



D E V E L O P M E N T A N D C L I M A T E C H A N G E

The **Social Dimensions** of Adaptation to Climate Change in **Ghana**





E C O N O M I C S O F A D A P T A T I O N T O C L I M A T E C H A N G E

The **Social Dimensions** of Adaptation to Climate Change in **Ghana**

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November 2010

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ACRONYMS AND ABBREVIATIONS

AMA	Accra Metropolitan Assembly
CBO	Community-based organization
DA	District Assembly
DEDA	Dagme East District Assembly
DESD	District Environmental and Sanitation Development
EACC	Economics of Adaptation to Climate Change
EPA	Environmental Protection Agency
GES	Ghana Education Services
GHS	Ghana Health Services
GCM	General circulation model
GPRS	Ghana Poverty Reduction Strategy
KNDA	Kasena Nankana District Assembly
INC	Initial National Communication
MOFA	Ministry of Food and Agriculture
MOH	Ministry of Health
MLG	Ministry of Local Government
NADMO	National Disaster Management Organisation
NGO	Nongovernmental organization
PDA	Pru District Assembly
PSD	Participatory scenario development
SARI	Savannah Accelerated Research Institute
TA	Traditional authority
TMA	Techiman Municipal Assembly
UNFCCC	United Nations Framework Convention on Climate Change
ZOVFA	Zuri Organic Vegetable Farmers Association

Note: Unless otherwise noted, all dollars are U.S. dollars.

GLOSSARY OF TERMS

Adaptation

Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (IPCC 2001a; 2001b)

Adaptive Capacity

The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC 2001a; 2001b).

Climate

Climate can be viewed as average weather. It represents the state of the climate system over a given time period and is usually described by the means and variation of variables such as temperature, precipitation, and wind, most commonly associated with weather (IPCC 2001a; 2001b).

Climate variability

Refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability) (IPCC 2001a; 2001b).

Climate change

Refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines climate change as a “change in climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural variability observed over comparable time periods” (IPCC 2001a; 2001b).

Disaster

A serious disruption of the functioning of a community or a society causing widespread human, material, economic, or environmental losses that exceed the ability of the affected community/society to cope using its own resources (UN/ISDR 2002).

Livelihood

Comprises the capabilities, assets (including both material and social resources), and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Chambers and Conway 1992).

Mainstreaming

Used in this document to describe the integration of climate issues in decision making processes such as planning and budgeting.

Mitigation

Entails all human interventions that reduce the sources or enhance the sinks of greenhouse gases (IPCC 2001a; 2001b).

Poverty

Now widely viewed as encompassing both income and non-income dimensions of deprivation, including lack of income and other material means; lack of access to basic social services such as education, health, and safe water; lack of personal security; and lack of empowerment to participate in the political process and in decisions that influence someone's life (UNDP 1997).

Resilience

The amount of change a system can undergo without changing state (IPCC 2001b).

Sensitivity

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise) (IPCC 2001a; 2001b).

Vulnerability

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC 2001a; 2001b).

ACKNOWLEDGMENTS

The social component of the Economics of Adaptation to Climate Change (EACC) study was developed through the joint efforts of the World Bank Social Development (SDV) and Environment Departments (ENV) and the LCR, AFR, EAP, and SAR Regions of the World Bank; ESSA Technologies Ltd and the International Institute for Sustainable Development (IISD), Canada; and research institutions in Bolivia, Bangladesh, Ethiopia, Ghana, Mozambique, and Vietnam. The study was undertaken by a core team led by Robin Mearns and comprising Anne Kuriakose, Carina Bachofen, Nilufar Ahmad, and Minna Kononen (all SDV). An overall synthesis report of all six country reports is available at www.worldbank.org/eacc. The study was designed and implemented in close collaboration with the team leader for the overall EACC study (Sergio Margulis), and Ana Bucher, Laurent Cretegny, Urvashi Narain, Kiran Pandey, Robert Schneider (all ENV), and sector consultants.

The Ghana country study for the social component was led by Robin Mearns and Anne Kuriakose (SDV), in collaboration with the EACC country team leader Peter Kristensen. The research partner in Ghana was Participatory Development Associates Ghana Ltd.

(PDA), where the study team was led by Tony Dogbe and comprised Joseph Yaro, George Ahiable, Tia Yahaya, and Kamil Abdul Salam. Support in methodology and workshop design and for training of trainers for the Participatory Scenario Development (PSD) workshops was provided by Livia Bizikova (IISD), Philip Bailey, and Samantha Boardley (all ESSA). A separate report is available summarizing this PSD work, along with a training of trainers manual at www.worldbank.org/eacc.

We could not have completed this work without the continuous logistical support provided by Hawanty Page (ENV), Grace Aguilar (ENV), Mustafa Pajazetovic, and Carmen Martinel (both SDV). We gratefully acknowledge editorial services provided by Robert Livernash, and production management provided by Danielle Christophe (SDV) and Robert Reinecke.

The Ghana country study has benefited greatly from peer review comments and other feedback from World Bank staff, including Carolyn Winter (AFTCS), and from external peer reviewers, including Sean Doolan, Edward Carr, Katrina Brown, and Richard Klein.

Any remaining errors and omissions are entirely those of the country study team.

EXECUTIVE SUMMARY

In partnership with the governments of the Netherlands and the United Kingdom, the World Bank instituted a global study on the economics of adaptation to climate change. The program's objective is to assist decision makers in developing countries in integrating adaptation measures into national development strategies, policies, and budgets. The economics of adaptation to climate change is a new research area and no agreed methodology to assess overall costs has yet emerged. An understanding of the full array of adaptation options, including institutional and policy changes, is crucial to prioritize the most effective adaptation strategies.

The study is intended to help decision makers in developing countries to better understand and assess the risks posed by climate change and to better design strategies to adapt to climate change and variability. This requires costing, prioritizing, sequencing, and integrating robust adaptation strategies into their development plans and budgets. Furthermore, this requires strategies to deal with high uncertainty, potentially high future damages, and competing needs for investments in social and economic development. The study is further intended to inform the international community's efforts, including UNFCCC and the Bali Action Plan, to provide access to adequate, predictable, and sustainable support, and to provide new and additional resources to help the most vulnerable developing countries meet adaptation costs. This report presents important knowledge on Ghana's vulnerability to climate change and various adaptation options that could be integrated into sectoral and spatial

planning. It provides the needed inputs for planning a sustainable future. The need to pay attention to community-level actions/responses through direct support and mainstreaming into national policy cannot be overemphasized.

This study seeks to:

- Identify some robust adaptation strategies and options at the local level.
- Provide a basis for understanding how to structure adaptation interventions so as to benefit the most vulnerable households and communities within vulnerable regions.
- Assess the impact of socioeconomic status, gender, and poverty in shaping a range of types of vulnerability of different social groups to climate change.
- Provide cost-benefit estimates for alternative adaptation responses in different agroecological zones.

