the region increased significantly for the 1994–2003 period when compared to the 1982–1993 period (Anyamba and Tucker, 2005). Within Burkina Faso, an increase in "greenness" has been seen in the central plateau, however more has occurred than can be explained by the increase in rainfall alone. Land use change is believed to be responsible in part for the reversal of the trend towards desertification; in some parts of the country a return to traditional water and soil conservation strategies (such as contour bunding and Zäi cultivation) has helped farmers reclaim some soil fertility and improve their crop yields. Whether the greening of the Sahel represents a return to normal rainfall levels or a larger trend towards wetter conditions in the face of anthropogenic climate change remains to be seen.

Key Point 3
Future climate change will likely make many current development challenges more complex and urgent

There is broad agreement that temperatures in West Africa will rise. But there is little consensus among the regional climate models on what will happen to rainfall in the region. Since 2001, an increasing amount of research has argued that increased rainfall in the Sahel may be more likely than initially considered. The key factors seem to be that increased temperature and CO_2 concentrations could cause a northward shift of the West African monsoon, which would increase vegetative production, in turn setting up a positive feedback loop between increased vegetative cover and precipitation (though this additional precipitation would be at least partially offset by a faster rate of evapotranspiration) (CIFOR, 2005:21). The rising rainfall of the 1990s may support these models.

Both Ghana and Burkina Faso have put considerable effort into assessing the possible impacts of climate change. In 2000, Ghana produced its first (and only) national communication on the subject, identifying three main sectors that might be affected:

1. *Water* – simulations using projected climate change scenarios suggested reduction in flows between 15–20 per cent and 30–40 per cent for the year 2020 and 2050 respectively in all river basins.

2. *Agricultural crops* – projections indicated that the average maximum temperature for the Sudanian Savannah zone is expected to increase by 3°C by 2100, with a 2.5°C increase in all other agro-climatic zones. They estimated that yields of maize would decrease by 6.9 per cent by 2020 but that the yield of millet, a more drought-tolerant crop, would not be affected.

3. *Coastal zones* – with a quarter of the population living below the 30m level, an estimated sea level rise of 1m by 2100 could inundate 1,120 km^2 of land and put 132,000 people at risk. The cost of protecting all densely-populated shorelines at risk with seawalls was estimated at US$1.14 billion, while protecting only the "important areas" would reduce the cost to US$590 million (EPA, 2000).

In 2007, using historical data from the end of twentieth century, the Ghanaian Environmental Protection Agency (EPA), projected steady rises in temperature and reductions in rainfall over the next decades. "Historical data across the country from the year 1960 to 2000 shows a progressive and discernible rise in temperature and a concomitant decrease in rainfall in all agro-ecological zones in the country." Based on this data, they estimate an average temperature rise of 0.6°C, 2.0°C, and 3.9°C; a rainfall decrease of 2.8 per cent, 10.9 per cent and 18.6 per cent; and a sea-level rise of 5.8 cm, 16.5 cm and 34.5 cm by 2020, 2050 and 2080 respectively (EPA, 2007:7–8). The EPA listed 10 areas vulnerable to climate change: water resources, agriculture and food security, biodiversity, human health, coastal zones, land management, national revenue, hydropower production, tourism, and women and the poor (EPA, 2007:6–8).

The 2007 National Adaptation Programme of Action (NAPA) for Burkina Faso identified four sectors as particularly vulnerable to climate change: water, agriculture, stock-breeding and forestry/fisheries. These four sectors form the basis of the Burkinabe economy and are vulnerable to four aspects of climate change: decline and variability in rainfall, heavy rainfall/flooding, rising temperatures and increased wind speeds.

1. *Water* – a projected increase in the frequency of heavy rains and flooding is expected to lead to widespread erosion and siltation along each of Burkina's four basin slopes. When combined with projected decreases in overall rainfall, the NAPA authors anticipate this will result in reduced run-offs by 2050, ranging from 29.9 per cent for the Nakanbé basin to 73 per cent for the Mouhoun basin.

2. *Agriculture* – Burkina's NAPA predicts that average annual rainfall will drop by 3.4 per cent by 2025 and 7.3 per cent by 2050. For an economy heavily dependent on rain-fed agriculture, such a drop will have significant implications for crops and planting cycles across the country; for example, cotton, maize and yams have already seen production drops in the south as a result of drought.

3. *Stockbreeding* – an expected rise in temperature of 1.7°C by mid-century will combine with decreased rainfall to reduce the drinking points open to stockbreeders. Floods are expected to compound these threats by killing livestock.

4. *Forestry/fisheries* – increased erosion and siltation are expected to damage land and water ecosystems, while land clearing, in part a reaction to rainfall pressures, is expected to continue apace. Forestry biomass is predicted to decrease from 200 million m^3 in 1999 to little more than 110 million m^3 by 2050 (MECV and SP/CONEDD, 2007).

It is important to note that not all the assessments predict universally negative impacts. Burkina Faso's 2001 National Communication to the UNFCCC suggests that both cotton production and the forestry sector would benefit if climate change led to higher levels of rainfall (in contrast to their 2006 NAPA, which projects a decrease in forestry biomass). Meanwhile, a 2002 study undertaken by the International Institute for Applied Systems Analysis predicts that the potential for cereal production could increase in Ghana, though decrease for Burkina Faso (Fischer *et al*, 2002). Meanwhile, some analyses argue that the carbon fertilization effect could lead to a potential increase of vegetative cover; one 2003 study estimated that the potential increase could be as much as 10 per cent of the Saharan land area per decade (Claussen, 2003).

Box 1: National Communications and NAPAs in West Africa

All parties to the United Nations Framework Convention on Climate Change (UNFCCC) are required to prepare a National Communications document in which they report on the steps they have taken or plan to undertake to implement the Convention. On January 8, 2007 Sierra Leone submitted its first National Communications, leaving Liberia as the only nation in West Africa to have yet to complete the exercise.

National Adaptation Programmes of Action (NAPAs), also prepared under the UNFCCC, are designed to allow Least Developed Countries (LDCs) to "identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change." By identifying existing coping strategies through the NAPA process, LDCs can prioritize those grassroots activities which require further support and enhancement, and areas where more investment must be made in adaptive capacity. Instead of focusing on future vulnerabilities through forecasting and scenarios, NAPAs focus on the needs of today, where "further delay could increase vulnerability or lead to increased costs at a later stage." Once identified, priority projects are presented to the Global Environment Facility (GEF) for funding.

Most West African nations have prepared or are preparing their NAPAs. Reports have been submitted by Guinea, Mali, Mauritania, Niger and Senegal; Benin, Burkina Faso, Cape Verde, the Gambia, Guinea-Bissau, Liberia, Sierra Leone and Togo are in the process of finalizing theirs (UNFCCC, 2007).

Key Point 4
There are links between climate change and security in the region

There is some anecdotal evidence that climate change in West Africa might already be associated with conflict. Anthony Nyong and colleagues saw a correlation between reports of conflict and drought periods in northern Nigeria. They also noticed that communities in northern Nigeria had successfully evolved traditional systems to manage new types of conflict, including those that result from climate-related events (Nyong *et al*, 2006:235). Nick Brooks suggests that drought helped to trigger conflict in some Sahelian areas, as in the case of the Tuareg rebellion in Mali 1990. The conflict began amid famine and widespread political repression despite being primarily an attempt by various Tuareg groups in Niger and Mali to secure an autonomous Tuareg state (Brooks, 2006).

However, there is little research that has managed to construct an *empirical* link between climate change and conflict in West Africa (or anywhere else for that matter). That is not to say that such a link might not appear in future, but the drivers of conflict and instability are complex. Simple models of causation are inappropriate. Barnett and Adger (2007) argue "[it] is necessary to be cautious about the links between climate change and conflict. Much of the analogous literature on environmental conflicts is more theoretically than empirically driven and motivated by Northern theoretical and strategic interests rather than informed by solid empirical research."