The data used in this study are predominantly primary in nature, with background information coming from secondary sources. The methodology draws upon a range of analytical frameworks, including the sustainable livelihoods framework, assets and capabilities frameworks, institutional risk pooling approaches, social risk management framework, and environmental entitlements analysis. The research process was divided into phases, including (a) data review and identification of hotspots and vulnerability/livelihood profiles based on key vulnerabilities and a review of the policy and institutional environment; and (b) validation of livelihood profiles at the field level and identification of alternative, robust adaptation pathways using participatory methods to elicit plausible scenarios.

We conducted five participatory scenario development (PSD) workshops involving a wide range of stakeholders, including government officials, local experts, and representatives to explore the future in rigorous, creative, and policy relevant ways. These workshops explored climate impacts and challenges, existing adaptation measures, and future developmental aspirations. They suggested rigorous adaptation strategies to meet the visions.

Key findings include:

- The current climate challenges—such as droughts, flooding, and increases in sea level—are severer and occur much more frequently than a few decades ago. The northern savannah bears the brunt of climate-induced livelihood impacts; agriculture is devastated and natural-resource-based activities are threatened by the consequent degradation. In the transition and forest belts, though droughts are not a major problem, variations in rainfall—especially deficits in the number of rainy days—pose new challenges to rural livelihoods. There is a shortening of the farming season in many places and the gradual fading of the secondary growing season in transition areas. The incidence of floods is especially high in flood-prone areas in the coastal and northern savannahs, as well as river towns. Stormy weather affects traditional structures across the entire country, and also damages/destroys modern infrastructure. The traditional signs for predicting weather patterns are no longer reliable. Dark clouds and winds no longer result in rain, while the start and end of the different seasons is less predictable. Coastal communities are under siege from the ravaging sea as it gradually surges inland.
- The direct and indirect impacts of climate change are specific to different sociogeographic zones and livelihood groups and sectors. In sectoral terms, agriculture, water, physical infrastructure, health, and the environment are the most affected. Indirectly, climate change ultimately leads to malnutrition resulting from food insecurity, health problems, and conflicts due to resource scarcity and degradation, and contributes to the decision to migrate.
- Vulnerability to climate change is not uniform but differs according to social groups and sectors. Social differentiation and access to resources—as enabled by both formal and informal institutions—accounts for the differential adaptations people face in their communities. The nature of the inheritance system, governance systems, and land tenure relations are important. Climate-enhanced social exclusion is on the rise as the number of “environmental refugees” increases with each climate hazard. The main categories of vulnerable groups include widows, disabled, aged, children, youths, divorced women, and the poor in general.
- Adaptation to climate change within the various livelihood systems in each agroecological zone constitutes an important means of obtaining sustainable livelihoods. Adaptation potential is determined by the social relations and processes that mediate access to resources. Social relations reflect interests of diverse groups, often influenced by cultural, economic, and physical change in the quest to achieve sustainable livelihoods and exert influence. Both *ex ante* and *ex post* strategies are used by people of different socioeconomic status. The popular adaptation strategies include livelihood diversification, adapting planting dates, and changes in crop varieties planted. Multiple livelihoods as an adaptation strategy are important in all the zones as a realistic adaptation strategy. The mix of coping and adaptation strategies is necessary for the survival of the poor. Coping strategies buy time for people to effectively plan the future based on the past and imagined scenarios of what trends will occur.
- With regard to sequencing adaptation pathways, interventions need to be considered for the short, medium, and long terms. Short-term interventions are less expensive and constitute advocacy, relief, and support of existing strategies. Medium-term interventions involve more infrastructure and institutional capacities needed to build area resilience, which is identified as the weakest link in Ghanaian adaptive capacity. Long-term interventions are a continuation of “hard” strategies of infrastructure and technology, but with a focus on management capacities to ensure sustainable integrated resource management. Adaptation strategies need specific leveraging, especially beginning with the agriculture, water, and services sectors, which have synergistic positive relationships with each other and other sectors. In terms of location, interventions

should be distributed according to the nature of threats and impacts and vulnerability characteristics.

- There are critical pro-poor measures that need to be in place at the national level to ensure that adaptive strategies will be effective and will help the poorest and most vulnerable. These include the need for (a) stronger government commitment to redistributive policies; (b) clear and effective rule of law regarding natural resource ownership and exploitation; (c) shifts from the current open access approach to natural resource utilization to a user rights approach; and (d) more efficient and transparent use of resources.
- At both the local and national levels, there is a focus on a mixture of both hard and soft adaptation measures. Soft adaptation measures dominate the short-term suggestions, while hard adaptation measures are proposed for the medium and long term in all zones except for the coastal fishing community, where hard measures are needed more immediately. There is a relative predominance of hard over soft adaptation measures because of the low investments in social and economic investments over the years, which have led to an adaptation deficit in infrastructural development. The high cost of these investments would require substantial external support in order to reduce the adaptation deficit.
- Policies at the national and regional levels—accompanied by institutional support—should

promote effective governance, transparency, sound financial management, systems for monitoring and evaluation, capacity building, operational independence, local participation, endogenous development, appropriate technology, and collaboration between implementing agencies and local communities.

RECOMMENDATIONS

Policy design and implementation processes need cautious and collaborative crafting that respond to the concerns of vulnerable groups with regard to climate and other challenges. Mainstreaming climate change issues into the wider policy framework should aim at building adaptive capacity at the household, area, and national levels. Prioritization among the numerous competing objectives needs an incremental policy framework for designated adaptation pathways designed over time. Program design should focus on increasing resilience, building adaptive capacity, reducing vulnerability and poverty, enhancing productivity, ensuring environmental sustainability, promoting sustainable livelihoods, and enhancing national capacity. This holistic policy and program implementation framework requires the technical and financial support of the international community. The success of Ghana in meeting the challenges of climate change and variability hinges on its own internal organization and the fidelity of the international community in honoring their promises and pledges.

1. INTRODUCTION AND OVERVIEW

In partnership with the governments of the Netherlands and the UK, the World Bank instituted a global study on the economics of adaptation to climate change with the objective of assisting decision makers in developing countries to integrate adaptation measures in national development strategies, policies, and budgets. Current estimates of the cost of climate change in developing countries and of the needed adaptation measures are in very short supply, and the ones available are rather crude and/or simplistic. This is largely because the economics of adaptation to climate change is a new research area and no agreed methodology to assess overall costs has yet emerged. An understanding of the full array of adaptation options, including institutional and policy changes, is crucial to prioritize the most effective adaptation strategies. This understanding must include the costs and benefits of the options as well as an analysis of how to foster private sector and community-level engagement on adaptation. Better estimates of the overall budgetary implications of implementing “climate resilient development” are needed to both enable developing countries to develop and implement national strategies and plans, as well as to inform discussions concerning possible international assistance.

The overall objective of the study is to help decision makers in developing countries to better understand and assess the risks posed by climate change and to better design strategies to adapt to climate change and variability. This requires costing, prioritizing, sequencing, and integrating robust adaptation strategies into their development plans and budgets. Furthermore, this

requires strategies to deal with high uncertainty, potentially high future damages, and competing needs for investments in social and economic development. The study is further intended to inform the international community’s efforts, including UNFCCC and the Bali Action Plan, to provide access to adequate, predictable, and sustainable support, and to provide new and additional resources to help the most vulnerable developing countries meet adaptation costs.

This report presents important findings on Ghana’s vulnerability to climate change and various adaptation options for mainstreaming into sectoral and spatial planning. It provides the needed inputs for planning a sustainable future.

STUDY RATIONALE AND APPROACH

This study aims to provide a methodology for identifying some robust adaptation strategies and options at the local level; to provide a basis for understanding how to structure adaptation interventions so as to benefit the most vulnerable households and communities within vulnerable regions; to assess the impact of socioeconomic status, gender, and dimensions of poverty in shaping a range of types of vulnerability of different social groups to climate change; and to inform perceived cost-benefit estimates for alternative adaptation responses in different agroecological zones.

This approach focuses on the following:

- *The local level, because most adaptation is ultimately local*
- *Vulnerable and disadvantaged socioeconomic groups*

- *Engaging vulnerable groups in collaborative analysis*
- *Building on existing adaptive responses*
- *Soft as well as hard adaptation options*
- *Ground-truthing analysis provided by the sectoral analyses*
- *Triangulation of different data sources.*

CONCEPTUAL FRAMEWORK

Climate change is a major threat to livelihoods and therefore the developmental aspirations of nations. Understanding the impacts of the current and future threats that climate change presents is crucial for planning to mitigate and adapt to the desirable and undesirable consequences. The impacts of current climate change events are best understood by those most affected, hence the need for a participatory analysis with both spatial and sector-specific constituents. In each sector or spatial unit, people and their activities have specific characteristics that influence their ability to avoid negative consequences, termed internal vulnerability. The degree and type of adaptation of a person (or a system) to climate change is determined by his/her vulnerability. Adaptations differ and offer solutions to different types of impacts. At the household level, short-term measures are often referred to as coping strategies, while medium- and long-term are adaptation strategies because the coping mechanisms have been perfected and are more planned. It is preferable to have ex ante strategies rather than ex post that respond to unanticipated events. We need to plan now based on known impacts of climate change in each sector and for major livelihood systems so as to eliminate the element of surprise that can distort household and government budgets and frustrate development efforts. Three components are distinguishable in this framework; (1) climate change impacts; (2) vulnerability of people and activities; and (3) adaptation strategies to avoid upsetting the country's planned development trajectory. This report is intended to determine from existing and anticipated strategies the most cost-effective and sustainable adaptation options that Ghana can pursue at both the sectoral and spatial levels.

KEY AREAS OF INQUIRY

Asset and Livelihood Systems

Impacts of climate change and adaptive strategies are directly related to the livelihood systems of any society.

Understanding the assets that people use in constructing their livelihoods and the type of strategies employed by socially disaggregated groups is crucial in mapping their adaptive capacities. Vulnerability to climate hazards differs by social systems, with differential rules of access to assets for attaining sustainable livelihoods, and also defines the adaptation options opened to different people in different sectors and places. The study assesses the assets and livelihood systems of people in different activities and different agroecological areas to measure their level of sensitivity and resilience. For each of the agroecological regions, livelihood profiles describe coping and adapting strategies and the aspirations of different groups, especially women and the most vulnerable. The report attempts to explain the social processes and relations that underpin social change and hence the status of livelihoods. Existing strategies in mitigating the effects of weather variability are important in current adaptation options and costing. Understanding the relationship between assets and the livelihood strategies used by different people—and how the institutional environment conditions success in coping and adaptation—is relevant for planning. The importance of assets to sustainable livelihoods is well-documented (Chambers 1988; Chambers and Conway 1992; Davies 1996; Scoones 1998; Brock 1999; Ellis 2000; Farrington 2001a). The rules of access and degree of sustainability of livelihoods impinges on social processes defined by governance, nature, economics, and politics (Baumann 2000; Farrington 2001b; Bryceson 2002; McCusker and Carr 2006b; Carr 2008). Direct effects of climate change are predicated on complex biophysical systems whose properties are reasonably well-understood and operate in the same manner wherever they are found. Indirect effects, however, translate direct effects through the lens of local livelihoods—which are really about local social relations—into observable activities and outcomes. These livelihoods and social relations are not universal in their workings, and therefore are highly variable in their outcomes.

Vulnerability and Climate Change

Vulnerability to climate change is the degree to which systems are susceptible to and unable to cope with adverse impacts (IPCC 2001; Adger et al. 2007). Therefore vulnerability in this study relates to the lack of capacity to adapt and to respond to stress as a result of

climate variability or change, with a consequent decline in well-being (Chambers 1989; Watts and Bohle 1993; Blaikie et al. 1994; Cutter 1996; Adger 1999; Dilley and Boudreau 2001). Two sides of vulnerability are worth noting: the first is the extent to which an individual, area, or activity is susceptible to unfavorable weather changes, and the second is the adaptive capacity of the local population. The individual access to different assets and resources provides a fair assessment of internal vulnerability, while the wider physical, social, and economic factors define external vulnerability. Assets are resources enabled by social processes rather than mere financial capital. They are a reflection of the outcomes of social relations. Ghana is vulnerable to climate change since a majority of its population is asset poor and relies heavily on natural-resource-based activities. Inequality in access to resources is differentiated by gender, age, status, tribe, politics, and policies (Bening 1975; Songsore 1992; Adjei 1999; Canagarajah, Newman et al. 2001; Cassiman 2001; Abdulai 2002; Amanor 2002; Hutchful 2002; Awanyo 2003; Boni 2005; Yaro 2006).

Power structures in society grant unequal access to resources, while the macroeconomic landscape imposes constraints on a large majority of people in coping and adapting to externalities. Identification of geographic “hotspots” or regions particularly vulnerable to the impacts of climate change will inform the construction of a set of vulnerability/livelihood profiles. The results of this analysis will inform the construction of vulnerability/livelihood profiles that will help identify common features in the way different social groups in rural or urban settings are expected to respond to climate variability and change. Livelihood groups will reflect different types of vulnerability to trends, shocks, and seasonality as they are disaggregated by gender, age, ethnicity, and occupation. The nature of vulnerability in these zones will help shape priorities and adaptation activities. The result is a typology of social and livelihood groups vulnerable to climate impacts and livelihood/vulnerability profiles for the zones, with examples of adaptive responses.

Policy and Institutional Framework for Climate Resilience

Ghana is actively involved in the discussion of climate change and how to mitigate and adapt to it. Ghana

hosted a conference on climate change in August 2008 that demonstrates its recognition of the seriousness of climate change on its natural resources, economy, and people. Ghana ratified the United Nations Framework Convention on Climate Change in 1995. The Kyoto protocol was adopted by Parliament in 2002. An Initial National Communication (INC) was produced in December 2000 and a second one in 2008. Among other things, these communications covered greenhouse gas emissions from 1990–96; carbon dioxide, methane, and nitrous oxide; vulnerability and adaptation assessment for water resources, coastal zones, and agriculture (cereal production); and climate change mitigation options in the energy and forestry sectors (EPA 2000d; Ministry of Environment and Science 2005; Energy Commission 2006).