Key Point 5
Climate change could exacerbate existing, latent tensions in Ghana and Burkina Faso

Our research (the workshop, literature and subsequent interviews) in Ghana identified five challenges and concerns (see also the Ghana case study):

1. *Managing the north-south divide*

   Ghana is characterized by a pronounced social divide. Poverty is concentrated in the rural north, which is less-well serviced than the south across the full range of government services. Historically, the rural north has suffered the most variable climate. Demand for water is rapidly rising with population growth. Ghana's national communication estimated that demand for irrigation water in the dry northern savannah could increase 12-fold by 2050 as a result of climate change and population growth. How the government manages development in the north in the context of an

increasingly changeable climate will be an acute challenge in the coming years.

2. *The division of water between energy in the south and agriculture in the north*

   The north-south divide is played out in the sphere of resource allocation between the different regions. One critical issue is the trade-off between water for agriculture in the north and water for hydro-energy production in the south. Just before the floods of August and September 2007, the level of water in the Akosombo dam had fallen critically low, leading to an energy crisis across the country.[3]

3. *The management of regional water sources*

   On a regional scale, the partition of water between Burkina Faso and Ghana will likely be a delicate issue in coming years, especially if climate change leads to significantly lower rainfall and run-off. Together Ghana and Burkina Faso constitute 85 per cent of the Volta basin and much of the Volta's flow travels through Burkina Faso before reaching Ghana. Only recently have the six riparian countries of the Volta come together to create a mechanism to govern the management of the basin (see Box 2, page 17). The floods that displaced an estimated 285,000 people in Ghana in September 2007 are an example of why such mechanisms might become more important in future; despite two weeks warning the opening of the Burkinabe Bagré dam to release excess water led to widespread flooding in northern Ghana and a certain amount of bad feeling (though the consequences of a ruptured dam would have been far more serious).

4. *Instability on borders*

   A further concern that was expressed, albeit vaguely, was the ramifications of conflict elsewhere caused by climate change impacts and what that might mean in terms of flows of refugees, potentially hostile neighbours and regional economic disruption.

5. *Economic stability and the structure of the economy*

   Some analysts predict that Ghana's climate may be unsuitable for cocoa by 2080.[4] This has led to concerns that the impact of climate change will fundamentally alter Ghana's economy, with unforeseen consequences for economic stability.

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3 http://addax.wordpress.com/category/ghana/

4 EPA (2007) presentation.

Meanwhile, local experts in Burkina Faso suggested four main areas of concern:

1. *Water availability*

   Water is a contentious resource. Siltation, erosion and variable and declining rainfall are expected to reduce water availability and quality. Our interviewees stressed that—given this threat and a growing population—a careful balance must be struck between consumption and production; crops and livestock; and upstream, domestic use and use by Burkina's downstream neighbours.

2. *Relations between pastoralist and agricultural communities*

   The expansion of farming and population growth is combining with drought and desertification to constrict the range and resource access of Burkina's pastoralist community. In addition, farmers are diversifying into stockbreeding. As a result, they rely less on the mutually beneficial relationships previously established with pastoralists for agricultural inputs such as compost and fertilizer, while increasingly competing with them in the marketplace. As productive systems evolve, so do social relationships.[5]

3. *Migration*

   Longer dry seasons are driving farmers to migrate from northern and central parts of the country into the fertile east and west, bringing them into contact with settled farmers in these richer areas. Greater populations congregating in smaller fertile areas may increase competition for valuable lands and accelerate environmental degradation (MECV and SP/CONEDD, 2006).

4. *Food security*

   Food security was deemed a concern across all three scenarios. Unpredictable, declining rainfall and expected increases in the frequency and gravity of floods and droughts have many worried about the capacity of the country to maintain its agricultural production. Richer countries can buy "virtual water" in the form of food imports, but this is not feasible for Burkina Faso on a large scale, leaving the country in a precarious position.

5 Interview with Bertrand Reysset, CILSS, 5 December 2007.

Box 2: The Volta Basin Authority

The Volta Basin Authority (VBA) was established in 2007 to coordinate water management policies for the six riparian countries of the Volta River basin (Ghana, Burkina Faso, Togo, Mali, Benin and Côte d'Ivoire). The Economic Community of West African States (ECOWAS), believing that there might be future conflicts in the region over the sharing of water resources, initiated the VBA's formation (Ghanaweb, 2007). For years, the 400,000 km^2 Volta basin had been one of the few transboundary water basins in Africa without a formal agreement in place for cross-border cooperation and management.

Ghana and Burkina Faso together account for 85 per cent of the basin's water usage. As such, the Authority is administered by a Ghanaian deputy out of offices in Ouagadougou, Burkina Faso, with input from the other four riparian countries. In addition to integrating the Volta water management policies across the six states, the VBA will establish an observation post to monitor trends in the basin, enhancing its ability to act as an early warning system should water issues arise.

The VBA, having recently been established, is not yet fully operational. However, should it grow into an effective institution with an appropriate level of influence over Volta water management decisions, it will have implications for water consumption for the basin's 20 million inhabitants, for agricultural decisions, for ecosystem conservation and for hydropower generation (Boakye, 2006).

Key point 6
But only in the extreme scenarios does climate change begin to present a determining factor in future economic and political instability

Climate change in the region is clearly one of many serious development issues. It is straightforward to see how climate change might be a (somewhat amorphous) *contributory* factor that exacerbates a number of existing problems such as land degradation, urban migration, food insecurity, power brown-outs and so on. Under specific external conditions (poor governance, recession, ethnic tensions and so on) these problems could undermine economic and political stability.

When discussing our best case and medium case scenarios, it was generally agreed (among the experts in our workshops and interviewees) that climate change could move from being a *development problem* to becoming a *security issue*, but that this jump depends on non-climate drivers; i.e., those external conditions such as governance, regional relations and so on. It is, for example, population growth, income distribution and government policy that push people to live on marginal lands in the first place. In other words, a community's vulnerability to climate conflict is not a constant—it can be increased or

decreased for reasons that have nothing to do with greenhouse gas emissions (Pielke, 2007:597).

Generally, it was not until we started discussing the worst case scenarios that the experts in our workshops and interviews felt that impacts of climate change themselves could present *deterministic* factors in serious future economic and political instability, or indeed in violent conflict.

This may be a partial consequence of what one interviewee termed the "plausibility structure" of the people we spoke to—the difficulty of imagining conflict breaking out in two stable countries with *relatively* peaceful histories over the past decade. However, our worst case scenario presents so many challenges to the environment and development that, in one sense, "all bets are off." The context becomes harder to recognize as being "Ghanaian" or "Burkinabe"—and so predictions become more tenuous.

There are plenty of well-intentioned reports wishing to increase awareness of greenhouse gas emissions by asserting a particular outcome. These tend to present a worst case scenario where drought is either assumed, or the possibility of increased rainfall is indicated only in terms of "devastating floods" and "the spread of disease," rather than in terms of increased agricultural yields or natural revegetation of desertified areas (CIFOR, 2005:46).

But our research challenges an overly deterministic approach to climate change as a security issue. While it may be effective as a campaigning strategy, it is not a solid foundation for appropriate policy. At times, it obscures the fact that in regions like West Africa, sustained attention (and funding) is still required to deal with the impacts of more predictable trends: malnutrition, poor land management, bad governance, inequitable trade, lack of basic services and so on. The danger of course is that inappropriate policies are generated as a result and that key underlying issues are overlooked.

Key point 7
Adaptation needs to focus on the full range of development problems affecting countries

"Adaptation" to climate change and the "climate proofing" of development aid have become the latest mantras of the development community. The first is about helping communities manage the effects of a changing climate (e.g., training farmers in water conservation practices). The second is about protecting development investments against the impacts of climate change (e.g., digging deeper wells) and ensuring that development projects do not unintentionally make people more vulnerable (by, for example, encouraging dependence on a drought-prone crop).