In line with Ghana’s efforts at combating the adverse effects of climate change, various climate change units have been set up by the government in various ministries and departments to study, advise, and implement strategies to mitigate and adapt to climate change. The Environmental Protection Agency (EPA) is the umbrella organization guiding the climate change process. Most policy documents originate from the EPA; each ministry’s climate change unit handles their respective department’s concerns. In addition, the 1994 Forest and Wildlife Policy, the Forestry Development Master Plan, and current policy reforms are aimed at reversing the loss of environmental resources (Bamfo 2008).

EPA is currently working on a national adaptation strategy to be presented in Copenhagen. These study results will contribute to consultation processes with sectors and districts, which will be useful with regard to costing adaptation options and influencing the budgetary allocations of the Ministry of Finance and Economic Planning.

People in Places: Socio-Spatial Approaches to Adaptation

A “people in places” paradigm allows the experiences of people in differentiated environments to influence the analysis of social phenomena (Forsyth and Leach 1998). The human-nature relationship is mediated by institutions, which are fueled by the forces of globalization,

global environmental change, and national, regional, and local socioeconomic conditions (Blaikie 1985; Abdulai and Delgado 1995; Angelsen 1997; Holden 1997).

Understanding the relationship between humans and their environment first requires holistically assessing the livelihoods of peasants in specific biophysical contexts, recognizing the fact that they wish to continue making a livelihood from natural resources. It is important to understand the opportunities and constraints to sustainable livelihoods. Access to environmental resources is important in achieving entitlements, which in turn has repercussions for sustainable livelihoods, poverty reduction, environmental quality, and eventually adaptation. Livelihoods are not only the circulation of various resources, commonly labeled as forms of “capital,” but also the means by which social roles are constituted and power circulated. The literature, in its concern for access to livelihood assets, cannot address the use of natural or physical capital without a discussion of the social

networks and relationships that enable access to those forms of capital (McCusker and Carr 2006).

Environmental entitlements refer to the alternative sets of utilities derived from environmental goods and services over which social actors have legitimate effective command and which are instrumental in achieving well-being (Leach et al. 1997). Entitlements are a result of negotiations via formal and informal institutions embedded in different interest regimes.

Understanding the social and spatial dimensions of vulnerability is key to understanding the nature and magnitude of impacts and the corresponding adaptations enabled by the constraints of the political, social, physical and economic milieu. The proposed adaptations are therefore not mere idealizations, but are geared toward a realistic vision informed by the current and projected trends, impacts, and capabilities.

2. SOCIAL DIMENSIONS OF CLIMATE CHANGE IN GHANA

Though climate change is a physical process involving changes in climatic variables, it is influenced by social processes that relate to the way society evolves through time. Climate change will impact on social, economic, and environmental systems and shape prospects for food, water, and health security (Adger 1999; Steffen et al 2004; Christensen et al. 2007). The capacity to mitigate and to adapt to climate change impacts depends on proactive measures adopted by different socioeconomic groups living in differentiated geographical circumstances. The physical, socioeconomic, and technological characteristics of different societies and social groups will influence the impacts of climate change, as well as their capability to adapt to and mitigate climate change.

Climate change increases the vulnerability of the poor in the areas of water supply, exposure to disease, increasing sensitivity of livelihood activities, and undermining of growth opportunities. The effects of climate change in Ghana will vary geographically. The north, transitional, and coastal zones are projected to be the most affected through droughts, shortened farming seasons, and sea erosion. The spin-off effects on the rest of the economy can lead to devastating consequences. Droughts and floods have characterized Ghana's recent past, causing losses of life and property, a reduction in economic growth, and a crisis in power generation from the hydroelectric dam.

The social dimension, which impacts physical and economic dimensions, mainly propels vulnerability to

climate change. Ghana is unable to cope with current climate variability and will struggle with projected changes due to poor institutional structures, poor individual capabilities, and the slow growth of its economy, which is associated with insufficient financial resources needed for adaptation and mitigation.

EXPECTED PHYSICAL IMPACTS OF CLIMATE CHANGE IN GHANA

According to Ghana's first Initial National Communication (INC) to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2000, three major physical impacts of climate change are distinguishable: (1) temperature changes, (2) rainfall changes, and (3) sea level changes. Climate change will lead to changes in geophysical, biological, and socioeconomic systems. An impact describes a specific change in a system caused by its exposure to climate change. Impacts may be judged to be harmful or beneficial (Schneider et al. 2007).

According to the INC, Ghana has experienced about a 1°C rise in temperatures over the past three decades (EPA 2000d). Two different scenarios were used to model future temperature increases. Based on these models, it is expected that mean daily temperatures will increase by 2.5°C to 3.2°C by 2100. In addition, in the last 30 years rainfall has decreased by 20 percent and runoff by 30 percent. It is projected that annual rainfall totals will decrease by 9–27 percent by the year 2100, with the range representing spatial variations. Tables 1 and 2 present the latest scenarios by Minia (2004).

Over the last 30 years, sea level rise has occurred at a rate of 2.1 mm per year. Using an assumed global sea level rise of 1 m by 2100, a large part of the east coast of Ghana would be inundated, accompanied by coastal erosion, intrusion of saltwater into surface and groundwater sources, and possible increased risk from earthquakes.

Declining rainfall has been reported throughout West Africa over the past 50 years and may be viewed in the long term as part of a general southward shift in the seasonal migration of the Inter-Tropical Convergence Zone (ITCZ) (Weldeab et al. 2007). Owusu and Waylen's (Owusu and Waylen 2009) study of rainfall patterns in Ghana shows that mean annual rainfall totals within all four agroecological zones experienced a decline from the period between 1951 and 1970 (P1) to the period between 1981 and 2000 (P2), except at Kete-Krachi. The reductions at six of the fifteen stations were significant at the 0.01 level and an additional four at the 0.05 level. Stations experiencing significant declines are located toward the southwestern forest, the coastal zones, and the savannah. During the 1951–70 period, annual rainfall totals in the forest zone dropped from around 1,800 mm to about 1,600 mm, the coastal and northern savannah saw a reduction from around 1,200 mm to about 1,000 mm, while the transition zone also experienced reductions from 1,400 mm to 1,200 mm. In general the reductions in the transitional and savannah zones, which occupy the northern half of Ghana, are minimal compared to the forest and coastal zones. Such changes are likely to have significant impacts for rainfed agriculture areas in Ghana. They conclude that such large-scale rainfall deficits have the potential to destroy plant cover, reduce evapotranspiration, increase surface albedo, and affect other aspects of water and energy balance, which can set in motion a long period of below-normal rainfall.