Good adaptation is good development, insofar as it helps to support livelihoods and build resilient infrastructure and communities. Clearly, healthy, well-educated communities with diversified sources of income will be better able to cope with the impacts of climate change. As McGray notes, "A significant area of overlap between adaptation and development is methodological. Rarely do adaptation efforts entail activities not found in the development 'toolbox'" (McGray, 2007:2).

This seems to be the case in Burkina Faso and Ghana, where at least some of the adaptive responses that are being presented at the moment have been around for years. Many were promoted when there was a great deal of public awareness in the 1970s and 1980s about the fight against desertification. They were later sidelined when donor interests moved elsewhere. One example is Zäi cultivation, a traditional form of agriculture in Burkina Faso and Mali that involves planting crops in small, circular pits perpendicular to the slope to capture rainwater and retain soil moisture. One interviewee remarked dryly that it is only now, after years of being ignored, that such techniques and projects are again becoming "fundable."

It is widely agreed that adaptation needs to help countries adapt to the full range of development problems that they face, not just those that arise as a result of anthropogenic climate change. Certainly, Ghana and Burkina Faso are faced by a number of pressing challenges that are only tangentially related to climate change, if at all; growing populations, rapid urbanization and the need to adjust to a swiftly globalizing world. Burkina Faso, for example, has the lowest adult literacy rate among the 177 countries on the human development index, a statistic that is debilitating for its economic prospects. Meanwhile, population growth in Ghana, at just below two per cent per year, is reducing the amount of agricultural land available per person far faster than even the most aggressive climate change scenarios.

On the one hand, a focus on adaptation is encouraging, introducing as it does a much needed temporal dimension into development planning (i.e., thinking about how the resource base and the environment will change over time and planning development interventions accordingly). If designed and implemented carefully then, adaptation could help to address some of the key natural resource issues that could become contentious as a result of climate change (food security, water allocation and so on). In the case of Ghana, we see two priorities for adaptation from a conflict-prevention perspective: explicitly addressing the North-South divide by supporting rural livelihoods in the North and reducing economic reliance on the cocoa sector in the South. In Burkina Faso, we see food security country-wide (but particularly in the north) as a priority area for adaptation. In addition, supporting formalized, peaceful dispute resolution between agricultural and pastoral communities

may become increasingly important. At a regional level, "conflict-prevention adaptation" should support the new and largely untested regional mechanisms for resource allocation and dispute resolution, such as the Volta Basin Authority.

On the other hand, we are concerned that some key development priorities might be forgotten in the donor rush to "do something" about climate change adaptation. Donor budgets can be a "zero-sum" game, where the institutional priorities are set centrally and money used for one objective becomes unavailable elsewhere. Universal primary education, for example, is rarely seen as a priority for adaptation. But education levels in Burkina Faso may well be a more important determinant of future well-being in the country than the impact of anthropogenic climate change.

Adaptation to climate change clearly needs to be integrated within wider plans for development assistance, and the additional costs for that adaptation need to be funded with "new money" so as not to undercut development priorities elsewhere. In short, the projected impact of climate change has to be examined within the context of other factors within the region. Two key questions need to be kept in mind. Firstly, to what extent will other forces of change (i.e., those apart from climate change) affect natural and human systems in West Africa during the twenty-first century? And, secondly, how do their projected impacts compare, qualitatively and quantitatively, with those of climate change?

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Case Study 1
Ghana

Ghana has long been considered a regional leader in West Africa. A relatively peaceful history and stable economy have helped place it within the "Medium Human Development" category of the latest HDI, higher than any other West African nation. Its life expectancy rates exceed those of the rest of sub-Saharan Africa by nearly 10 years, and its GDP per capita (in PPP terms) is almost US$500 above that of its neighbours (UNDP, 2007). In 2007 the country celebrated its 50th birthday, reminding the world of its position as the first country in sub-Saharan Africa to gain its independence. Its president, John Kufuor, sat as Chairperson of the African Union for 2007, and in January 2008 the country brought together the continent by hosting the African Cup of Nations football tournament.

Climate change may still present severe challenges despite Ghana's relatively strong position in the region. Its geography suggests that it will be fighting sea level rise along its southern coast while combating desertification in the north. Declining and variable rainfall will present problems for agriculture and the production of hydro-energy, both crucial sectors for the economy. Water sharing and management policies among the riparian countries of the Volta basin will move up the political agenda, especially given the damaging floods of August and September 2007.

Source: CIA (2008)

Ghana: Background

Ghana's topography shows a marked contrast as you move from the Gulf of Guinea in the south to the Burkinabe border in the north. The wet southwest of the country used to be covered by dense rainforest, but large tracts have been cleared to plant cocoa, banana and oil palm. The centre of the country is dominated by the man-made Lake Volta; when the Akosombo Dam was constructed in 1964, Lake Volta rose up behind it, inundating a large area of the country (five per cent) and creating one of the largest lakes in Africa. Three-quarters of the country's area lies within the basin of the lake's source waters, the Black and White Volta Rivers (EPA, 2000). Moving northwards, dry savannahs extend towards the Burkinabe border and the Sahelian zone of West Africa.

Temperatures are typically high, ranging on average from 24˚C to 30˚C. Rainfall is concentrated in the southwest, which typically experiences annual precipitation of about 2,000 mm. This rainfall decreases as you move north, falling to less than 1,100 mm. However, the driest part of the country extends for 40 km east of Sekondi-Takoradi on the southern coast, where the annual rainfall is about 750 mm (EPA, 2000).

Agriculture and livestock remain at the centre of Ghana's economy, accounting for 35.8 per cent of the country's GDP and employing 55 per cent of the working population (UNDP, 2007). Although food crops are the most important contributor to agricultural output, cocoa production continues to dominate as an individual export crop: in 2006, cocoa exports earned the country over a billion dollars and constituted 27.2 per cent of total exports (World Bank, 2007b). This helped Ghana maintain its position as the world's second largest producer of the bean, trailing only its neighbour Côte d'Ivoire (FAOSTAT, 2008). Gold is another key source of export earnings: in 2003 it made up 32 per cent of the country's exports, placing Ghana seventh in the world for production and second on the continent after South Africa (BBC, 2005).

Ghana is most densely-populated in the south. A quarter of the country's 22.5 million people live in the coastal zone, an area within 30m of sea level which constitutes just seven per cent of Ghana's land area (UNDP, 2007). Poverty is concentrated in the rural north; this part of the country remains less well-serviced than the south and the urban areas for the full range of government services: health care, education, agricultural support and so on. This perpetuates a stark north-south divide in the country.

The country won its independence from the British in 1957 under its first president, Kwame Nkrumah. What followed was a bout of serious post-colonial instability, with Ghana experiencing nine changes of government and four military coups in the 26 years between 1957 and 1983. But fortunately Ghana managed to avoid much of the violence commonly associated with political

instability in the region. The final two coups (in 1979 and 1982) were led by Jerry Rawlings who, with fellow army officers, established a military technocracy which ran Ghana for a decade. Ghana made the peaceful transition back to democracy in 1992, with Mr. Rawlings winning the election and leading the democratically-elected government for the next eight years. In 1994, during his tenure, a state of emergency was declared in response to severe inter-ethnic fighting in northern Ghana which claimed the lives of more than a 1,000 people and caused the internal displacement of 150,000 more. In 2000, current president, John Kufuor, defeated Mr. Rawlings' Vice President, John Atta-Mills, in a general election, and he has maintained the post since.