There is an apparent shift in the rainfall regime in Ghana toward a longer dry season and vanishing short dry spell; the effects tend to negate each other (Owusu et al. 2008). The reduction in annual rainfall has been associated with a shift in the rainfall regime, especially in the southern portions of the Volta basin. The months most affected are September and October, coincident with the peak of the minor rainy season of the humid south and peak rainfall in the unimodal north of the

basin, as well as the July/August short dry spell. The short dry spell has become wetter in the second period, while the wet September/October months are becoming drier. This results in diminished rainfall toward the end of the rainy season, leading to a prolonged dry season with increased evaporation, which exacerbates the reduction in lake levels.

Yaro (2004) describes a pattern of rainfall for Navrongo between 1960 and 1997. Rainfall amounts for Navrongo have gone through less variation in the 1960s, followed by higher variations in the 1980s and 1990s. The deviations from the monthly means are used as a yardstick for explaining enabling and constraining conditions imposed by rainfall variability. An average of 75 rainy days well-distributed among the critical months of April to November is supposed to lead to a good harvest, *ceteris paribus*. There is a correlation between annual rainfall and the number of rainy days. The years with lower rainfall totals also registered a lower than average number of rainy days. In the 36-year period from 1961 to 1997, 18 years registered lower than expected rainy days. In the 1960s the spacing was wide enough, but consistently decreased in the 1970s until it reached a crisis in the early 1980s, when the area experienced the worst shortage of water for plant growth, with 1983 registering the highest deficit of –16 rainy days. Since 1985, a year of favorable conditions is usually followed by one of bad conditions, as seen between 1988 and 1997. However, some years have shown a discordant distribution pattern, whereby most rainy days are concentrated in the peak of the rainy season in July rather than April and May, when a shortage of moisture can nullify the investments of farmers. Total rainy days were adequate in 1964, 1966, 1970, 1976, 1977, 1989, and 1994, but yet registered negative values for the early months of the rainy season when crops really needed moisture.

The general circulation model (GCM) used by Bonsu et al. (1998) and Minia (2004) predicted increases in maximum (Table 2) and minimum temperatures and solar radiation but predicted decreases in rainfall generally. There are huge uncertainties in the future pathways of this climate, as reflected in the IPCC's AR-4 (Christensen et al. 2007). The drivers of climate change in West Africa are not well-understood, as opposed to southern Africa, where they are better understood.

Table 1 shows a general predicted decline in rainfall for all the zones. The negative figures show anticipated reductions in rainfall with the coastal savannah being hardest hit by drought conditions since it already experiences low rainfall totals annually. Reductions for the northern savannahs are not severe but significant enough to eliminate the cultivation of high moisture-loving crops. Table 2 shows the anticipated rises in temperature with incremental tendencies up to a maximum of over 5°C by 2080. These temperature increases will trigger changes in other weather variables and impact on agriculture and water systems.

The impacts of these trends on the economy and people are better understood by examining their impacts on the different sociogeographic regions. Traditionally, Ghana has been divided into six agroecological zones: (1) the Guinea savannah, (2) Sudan savannah, (3) the forest-savannah mosaic or transition, (4) the semi-deciduous forest, (5) the rainforest, and (6) the coastal savannah (Figure 1).

This study merges the Guinea savannah and the Sudan savannah into one zone, the savannah zone. Also, we merge the semi-deciduous forest and the rainforest into one zone, the forest zone. Rainfall variability poses the

most serious challenge in all regions except the rainforest, with impacts on all sectors of the economy. Rainfall variability refers to the differences in rainfall from place to place, the differences in rainfall between years, and the differences in rainfall distribution within the same year. Environmental change emerging through the driver of climate change could inflict harsh and extreme environmental conditions upon rural smallholder farmers, and therefore has direct implications for creating unsustainable livelihoods and/or reducing the livelihood options of poor farm households, especially within the agricultural and livestock sectors (EPA 2000b; Brown and Crawford 2008).

The coastal savannah is the most vulnerable to sea erosion and inundations. Flooding has also been severe along the sprawling urban cities and towns of coastal Ghana, due mainly to the increasing frequency of storm activities and poor urban planning. Rising sea levels will impact the coastal zone through shoreline recession, increased flood frequency, inundation of coastal lands and wetlands, and the salinization of surface and groundwater (EPA 2000a). According to the EPA, climate change is expected to affect sandy beaches in two ways: (1) the rise in sea level expected from climate change will accelerate the rate of recession on sandy

TABLE 1. SCENARIOS OF MEAN ANNUAL CHANGE IN RAINFALL FOR ECOLOGICAL ZONES (%)

Year	Sudan Savanna	Guinea Savanna	Transitional	Deciduous rainforest	Rainforest	Coastal Savanna
2020	-1.1	-1.9	-2.2	-2.8	-3.1	-3.1
2050	-6.7	-7.8	-8.8	-10.9	-12.1	-12.3
2080	-12.8	-12.8	-14.6	-18.6	-20.2	-20.5

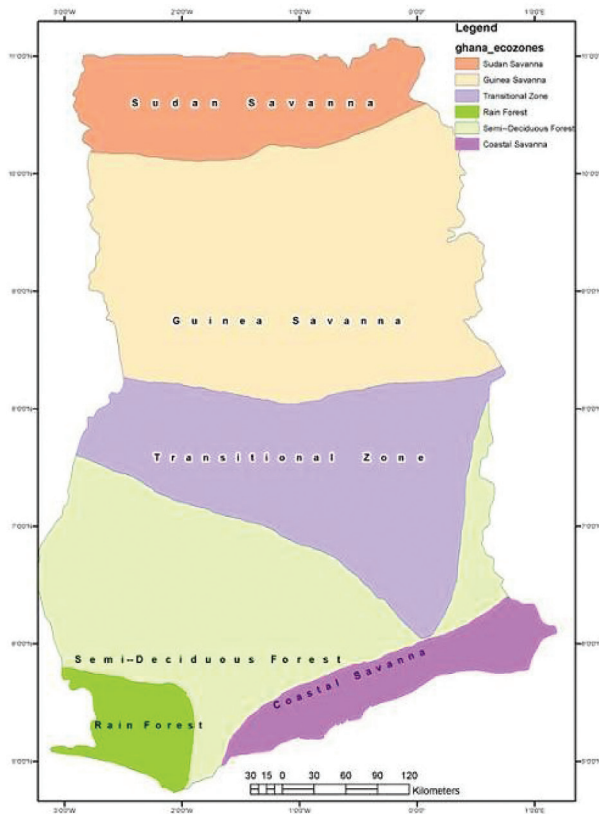
Source: Minia 2004

TABLE 2. SCENARIOS OF MEAN ANNUAL TEMPERATURE CHANGE FOR ECOLOGICAL ZONES

Year	Sudan Savanna	Guinea Savanna	Transitional Savanna	Deciduous rainforest	Rainforest	Coastal Savanna
2020	0.8	0.8	0.8	0.8	0.8	0.8
2050	2.6	2.5	2.5	2.5	2.5	2.5
2080	5.8	5.4	5.4	5.4	5.4	5.4

Source: Minia 2004

FIGURE 1. GHANA'S AGROECOLOGICAL ZONES OF GHANA



shores, which is expected to be about 8 meters per years (Ly 1980); and (2) through increases in littoral transport capacity arising from increases in the intensity and duration of storms. A 1 meter increase in sea level will cause an estimated recession between 250 and 300 meters, which translates to a land loss of 37 to 45 km². Indigenous fishing communities—through the loss of physical assets and livelihoods—will be affected the most. Biodiversity in lagoons, marshes, and estuaries of the Volta delta is already at risk.