Climate change in Ghana

The Ghanaian Environmental Protection Agency projects steady temperature increases and reductions in rainfall over the coming decades:

> "Historical data across the country from the year 1960 to 2000 shows a progressive and discernible rise in temperature and a concomitant decrease in rainfall in all agro-ecological zones in the country. Based on this data it's estimated that temperature will continue to rise by on average about 0.6˚C, 2.0˚C, and 3.9˚C by the year 2020, 2050 and 2080 respectively. Rainfall is also predicted to decrease on average by 2.8 per cent, 10.9 per cent and 18.6 per cent by 2020, 2050 and 2080 respectively in all agro-ecological zones. In terms of sea-level change from 1990 levels this indicates an average rise of 5.8 cm, 16.5 cm and 34.5 cm by 2020, 2050 and 2080."(EPA, 2007:7–8)

Vulnerabilities to climate change

In 2000, Ghana produced its initial (and only) national communication on climate change. It identified three main sectors that would be affected by climate change:

A. Water

Simulations using projected climate change scenarios indicated a reduction in flows between 15–20 per cent and 30–40 per cent for the year 2020 and 2050 respectively in all river basins (EPA, 2000:9). The communication predicted that by 2050 climate change and population growth could lead to a 12-fold increase in the demand for irrigation water in Ghana's dry interior savannah over the base period. Should usage rates and demand increase while rainfall declines, hydropower generation in the country could be seriously affected; low rainfall in early 2007 led to frequent blackouts in Accra and concerns over the continued operation of the Akosombo dam, which supplies the country with 60 per cent of its energy needs (Reliefweb, 2007).

B. Agricultural crops

The projections of the EPA indicated that the average maximum temperature for the Sudan Savannah zone is expected to increase 3˚C by 2100 and 2.5˚C in all other agro-climatic zones. They estimated that yields of maize would decrease by 6.9 per cent by 2020 but that the yield of millet, a more drought tolerant crop, would not be affected.

C. Coastal zones

With a quarter of Ghanaians living on the coast, an estimated sea level rise of one metre by 2100 could inundate 1,120 km^2 of land and put 132,000 people at risk. The EPA estimated that the cost of protecting all shorelines at risk with populations greater than 10 persons per km^2 with seawalls is US$1.14 billion, while the protection of only the "important areas" reduces the cost to US$590 million.

In 2007, the Ghanaian EPA identified 10 areas of vulnerability (EPA, 2007:6–8):

1. *Water resources* – especially in international shared basins where there is a potential for conflict and a need for regional co-ordination in water management.
2. *Agriculture and food security* – food insecurity resulting from declines in agricultural production as a result of declining soil fertility due to water stress. Recent studies in Ghana indicate that an increased number of extreme weather events will worsen food security, decreasing, for example, the maize yield by seven per cent by 2020. Ocean warming meanwhile will also modify ocean currents, with possible impacts on coastal marine fisheries.
3. *Biodiversity* – natural resources productivity and biodiversity that might be irreversibly lost.
4. *Human Health* – as a result of increased incidence of vector born diseases, especially in areas with inadequate health infrastructure, leading to loss of manpower, decreased productivity and stress to the National Health Insurance Scheme.
5. *Coastal zones* – Ghana has a coastal band of about 500 kilometres, with some areas well below sea level. The band is vulnerable to sea level rise, particularly roads, bridges and buildings of historical importance. The eastern coast of Ghana is subject to sizeable coastal erosion of around three metres per year.
6. *Land management* – exacerbation of desertification by changes in rainfall and intensified land use. But land use changes as a result of population

and development pressure will continue to be the major driver of land cover change in Ghana, with climate change becoming an increasingly important contributing factor by 2050.

7. *National revenue* – could decline as a result of impact on cocoa production. The formal and informal sectors of the economy are strongly based on natural resources: agriculture, logging, eco-tourism, pastoralism and mining are dominant. Climatic variations that alter the viability of these activities, for better or for worse, have very high leverage on the economy.
8. *Energy (hydropower) production* – decreasing as a result of declining water resources. This threatens hydropower generation and so energy security: Akosombo dam has reached critically low levels threatening energy generation and industrial activity.
9. *Tourism* – because of impacts on coastal infrastructure, natural parks and ecosystems.
10. *Women and the poor* – climate change impacts women and the poor because they depend on natural resources and economic sectors (like agriculture) that are susceptible to climate change.

Climate change as a threat to economic and political stability

Our research (the workshop, literature and subsequent interviews) in Ghana identified five principle challenges for economic and political stability as a result of climate change:

A. Managing the north-south divide

Ghana is characterized by a pronounced social divide. Poverty is concentrated in the rural north, which is less-well serviced than the south across the full range of government services. Historically the rural north has suffered the most variable climate. Demand for water is rapidly rising with population growth. Ghana's national communication estimated that demand for irrigation water in the dry north savannah could increase 12-fold by 2050 as a result of climate change and population growth. How the government manages development in the north in the context of an increasingly changeable climate will be a challenge that many of our interviewees thought would become increasingly acute in the coming years.

B. The division of water between energy in the south and agriculture in the north

The north-south divide is played out in the sphere of resource allocation between the different regions. One critical issue is the trade-off between water for agriculture in the north and water for hydro-energy production in the

south. Just before the floods of August and September 2007 the level of water in the Akosombo dam had fallen critically low, leading to a power crisis across the country.[6]

C. The management of regional water sources

On a regional scale the partition of water between Burkina Faso and Ghana will likely be a delicate issue in coming years, especially if climate change leads to significantly lower rainfall and run-off. The floods that displaced an estimated 285,000 people in Ghana in September 2007 are an example of why mechanisms like the Volta Basin Authority might become more important in future; despite two weeks advance warning the opening of the Burkinabe Bagré dam to release excess water led to widespread flooding in northern Ghana and some tension.

D. Instability on borders

A further concern that was expressed, albeit vaguely, was the ramifications of conflict elsewhere caused by climate change impacts and what that might mean in terms of flows of refugees, potentially hostile neighbours and regional economic disruption.

E. Economic stability and the structure of the economy

Some analysts predict that Ghana's climate may be unsuitable for cocoa by 2080.[7] This has led to concerns that the impact of climate change will fundamentally alter the basis of Ghana's economy, with unforeseen consequences for economic stability. Cocoa production hit nearly 750,000 tonnes in the 2005–2006 growing season. The stated government aim is to increase this to 1,000,000 tonnes—roughly the level of Côte d'Ivoire before the conflict broke out there (Koranteng, 2007). This policy runs counter to predictions that coca might become unviable as a crop within decades.

6 http://addax.wordpress.com/category/ghana/

7 EPA (2007) presentation

Table 1. Scenario analysis for six areas of vulnerability, Ghana

	Best case scenario	Medium case scenario	Worst case scenario
Agriculture and food security	*Threats* - Reduced crop yields - Sudden-onset events - Dependence on food aid - Pastoralist-farmer conflicts - Soil leeching in the south *Opportunities* - Irrigation/water harvesting - Diversification into tree crops, livestock - Addressing land tenure issues	*Threats* - Reduced rainfall - Decreased crop yields - Decrease in food production, especially in the north	*Threats* - Loss of productive farmland - Changes in cropping patterns - Loss of crop varieties - Food insecurity *Opportunities* - Diversification of agriculture - Commercialization and intensification of agriculture - Improved efficiency of food preservation and storage
Productive systems and exports	*Threats* - Reduced generating capacity for hydro energy and high national dependence on that energy - Lack of ready markets - Primary commodity dependence	*Threats* - Energy crisis, due to reliance on hydropower - Increased reliance on government help	*Threats* - Pressure on natural resources - Increased deforestation - Biodiversity loss, migration - Changes in species composition - Worsening of poverty levels - Loss of livelihood options *Opportunities* - Shift to alternative species - Substitutes – research, imports
Water	*Threats* - Competition for water between northern, agricultural needs and southern hydro energy needs - Women spending more time looking for water - Decreased water in the Volta Basin - Strained urban access	*Threats* - Reduced water availability - Challenges for storage, transport and distribution *Opportunities* - More cooperation in the Volta basin	*Threats* - Decreased water availability - Uninhabitable areas - Pressure on available water resources - Increased water costs *Opportunities* - Private sector participation - Promotion of efficient water use - Diversification of water sources

	Best case scenario	Medium case scenario	Worst case scenario
Natural Disasters	*Threats* - Increased floods and droughts - Regional infra-structure weaknesses (Bagré Dam) - Fishing communities and harbour infrastructure open to threat - Waterlogged coastal lands *Opportunities* - Salt intrusion could be an opportunity for growth for the salt industry, or disaster depending on the scale	*Threats* - Coastal erosion - Flooding - Sea water intrusion	*Threats* - Increase in storm surges - Coastal erosion - Bio-diversity loss - Livelihoods – fishing, farming - Increased salinization - Effect on marine resources - Reduction in crop production *Opportunities* - Investments in coastal protection system - Strengthening of early warning and response mechanisms
Migration	*Threats* - Increased deforestation for plantations - Multiplier effect – one member goes, family follows *Opportunities* - Redress land tenure issues, particularly for women	*Threats* - Decrease in agricultural production leads to southwards movement	*Threats* - Pressure on existing facilities – medical, schools, transportation - Cultural conflicts - Increased unemployment, poverty - Decreased livelihood security - Increased resource-use conflict
Health	*Threats* - Increase in malaria, vector-borne disease - Water shortages leading to problems for hygiene-related disease, women and children who traditionally fetch water	*Threats* - Clinical suspected malaria, malaria, river blindness - Increased budgetary pressure on health care system	*Threats* - Increase in water-borne disease and vectors of transmission - Pressure on health infrastructure - Pollution of water resources *Opportunities* - Increased health spending

Case Study 2
Burkina Faso

Burkina Faso is one of the poorest countries in the world, ranked 176th of 177 countries on the 2007/08 Human Development Index (UNDP, 2007). This landlocked West African country also sits at the confluence of a number of different impacts of climate change: drought and desertification threaten northern communities in the Sahelian transition zone; flash floods have taken lives and tested infrastructure in the Volta Basin; and increasingly variable rainfall has thrown its agrarian economy into periods of uncertainty and financial loss. So far, Burkina Faso has avoided the worst ethnic and resource-based conflicts of its neighbours but how it manages climate change could help dictate its future economic and political stability.

Source: CIA (2008)

Burkina Faso: Background

Burkina Faso is made up of two vegetative zones: the Sahelian transition zone in the north, characterized by semi-desert grass and shrublands, and the Sudanian field to the south, which is wider and marked by savannahs and woodlands. Rainfall and vegetation differ across these climatic zones, with the Sahelian zone receiving on average 600 mm of rain per year and the southwest of the country (its wettest and most productive region) receiving more than

900 mm (MECV and SP/CONEDD, 2006). Rainfall variability increases across the Sahel as you move northwards; in fact, the region is known for having among the highest levels of climatic variability (both spatial and temporal) in the world (Wang, 2004). No major water sources flow into Burkina Faso, and water resources drain out of the country by three main rivers: the Red, White and Black Voltas.

Climate change will interact with a number of development challenges already faced by the country and its people. Life expectancy remains low at 51.4 years, while 38 per cent of children under the age of five are underweight. Doctors are in short supply, with one doctor for every 20,000 people; by contrast, there is a doctor for every 341 people in Denmark. Adult literacy rates are the lowest of any country on the HDI, standing at 23.6 per cent (UNDP, 2007).

Population growth will add to these challenges. Burkina Faso's population is expected to swell to 18.5 million people by 2015, from just 13.9 million in 2005, presenting a serious challenge to food security, resource access and water allocation. While the overwhelming majority of the Burkinabe population remains rural, urban population growth outpaces that of the countryside, straining the already stretched carrying capacity of the country's major cities (UNDP, 2007).

Income poverty is widespread: 27.2 per cent of the population live on less than $1 per day, and 71.8 per cent live on less than $2 (UNDP, 2007). This poverty is concentrated in the countryside, as is most economic activity; pastoral and agro-forestry activities employ 86 per cent of the working population and are responsible for 40 per cent of the GDP (25 per cent for agriculture, 12 per cent for livestock and three per cent for forestry and fishing) (MECV and SP/CONEDD, 2006). This agricultural sector is among the least productive in Africa. The country's soils are poor and contain high levels of mineral salt, rainfall is frequently insufficient, irrigation systems are minimal, and wind and water erosion is widespread. Along with financial and technical constraints, this has resulted in a situation of subsistence farming, low incomes and food insecurity (MECV and SP/CONEDD, 2006).

Despite this rather bleak picture, and despite the history of ethnic and resource-based violence experienced by many of its neighbours, Burkina Faso is by and large a peaceful, stable country. Since the 1987 coup that brought current president Blaise Compaoré to power, the country has not experienced any prolonged periods of violent insecurity; development challenges abound, but the Burkinabe people remain peaceful and resilient. This resilience will be increasingly challenged by climate change, but as climate variability has long been a fact of life in the country, "the adaptability of natural and human systems [is] unsurprisingly already well developed" (CIFOR, 2005). This is not to suggest that climate change could not overwhelm adaptive capacity in the

future, or that future vulnerabilities could not spark conflict; it is merely to suggest that the Burkinabe people have been facing these challenges in a largely peaceful way for years, and have certain tools and strategies at their disposal as they face climate threats in the future.

Climate change impacts and vulnerable sectors

There is a broad consensus in the scientific community that differential changes in sea surface temperatures (SSTs) in the Atlantic (north and south) and the Indian Oceans are the primary driver of climate change in West Africa (CIFOR, 2005). What is unclear is how these SSTs will impact rainfall in the region; models all predict a warming West Africa, but whether it will be wetter or drier remains up for debate.[8] This uncertainty must be taken into account when considering future instability resulting from climate change; these are, after all, assumptions based on assumptions.

Regional climate trends

After a period of unusually high rainfall in the 1930s and 1950s, the Sahel was hit by a devastating 30-year drought, which saw mean annual rainfall drop by 20 to 30 per cent across the region (Hulme, 2001). This resulted in what Hulme (2001) refers to as the "most dramatic example of multi-decadal climate variability that has been quantitatively and directly measured." An estimated 500,000 people died across the Sahel (CIFOR, 2005).

Annual rainfall has since partly recovered, and has contributed to the recent "greening" of the Sahel: vegetation cover across the region increased significantly for the 1994–2003 period when compared to the 1982–1993 period (Anyamba and Tucker, 2005). Within Burkina Faso, an increase in "greenness" has been seen in the central plateau, however more has occurred than can be explained by the increase in rainfall alone. Land use change is believed to be responsible in part for the reversal of the trend towards desertification; in some parts of the country a return to traditional water and soil conservation strategies (such as contour bunding and Zäi cultivation) has helped farmers reclaim some soil fertility and improve their crop yields. The northern Burkinabe province of Oudalan, once cited as an example of severe desertification in the 1970s and early 1980s, has shown an increase in greenness since the mid-1980s—proving that rainfall alone, which was still low in those years,

8 Some models predict that a cooler northern Atlantic will combine with warmer water around Africa to weaken the West African monsoon, leading to drought across the Sahel. Others show that increased temperatures and CO_2 concentrations can cause a northward shift of the West African monsoon and increased vegetative production, with a further positive feedback loop existing between increased vegetative cover and precipitation (CIFOR, 2005).

cannot fully account for the increase in vegetation cover (Rasmussen, 2001). Whether the greening of the Sahel represents a return to normal rainfall levels or a larger trend towards wetter conditions in the face of anthropogenic climate change remains to be seen.

Burkina Faso: climate change vulnerability

2007 was seen by many in Burkina Faso as illustrative of the changes ahead: increased rainfall variability despite total rainfall in line with past yearly averages; dramatic flooding (33 dead, 28,000 homeless); threats to infrastructure with international implications (61 dams and causeways destroyed, the release of waters from the Bagré Dam into Ghana following August's flooding); a poor harvest; and a corresponding decline in production (IRIN, 2007a).