Climate change will affect water availability for domestic use, industrial applications, and hydroelectric generation. Water availability in turn has positive links with disease prevalence in tropical countries; in that insufficient water for domestic uses can harm health

outcomes, while flooded areas are also at risk for reduced sanitation and waterborne disease. Both drought and floods have impacts on the continental hydrological cycle, water resources, disease incidence, and food security. Potential water availability from precipitation declines as one moves from south to north. However, total amounts alone do not indicate the amount of available water; other important factors include the various storage mechanisms, such as rivers, lakes, and underground aquifers. Domestic water availability is already a big issue in major cities of Ghana, due mainly to technical inefficiencies in coping with increasing urbanization and physical availability of water. The major river basins include the Pra, Ayensu, Bia, Volta, and their tributaries. Scenarios developed by EPA (EPA 2000c) indicate that runoff in all representative basins are sensitive to changes in precipitation and temperature with a 10 percent change in precipitation. Reduction in rainfall is accompanied by poor timing of the available water, which tends to concentrate in fewer months rather than a benevolent spread across the year. Distributional problems constitute the biggest challenge for agriculture in the future.

In the health sector, climate change will increase the incidence of diseases carried in the water, air, and food, leading to deteriorating health conditions. Increased heat stress and drought-related deaths in both humans and livestock are already occurring in the extreme north of the country. These lead to increased budgetary problems, with serious consequences for the National Health Insurance Scheme. Changes are also expected in the range of some infectious disease vectors. Flooding will increase the range of the mosquito and hence different strains of malaria, while the incidence of parasitic infections might increase. Malaria is already the number one killer in Ghana and is likely to continue, exacerbated by poor urban planning. In socioeconomic terms, these impacts mean losses in productive man-hours and stress on government budgets.

SOCIAL VULNERABILITY IN GHANA

Vulnerability to climate change is the degree to which groups of people and livelihood systems are susceptible to, and unable to cope with, adverse impacts. The concept of risk, which combines the magnitude of the

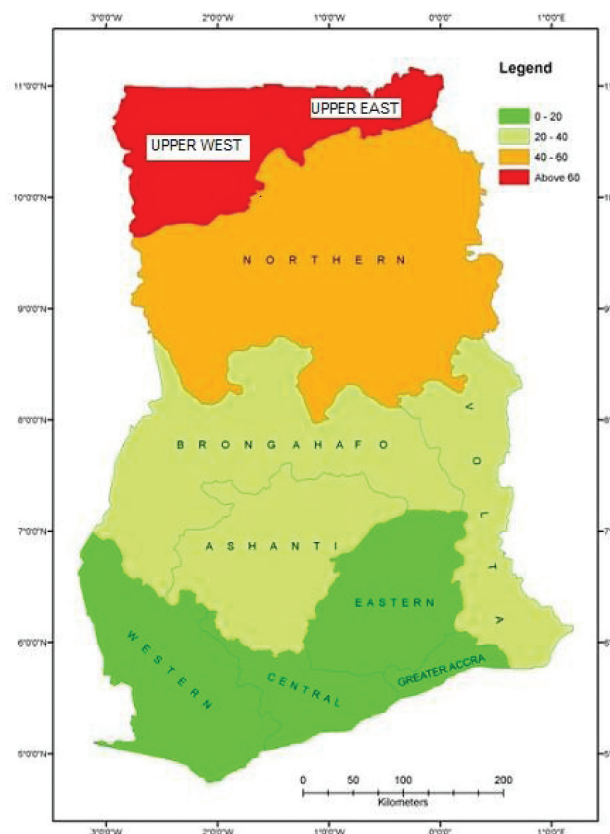
impact with the probability of its occurrence, captures uncertainty in the underlying processes of climate change exposure, impacts, and adaptation (Schneider et al. 2007). An important developmental question is the following: Which social and economic groups in Ghanaian society are/will be vulnerable to climate change, in what ways, and why these groups? Complex combinations of socioeconomic, political, environmental, cultural, and structural factors act and interact to affect vulnerability to climate change and variability. African economies have recently registered a significant overall increase in economic activity, with Ghana being among the best performers in terms of growth (World Bank 2006; GSS 2007). Despite this positive progress, several African economies remain vulnerable to regional conflicts, the vagaries of the weather and climate, volatile commodity prices, and the various influences of globalization (Devereux and Maxwell 2001).

According to the various GLSS surveys, poverty levels have been falling in Ghana (GSS 1995; GSS 2000; GSS 2007). The number of the poor in Ghana was 28.5 percent in 2005/06, falling from 39.5 percent in 1998/99. Those described as extremely poor declined from 26.8 percent to 18.2 percent. The general decline in poverty can be attributed to the high growth rates in cocoa production benefiting from government intervention achieved due to the implementation of the GPRS I and II (Ghana poverty reduction strategy). The incidence of poverty varies by locality, sex, occupation, and ecological zone. Generally, the bulk of Ghana's poor live in rural areas in regions with a high dependence on agriculture. The northern savannah regions are the poorest in Ghana compared to the transitional and forest regions. Climate seems to have a relationship with poverty levels, with the exception of the largely non-agrarian economy of the coastal savannah.

Their dependence on rainfall exposes farmers to the variability of climate in the absence of interventions and conducive policy. According to Nelson and Agbey (2007), ecological zones with high rainfall and low temperatures had a lower poverty level than those with low rainfall and high temperatures. This correlation has little explanatory value without considering the sociopolitical and historical factors accounting for plantations, mining, and urban growth. Colonial and post-colonial

policies have always favored plantation agriculture and mining. Food crops and livestock have been relegated to savannah zones, an ideal environment for production. There has subsequently been a paralysis of northern development (Bening 1975; Rothchild 1991; Rimmer 1992; Songsore 1992; Songsore and Denkabe 1995; Pupilampu 1999; Songsore 2003), or underdevelopment. As defined by Plange (1979), underdevelopment is the process by which a country's realistic possibilities for economic growth are thwarted and distorted, usually by contact with another and more highly "developed" economic system. Northern economic systems have been relegated and thwarted by capitalist interests in the south defined by globalization and enforced by structural adjustment policies. (See Figure 2 showing the regional distribution of poverty in Ghana.)

FIGURE 2. MAP SHOWING DISTRIBUTION OF POVERTY BY AGROECOLOGICAL ZONES



Poverty is a reflection of the distribution of power, social relations, and government policy. Since coping and adaptation are key to reducing vulnerability to climate change and variability, which in turn depend on the capabilities of people, the poorest people have the higher sensitivity and lower resilience in the face of climate impacts. Dependence on the physical environment for their livelihood exposes the bulk of the Ghanaian population—agriculture accounts for about 60 percent of the labor force—to climate hazards. Agricultural capital—in the form of irrigation, silos, erosion control, and other necessary infrastructure—is poorly developed, especially in food-crop areas.