Burkina Faso's National Adaptation Programme of Action (NAPA) team, through a participatory process with local communities, identified four sectors deemed currently vulnerable to climate change: water, agriculture, stockbreeding and forestry/fisheries. These four sectors form the basis of the Burkinabe economy and are seen at the moment to be vulnerable to four primary climate impacts: decline and variability in rainfall, heavy rainfall/flooding, rising temperatures and increased wind speeds (MECV and SP/CONEDD, 2006).[9]

A. Decline and variability in rainfall

Between August 24 and 25, 2007, 112 mm of rain fell on Sandema, a town just across the border from southern Burkina Faso in Ghana's Upper East Region (IRIN, 2007b). The downpour amounted to 20 per cent of the yearly average rainfall for the area, and contributed to flooding and widespread displacement across both countries.

August's rains, though extreme, reflect an increase in rainfall variability for a region that is used to seeing monthly fluctuations. According to the country's NAPA, the decline and increased variability of rainfall represents one of the most harmful impacts of climate change currently being experienced in Burkina Faso. Burkina's NAPA team projects that average annual rainfall will decline significantly by mid-century, falling by 3.4 per cent by 2025 and 7.3 per cent by 2050. This will be accompanied by strong inter-annual and seasonal variability: July, August and September are expected to show reductions of 20 to 30 per cent from their current levels, whereas November will see an increase of 60 to 80 per cent of its average annual rainfall.

9 Climate projections were reached in the NAPA using the MAGIC/SCENGEN model.

These twin problems will have implications for planting and harvesting cycles. Shortened rainy seasons will affect many parts of the country, making harvesting difficult and leading to production shortfalls. This is particularly worrying given the Burkinabe economy's dependence on cotton: it garners 60 to 70 per cent of the country's export earnings and is responsible for six per cent of the GDP (World Bank, 2005). Such shortfalls can in turn lead to hoarding and aggravated price spikes.[10] In addition, the NAPA warns that droughts will accelerate deforestation and reverse some of the more recent positive results in the fight against desertification.

Projected rainfall trends will also affect water flows in the country's four basin slopes. In relation to water flows between 1961 and 1990, the NAPA team expect decreases of 45.6 per cent at Comoé and 54.7 per cent at Mouhoun by 2025. This will be driven by decreased rainfall, increased erosion and vegetation degradation. By contrast, the Nakanbé and Niger basin volumes will initially swell due to initial runoffs (by 35.9 per cent and 47 per cent, respectively). These effects are erased by 2050, however: decreases across all basins are expected at 68.9 per cent for Comoé, 73 per cent for Mouhoun, 29.9 per cent for Nakanbé and 41.4 per cent for Niger (MECV and SP/CONEDD). A decline and increased variability in rainfall will have a significant impact on all four of the identified vulnerable sectors:

- *Water* – premature dryness of wells and sumps; weak filling of water sources; insufficient water supply; and aggravation of the hydrological cycle.
- *Agriculture* – disturbance in the agricultural calendar; lower agricultural outputs; risk of disappearance for less-resilient species; water deficit for farms; and food insecurity.
- *Stockbreeding* – fodder resource deficit; losses of livestock; water deficit for livestock; and lower productivity.
- *Forestry/fisheries* – Lower soil water reserve after the death of trees and vegetation species; and loss and migration of fauna species (MECV and SP/CONEDD, 2006).

B. Heavy rainfall/flooding

Rainfall variability, like that experienced in Sandema, threatens Burkina Faso with an increase in floods, which bring with them significant human and economic costs. In 2007, flooding left 33 dead and hundreds injured. It destroyed 13,000 ha of land, resulting in losses of 100,000 tonnes of cereals valued at 10 million CFA. Sixty-one dams and causeways were destroyed, and 10 million

10 Taken from the workshop.

CFA will be required to fix roads throughout the affected areas (Sawdogo, 2007). Unfortunately the flooding of 2007 was not unprecedented, nor was the damage; in 1999, economic losses from flooding amounted to 1,803,000,000 CFA, whereas, in 1994, losses totalled 63.9 billion CFA (MECV and SP/CONEDD, 2006). Increased flooding and heavy rains will carry with them a number of implications for the identified vulnerable sectors:

- *Water* – risk of destruction of water infrastructure; siltation of lakes and rivers; and surface water pollution.
- *Agriculture* – lower outputs; streaming and hydrous erosion; scrubbing of the soils; losses of harvests; and destruction of farms.
- *Stockbreeding* – drowning of livestock; and prevalence of humidity-related disease.
- *Forestry/fisheries* – erosion; and carrying of fish out of the rivers (MECV and SP/CONEDD, 2006).

C. Rise in temperatures

Climate models, uncertain in some projections, do agree that West Africa is getting hotter. Burkina is already experiencing hotter temperatures, specifically in December, January, August and September.

Temperatures are expected to rise by 0.8˚C by 2025 and by 1.7˚C by mid-century (MECV and SP/CONEDD, 2006). This will affect sector vulnerabilities in the following ways:

- *Water* – premature drying up of surface water sources; increase in water demand; and increased evaporation.
- *Agriculture* – deterioration of soil quality; expansion of agricultural land to compensate for falling output; disappearance of certain species; potential upsurge of certain farm predators (locusts, caterpillars); and lower production in market-gardening crops.
- *Stockbreeding* – lower-quality fodder; and early drying up of drinking points.
- *Forestry/fisheries* – water deficit for fauna; decline in soil quality; reduction in biodiversity quality and quantity; migration of vegetation species; and increase in evapo-transpiration levels.

D. Increased winds

Human and animal overexploitation of the vegetation cover is interacting with rainfall variability to accelerate desertification, and is in turn worsening the ero-

sive impacts of wind. Land clearing shows little sign of slowing down: forestry biomass is expected to decrease significantly, from almost 200 million m^3 in 1999 to little more than 110 million m^3 in 2050. This has already resulted in increased winds and a dust sheet, and is particularly problematic in November and December, when strong Harmattan winds blow in from the north. The impact of increased winds on water, agriculture, stockbreeding and forestry will be:

- *Water* – increased evaporation of water levels; silting of lakes; and increased water pollution.
- *Agriculture* – destruction and defloration of fruit trees; lower output; and propagation of unfavourable crops for seed productions.
- *Stockbreeding* – lower availability of water; deficits in fodder; and propagation of viral diseases.
- *Forestry/fisheries* – destruction of big trees; acceleration of bush fires; and increase in evapo-transpiration levels (MECV and SP/CONEDD, 2006).

Climate change and political and economic instability

While climate change is undoubtedly a serious development issue in Burkina Faso, the workshops and interviews indicated that the risk of violent conflict became clear under the worst case scenario; before reaching this point, experts believed that Burkina Faso had the capacity to face climate change in a more peaceful and constructive way. This is not to say that the country will not face hardships, or that vulnerable "hotspots" should be ignored. We conclude the case study with some of the more prevalent areas towards which attention should be paid.

A. Water availability

Water is a potentially contentious resource. Siltation, erosion and variable and declining rainfall are expected to reduce water availability and quality. Our interviewees stressed that given this threat and a growing population, a careful balance needs to be struck between consumption and production; crops and livestock; and upstream, domestic use and use by Burkina's downstream neighbours. While climate models cannot say with any certainty how climate change will affect water supply in West Africa in the future, practical steps must nonetheless be taken to manage water resources efficiently. This appears to be beginning to a degree, both on the local scale through simple, traditional solutions like contour bunding, Zäi cultivation and "demi-lunes" to capture rainfall; to national initiatives like the Presao rainfall prediction program;[11]

11 http://medias.obs-mip.fr/acmad/fr/fr/presao-02/infonote_uk.htm

and regional initiatives like the Volta Basin Authority, designed to increase cooperation and improve management of water resources among the basin's riparian states.

B. Pastoralist/farmer tensions

Farmer-pastoralist relations are already a contentious issue in Burkina Faso. The migration of farmers is combining with drought and desertification to further restrict the movements and resource access of Burkina's pastoralist communities. Conflict between the two groups over land and resource access was less of an issue in the past, when lower population densities and established relationships between settled farmers and transhumant groups allowed migratory corridors to remain open and land access unfettered. However, competition is already rising between these groups for increasingly sparse land. And with both farmers and pastoralists forced to move, new groups will be coming into contact with each other and traditional relationships and dispute resolution mechanisms could break down.

In addition to these challenges, some farmers seeking to diversify their income stream in the face of uncertain harvests have turned to stockbreeding. As a result, they rely less on the mutually beneficial relationships previously established with pastoralists for agricultural inputs such as compost and fertilizer, while increasingly competing with them in the marketplace; as productive systems evolve, so do social relationships. These factors all combine to threaten the pastoral way of life and to further marginalize Burkina's transhumant community.

C. Migration

One traditional coping strategy to deal with climate change threats is migration, which for Burkina's transhumant communities is a common coping strategy but which, as more actors get involved, is increasingly viewed as a source of local conflict. Longer dry seasons are driving farmers to migrate from the north and central parts of the country into the fertile east and west, bringing them into contact with settled farmers in these richer areas. Greater populations congregating in smaller fertile areas will increase competition for valuable lands and has, in some cases, led to environmental degradation (MECV and SP/CONEDD, 2006).

For those not moving in search of new lands to cultivate, Burkina's cities offer hope of economic advancement. And while economic conditions in the cities are undoubtedly better for some, accelerated urban migration is driving the growth in peri-urban poverty and is testing the ability of municipal governments to meet public service demands.

D. Food insecurity

Food security was deemed a concern across all three scenarios. Unpredictable, declining rainfall and expected increases in the frequency and gravity of floods and droughts have many worried about the capacity of the country to maintain its agricultural production. Experts also believe that climate change will contribute to ecosystem degradation (through erosion, siltation, etc.) and will further shift productive land from the north to the south of the country. The wetter south is, however, not immune to these challenges; certain crops—including cotton, maize and yams—have already seen production drop as a result of drought in the area (MECV and SP/CONEDD, 2006). If the agricultural sector cannot keep pace with the growing population, political and economic instability could result.

Table 2. Scenario analysis for six areas of vulnerability, Burkina Faso

	Best case scenario	Medium case scenario	Worst case scenario
Agriculture and food security	*Threats* - Food insecurity - Transhumant way of life *Opportunities* - Intensification of agriculture - Fewer resource conflicts between farmers - Reduced rural population with a move towards a service economy	*Threats* - Reduced land quality - Reduction in the agricultural population - Increase in drought *Opportunities* - Adoption of new technologies - Adoption of cash crops - Adoption of new land policies	*Threats* - Population displacement - Food insecurity - Biodiversity loss - Reduction in protected areas - Ecosystem degradation and a movement from north to south of productive land *Opportunities* - Forced changes and modifications to productive systems - Adoption of new technologies
Productive systems and exports	*Threats* - Reduction in imports (good for domestic production) *Opportunities* - Diversification towards animals and derived products - Move towards producing for markets	*Threats* - Reduction in productive capacity - Increased costs of production *Opportunities* - Increase in export capacity - Development of secondary and tertiary sectors	*Threats* - Increased competition - Disappearance of low-performing sectors - Movement towards industry and GHG emissions increase - Threats to national food sovereignty

	Best case scenario	Medium case scenario	Worst case scenario
			Opportunities - Development and diversification of productive systems - Improved commercial exchanges - Intensification of agriculture
Water	*Threats* - Increase in waterway siltation - Reduced water availability *Opportunities* - Capture of new water sources - Improved water storage capacity - Improved use of water	*Threats* - Reduced water availability - Increase in water conflicts *Opportunities* - Improved systems for harnessing water resources - Accelerated integration of water management tools	*Threats* - Water crisis - Increase in water conflicts - Water quality problems *Opportunities* - Changes in water usage - Increase in the organization and performance of IWRM systems - Move towards more efficient technologies for water usage
Natural disasters	*Threats* - Increased flood risks - Increased migration - Threats to unprepared infrastructure - dams, roads - Droughts squeezing pastoralists out of traditional migratory routes - Ability to help those in need increasingly stretched	*Threats* - Increase in the frequency and gravity of natural disasters - Increase in unsupervised bushfires *Opportunities* - Increased social cohesion - New adaptation technologies (drainage, etc.)	*Threats* - Droughts - Floods - Increase in extreme weather conditions - Increase in landslides *Opportunities* - Development of an early warning system for vulnerable groups - Improved natural disaster management - Reforestation and GHG capture

	Best case scenario	Medium case scenario	Worst case scenario
Migration	*Threats* - Population growth - Increase in tensions between migrant/ host communities, across borders - Increasingly rural-urban (with service economy – takes time) – decrease in rural population	*Threats* - Increased migration - Decreased active population - Slower development *Opportunities* - Increasingly ethnically-mixed population - Preserve cultural values	*Threats* - Accelerated destruction of ecosystems - Increased social conflicts - Social destabilization - Loss of ethno-linguistic differences - Rending of the social fabric *Opportunities* - Establishment of a national identity
Health	*Threats* - Growth in AIDS with urban growth - Water quality problems related to storage - Worsening situation for vector-borne diseases like malaria	*Threats* - Vector-borne diseases - Increased mortality rates *Opportunities* - Investments in health, sanitation - Adoption of new water-treatment technologies	*Threats* - Increase in vector-borne diseases - New types of parasites *Opportunities* - Re-evaluation of ways of life - Development of medical research and protection systems

Annex 1
Climate change scenarios

The IPCC, in its *Special Report on Emission Scenarios* (2000), devised a series of six future emissions scenarios looking at possible future climate change, which varied according to demographic, technological and economic developments. The six basic 'storylines' of the SRES are each based on different rates of population and economic growth, as well as the future "energy mix." They range from the most greenhouse gas intensive (A1F1 – where energy remains fossil fuels and economic growth is rapid) to the least intensive B1 storyline (where the world economy moves towards less resource intensity and cleaner technologies). All the scenarios assume no additional climate change initiatives such as the implementation of the UNFCCC or the achievement of the emissions targets of the Kyoto protocol.

The six emissions scenarios, as laid out by Working Group 1 in the Third Assessment Report of the IPCC, are as follows (IPCC, 2001):

A1. The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end-use technologies).

A2. The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

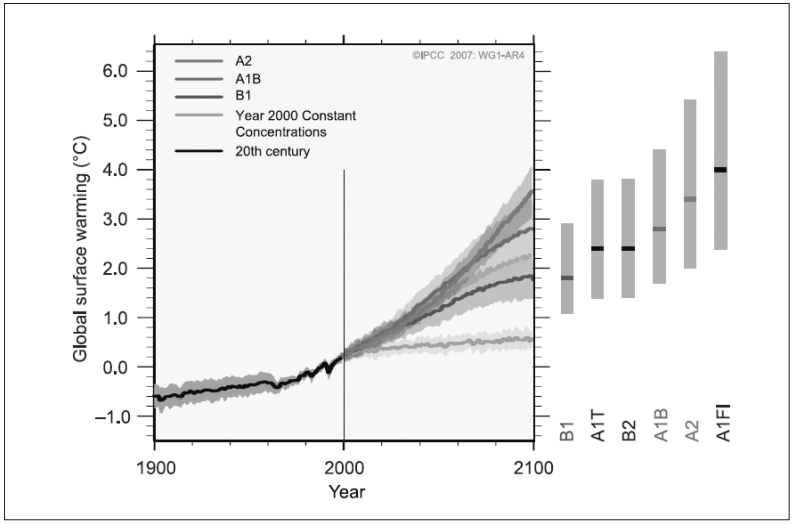
B1. The B1 storyline and scenario family describes a convergent world with the same global population that peaks in mid-century and declines there-

after, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the A1 and B1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

The corresponding surface temperature increases for each scenario can be seen in the graph below:

Chart 1. Multi-modal averages and assessed ranges for surface warming



Source: IPCC (2007b)

Ghana and Burkina Faso case studies

For the purposes of this study, three of the SRES scenarios (B1, A1B and A1F1) were chosen as starting points to imagine highly speculative scenarios for the best, medium and worst cases for future global climate change. These three adjusted scenarios were then used to gauge future vulnerabilities in Ghana

and Burkina Faso to climate change, and to look at the implications of these vulnerabilities for political and economic stability within each country:

Best case scenario

The best case scenario builds on the B1 scenario of the SRES. As mentioned, the B1 storyline describes a world whose population peaks mid-century around nine billion and declines thereafter towards seven billion. States move rapidly towards service and information economies, and there is a reduction in material intensity and an introduction of clean and resource-efficient technologies. "The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives" (IPCC, 2001).