The political economy of agrarian development in Ghana explains the disparities in development nationwide. Progress in the forest sector is mainly due to the prominence given cocoa production in the country's macroeconomic policies. Food-crop producers have not been given as much attention by policy makers, therefore resulting in poorer performance in the savannah and the transitional zones. Coastal fisherfolk, especially those who depend more on fishing livelihoods and to a small extent on farming, are exposed to the double effect of sea level rise and a dwindling fish catch. Their condition is getting precarious as fish stocks dwindle, farmlands are converted to peri-urban developments, and poor skills prevent any meaningful integration into the modern urban economy (Palmer 2007). Increasing prices of both food and non-food commodities, the increasing cost of living, and unemployment or underemployment are also contributing to declines in income, which affects the ability of the poor to save, accumulate working capital, and pay for services, food, and the basic essentials of life (Hutchful 2002; Yaro 2002; UNDP 2007).

Many more women are poorer than men in all regions, which is a reflection of traditional patriarchal norms translated into current access patterns to resources and privileges enjoyed by the different sexes. Traditional inheritance systems give precedence to men over women (Levin et al. 1999; Quisumbing et al. 2001; Awumbila and Ardayfio-Schandorf 2008).

Though urban areas have a lower incidence of poverty than their rural counterparts, serious pockets of poverty exist in urban areas. Poverty has worsened in the capital

city of Accra, which is a major destination for many poor migrants seeking refuge from excruciating conditions in rural areas (GSS 2007). The political economy of Ghana—characterized by pro-urban and pro-export policies—creates “hotspots” in non-urban and non-export zones, with consequent migration of the vulnerable to urban areas to create new urban hotspots.

NATIONAL PLANNING FOR CLIMATE CHANGE

Under the aegis of EPA and the National Development Planning Commission (NDPC), the government has put together a draft National Adaptation Strategy. According to EPA (2009):

“The goal of the National Adaptation Strategy (NAS) is to future-proof developments and to build in resilience to climate change impacts now and in the future in order to reinforce and increase the capacity of Ghanaian society and ecosystems to adapt to climate change. Ultimately the NAS is to position Ghana to reduce the risks of climate change impacts and realize any opportunities that climate change provides for sustainable development.”

The short- to medium-term (2–7 years) plan is to build Ghana's capacity to deal with climate change impacts and reduce vulnerability in key sectors, ecosystems, districts, and regions of the country. The following objectives are set to achieve the goal of the NAS:

- Improve societal awareness and preparedness for future climate change
- Enhance the mainstreaming of climate change into national development to reduce climate change risks
- Increase the robustness of infrastructure development and long-term investments
- Enhance the adaptability of vulnerable ecological and social systems by increasing the flexibility and resilience of these systems
- Avoid maladaptation by reversing the trends that increase vulnerability
- Foster competitiveness and promote technological innovation.

Several piecemeal adaptations have previously been suggested in the different sectors of the economy. The

energy and forestry sectors have been more active in mainstreaming climate concerns into their agenda. The current coping mechanisms used by the state, civil society, and individuals are short term and most often do not allow meaningful adaptation. The NAS will present

an opportunity to mainstream climate change challenges into sectoral and district plans. However, the institutional framework for collaborative planning for adaptation is still weak and needs strengthening with enough resources to transform visions into reality.

3. RESEARCH METHODOLOGY

RESEARCH STRATEGY AND QUESTIONS

This study's methodology draws upon a range of analytical frameworks, including the sustainable livelihoods framework, assets and capabilities frameworks, institutional risk pooling approaches, social risk management framework, and environmental entitlements analysis. It is intended to bridge the gap between community needs and priorities at the micro level and policy processes at the macro level. By identifying and assessing the most urgent adaptation needs of the most vulnerable as well as their local coping and adaptive strategies, the proposed inter-sectoral, bottom-up approach will provide recommendations for setting priorities for action and help develop a robust, integrated approach for increasing resilience to climate risks at the national and local level.

The research process is divided into phases, including:

- Data review and identification of hotspots and vulnerability/livelihood profiles based on key vulnerabilities.
- Identification of alternative, robust adaptation pathways using participatory methods to elicit plausible scenarios. The components include:
 - a. Review of existing qualitative and quantitative secondary data on poverty, vulnerability, and climate hazards and validation at field level.
 - b. Review of policy and institutional environment for local adaptation.

- c. Validation of livelihood profiles at field level through community/civil society focus group discussions and other participatory methods.
- d. Semi-structured interviews, 12 per community site, sampled from different well-being tiers.

The study seeks to answer the following questions:

- What are some robust adaptation strategies and options at the local level?
- How can adaptation interventions be structured so as to benefit the most vulnerable households and communities within vulnerable regions?
- What are the impacts of socioeconomic status, gender, and poverty in shaping a range of types of vulnerability of different social groups to climate change?
- How can we determine perceived cost-benefit estimates for alternative adaptation responses in different agroecological zones?

SITE SELECTION AND SAMPLING

The districts from which the sites for the field validation were selected were based on a literature review as well as the preliminary criteria suggested in the terms of reference, which informed the selection of the major hotspots in the country. The sites should be regarded as cases that seek to explain the differential vulnerabilities and adaptation options. They are not representative of entire ecological zones as these zones have micro-ecological, economic, cultural, and political differences. The selected research sites are presented in Table 3.

TABLE 3. SELECTION OF RESEARCH SITES

<i>Selected Sites</i>	<i>Features/ Rationale</i>	<i>Vulnerability To Climate</i>	<i>Existing Initiatives</i>
Coastal Savannah Zone • Site 1: Ada-Anyakpor , in the Dangbe-East (Ada) District	(1) Shows livelihood profiles of fisherfolk Exemplifies the struggles of a coastal community	Dry climate with increasing rainfall variability and hotter temperatures Prone to sea erosion and tidal flooding	Civic Responses, e.g. <i>Radio Ada</i> in Dangme East district, coastal zone
• Site 2: Nima in the Accra Metropolitan Assembly (AMA) Both sites in the Greater Accra Region	(2) Harbors most of the urban poor in Accra Shows relationship between poor urban planning and risk of disasters	Prone to flooding Increased risk of disease infections Poverty and disaster response systems Poor shelter provision and drainage systems	This site is one of the communities included in 1995 Participatory Poverty Assessment
Forest Zone • Site 3: Gonukrom in Wassa Amenfi West (Asankragwa) District • Site 4: Kamaso in Wassa Amenfi West (Asankragwa) District Both in Western Region	(3) Major cocoa growing area; new frontier for agricultural migrants Issues of land tenure, economic policy, and migration brought to bear	Decreasing rainfall will affect cocoa production High humidity and high temperatures will be harmful to agriculture Logging and mining will reduce carbon sinks Economic policy to lead to reduction in forests	The two sites are among the communities of the IUCN's Livelihoods and Landscapes Initiative (REDD) World Bank's Forest Carbon Partnership Facility (FCPF)
Transitional Zone • Site 5: Buoyem in Techiman District	Major food crop zone Migrant receiving region Increasing environmental problems Urban growth and alternative livelihoods	Variations in rainfall and temperature to affect production Migration increases land pressure Poverty reduces adaptation	Techiman District is where the Environmental Protection Agency (EPA) and the National Development Planning Council supported by UNDP are piloting district-level planning for climate change adaptation
• Site 6: Dzatakpo in Pru District Both in the Brong Ahafo Region	Inland fishing community Shows livelihoods of fishermen and fish mongers Multiple livelihoods	Effects of climate on lake Volta Decreasing fish stocks and adaptation by fishing communities Human capital and adaptable livelihoods	No existing initiative
Northern Savannah • Site 7: Boayini (Guinea Savannah) in East Mamprusi District in Northern Region	Fragile environment High poverty incidence Agrarian economy Female outmigration to cities	Highly variable weather and agriculture Environmental bankruptcy Resilience of households	The two sites are among the communities in which CARE-Ghana is supporting local-level adaptation to climate variability and change in Northern Ghana
• Site 8: Tetauku (Sudan Savannah) in Bawku East District in the Upper East Region	Dry environment Highest poverty incidence in Ghana Agrarian economy High out-migration	Highly variable weather and agriculture Environmental bankruptcy Sensitivity of households	The Bawku District was included in 1995 Participatory Poverty Assessment