Under this best case scenario, atmospheric concentrations of CO_2 would stabilize at around 600 ppm by the end of the century, leading to a global temperature rise of around 1.8°C and a sea level rise of 18 to 38 cm over the next 100 years. Based on the findings of the Stern Review, this temperature rise—despite this being the best case scenario—would still lead to a 20–30 per cent decrease in water availability in some vulnerable regions of the world, including southern Africa (Stern, 2006). Crop yields would decline across tropical regions and would fall by as much as five to 10 per cent in Africa. Globally, up to 10 million more people would be affected by coastal flooding each year.

Further diverging from the B1 storyline, this best case scenario imagines that a serious post-2012 regime is put in place by the international community to reduce carbon emissions. The BRIC countries (Brazil, Russia, India and China) join as full members and work to cut their own emissions. In addition, widespread international support for adaptation helps vulnerable countries cope with the worst impacts of climate change.

Medium case scenario

The medium case scenario uses the SRES A1B storyline as its starting point. A1B envisages the same population curve as B1 and predicts a world of very rapid economic growth with the swift up-take of new and more efficient technologies. As listed above, it expects convergence among regions, increased social and cultural interactions and a substantial reduction in the differences in per capita income across regions. In contrast with the best case scenario, in this storyline the world's energy is sourced from a balance between fossil-intensive and non-fossil energy sources; as such, its emissions will be higher.

For the A1B scenario, atmospheric concentrations of CO_2 would grow to 850 ppm, three times pre-industrial levels, over the next 100 years. As a result, tem-

peratures would increase over the same period by approximately 2.4°C (with a range of 1.7°C to 4.4°C). This would carry with it greater practical implications. Sea level rise would be between 21 and 48 cm and the resultant coastal flooding would affect between 11 and 170 million additional people every year. Precipitation in sub-tropical areas would fall by up to 20 per cent. Should temperatures increase by 3°C (only slightly more than the mean projected increase), one to four billion people would suffer water shortages and 150 to 550 million additional people would be at risk of hunger (Stern, 2006). Economic and climate-induced migration to cities and across borders would increase, and could strain the carrying capacities of recipient communities.

Finally, under this scenario we imagine that international efforts to reduce greenhouse gas emissions are delayed, patchy and not particularly effective. Some effort and funds are invested into adaptation, but not enough to meet the need.

Worst case scenario

The worst case scenario is built on the A1F1 storyline. This SRES scenario differs from the A1B scenario only in that it forecasts a continued dependence on fossil fuels for the world's energy needs —a 'business as usual' scenario.

Following this trend, atmospheric concentrations of CO_2 would be 1,550 ppm by 2099, five times pre-industrial levels and four times the current level. This concentration would result in a global temperature increase of 4.0°C (with a likely range from 2.4°C to 6.4°C) and a corresponding sea level rise of between 29 and 59 cm. According to the Stern Review, a warming of 4.0°C would result in a 30 to 50 per cent decrease in water availability in southern Africa, and a decrease of 15 to 35 per cent in agricultural yields across the continent (Stern, 2006). With high climate sensitivity, the number of people exposed to flooding per year could be as many as 160 million by the 2050s and 420 million by the 2100s. Tens of millions of people would be displaced by extreme weather events, such as floods, storms and droughts, and many millions more displaced by climate processes like desertification, salinization of agricultural land and sea-level rise. Under this final scenario, no action is taken by the international community to reduce greenhouse gas emissions, and no serious support is given to climate change adaptation.

These three scenarios all assume a roughly linear path for climate change; the picture would change in the case of abrupt climate event such as the collapse of the Gulf Stream or the melting of the Greenland or Antarctic ice sheets. The IPCC estimates that the melting of the Greenland ice sheet would cause a seven metre rise in global sea levels. (IPCC, 2001). The Stern Review estimates that the dramatic rise in sea level resulting from the melting or collapse of the

ice sheets could eventually threaten four million km^2 of land currently home to five per cent of the world's population (around 310 million people) (Stern, 2006).

Annex 2
Ghana and Burkina Faso at a glance

Table 3 presents data on Ghana and Burkina Faso and compares some key figures between these two countries, the sub-Saharan Africa region, Denmark and other high-income (OECD) countries.

Table 3. Statistical snapshot of Ghana and Burkina Faso

	Ghana	Burkina Faso	Sub-Saharan Africa group	Denmark	High-income countries
Population 2005 (millions)	22.5	13.9	722.7	5.4	1,172.6
Population 2015 (millions)	27.3	18.5	913.2	5.5	1,237.3
Land area (1,000 km^2)	227.5	273.6	23,597	42.4	32,904
GDP ($ billions) 2005	10.7	5.2	589.9	258.7	34,851
GDP growth rate 1990–2005	2.0%	1.3%	0.5%	1.9%	1.8%
GDP per capita US$ PPP 2005	2,480	1,213	1,998	33,973	29,197
Life expectancy at birth	59.1	51.4	49.6	77.9	78.3
Adult literacy rate (% aged 15 and above)	57.9	23.6	60.3	99.0	99.0
Annual population growth rate					
1975–2005	2.6	2.8	2.8	0.2	0.8
2005–2015	1.9	2.8	2.3	0.2	0.5
Urban population (% total)					
2005	47.8	18.3	34.9	85.6	75.6
2015	55.1	22.8	39.6	86.9	78.2
Urban population growth (average annual increase, 1990–2005)	4.2	4.8	4.0	0.4	1.1
Agricultural land (% of land area)	65	40	44	61	39
Irrigated cropland (% of cropland)	0.5	0.5	3.6	19.7	11.8
Population density, rural (people/km^2 arable land)	272	211	373	35	325

	Ghana	Burkina Faso	Sub-Saharan Africa group	Denmark	High-income countries
Deforestation (average annual %, 1990–2005)	1.7	0.3	0.6	-0.8	-0.1
Internal freshwater resources per capita (m^3)	1,370	945	5,229	1,108	9,640

Source: UNDP (2007), World Bank (2007a)

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Assessing the security implications of climate change for West Africa

Traditionally seen as an environmental and an energy issue, climate change is now also being cast as a threat to international peace and security. Africa, though the least responsible for greenhouse gas emissions, is seen as the continent most likely to suffer its worst consequences—a function of the continent's reliance on climate-dependent sectors (such as rain-fed agriculture) and its history of resource, ethnic and political conflict.

The security implications of climate change have become the subject of unprecedented international attention; in 2007 climate change was the focus of both a Security Council debate and the Nobel Peace Prize. There have been some attempts to construct scenarios of the ways in which warming temperatures might undermine security at a global scale. But the country-level security impacts of climate change have been lost in the political rhetoric. Local experts are rarely consulted.

This paper is a modest effort to address this research gap. Drawing on field visits and consultations with local experts, this paper explores the extent to which climate change will undermine security in two different countries in West Africa, Ghana and Burkina Faso.

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