Background to Sites

1. Forest Zone: Gonukrom and Kamaso

The rainfall distribution pattern in the forest is bimodal from April to July and September to November. There is a main dry season from November to February–March. The annual rainfall records above 1,900 mm and is distributed throughout the year with a mean monthly rainfall of 250 mm. The region receives its maximum monthly temperature of about 30°C between March and April and the lowest temperature of about 26°C in August. Humidity is normally higher during the rainy season (75–80 percent) and lower in the rest of the year (70–80 percent) (Dickson and Benneh 1970).

Gonukrom largely consists of people who belong to the Wassa ethnic group, while Kamaso is purely a migrant/settler community composed of migrants from different parts of the country. Both communities have a significant population of migrants. In terms of poverty, there have been good achievements made in the forest region, mainly due to the prominence given to cocoa production by the country's macroeconomic policies.

2. Transition Zone: Buoyem and Dzatakpo

The transition zone is a major food crop zone and a migrant receiving region. The transition zone experiences rainfall values between 1,000 and 1,500 mm, adequate to support luxuriant vegetation (Gyasi et al. 1995). Its maximum monthly temperature is about 30°C between March and April, and its lowest temperature is about 26°C in August. Humidity is normally higher (75–80 percent) during the rainy season. The major livelihood activity in Buoyem is food crop farming, including maize, tiger nuts, and tomatoes. In Dzatakpo, fishing is the major livelihood activity due to its location on the Pru River. Dzatakpo is largely dominated by Ewe migrants from Marfi and Anlo in the Volta region and has an estimated population of 1,000 people. Buoyem is an Akan community with an estimated population of over 5,000 people. Buoyem is better endowed in terms of its forest, river, and land resources, which attracts migrants from across the country, especially the three northern regions.

3. Northern Savannah Zone: Boayini and Tetauku

The northern savannah zone is predominantly a grassland agroecosystem with scattered shrubs and trees. It

has a unimodal rainfall distribution, and an annual average rainfall of 1,000 mm. Mean monthly temperature varies from 36°C in March to 27°C in August. The northern savannah can be divided into the Guinea savannah and the Sudan savannah. The Guinea savannah occupies most of the northern region and has better ecological conditions for farming than the Sudan savannah, which is found in the two upper regions.

Boayini is located in the East Mamprusi District in the northern region. The community has a total population of 1,400. The tribes in the community include Tampilensi, Mamprusis, Bimobas, Mosis, and Fulanis. Tetauku is also located in Bawku East District in the upper east region. It has a total population of 898, including 394 males and 504 females. The community is dominated by the Mamprusi tribe. The savannah zone is the leading producer of several cereal grains (including maize, rice, sorghum, and millet), along with yams, cowpeas, and tobacco. In addition, the area dominates the rest of the country in the production of livestock (Karbo and Agyare 2002).

4. Coastal Savannah Zone: Anyakpor and Nima

The coastal savannah zone occupies the entire east coast from the central region through the Greater Accra region to the Volta region. It has the highest concentration of population in Ghana, with the Accra Metropolitan Area having a population density of 3,388 persons per km² (EPA 2000a). It has a dry equatorial climate with mean annual rainfall between 740 mm and 890 mm. This belt receives the least amount of rain in Ghana and hence is the driest region in the country. The main activities of people in this zone are fishing and farming in the rural areas, while the urban centers have a complex economy of global orientation.

Anyakpor community is located on the outskirts of Ada-Foah. The major ethnic group in this community is called Dangme. It is a typical coastal village with a population of about 800 people. The main livelihood activities include fishing, food crop farming, and fish mongering. Nima is an urban slum composed of mostly migrants. It typifies the livelihoods of vulnerable urban migrants to socioeconomic and climate change challenges.

METHODS: TOOLS EMPLOYED

The study used mainly qualitative methods, supplemented with a quantitative survey. Data were collected from two main sources. Existing quantitative and qualitative data were collected from secondary sources to identify sociogeographic zones (hotspots), review the policy and institutional environment for local adaptation, and draft livelihood profiles.

Primary data collection used a combination of tools under the Participatory Rural Appraisal (PRA) methodology to validate livelihood profiles at the field level and engage participants on climate change impacts and the corresponding coping and adaptation strategies that various groups used in sustaining their livelihoods. This methodology draws upon a range of data collection tools and techniques, including community/civil society focus group discussions, ranking/scoring, seasonal diagramming, timelines, well-being categorization, as well as semi-structured interviews and key informant interviews with households, to gather information regarding climate hazards, impacts, and adaptation practices. About three to four focus group discussions were organized in each community differentiated by gender, age, and ethnicity, in order to identify and assess the most urgent adaptation needs of the most vulnerable as well as their local coping and adaptive strategies (Appendices 5 and 6). Additionally, a limited number of household questionnaires (Appendix 1), 10 per study site, were sampled from different well-being tiers during the wealth ranking exercises in eight communities of the four delineated agroecological zones in Ghana (Appendix 4). We collected household-level data on assets, sources of livelihood, income and exchange, capital investments, credit, education, illness, access to common property resources, and other variables related to household livelihoods.

There were also five participatory forums—“Participatory Scenario Development (PSD) workshops”—of which two were conducted at the national level and three at the zonal level. PSD provides an opportunity for a range of stakeholders—including government officials, local experts, and representatives—to explore the future in a rigorous, creative, and policy-relevant way. In these workshops, participants developed desired, yet realistic, adaptation pathways for national,

regional, and/or livelihood groups within the country, evaluating both existing and alternative adaptation options in order to prioritize investments in the short, medium, and long-term. In the national workshop, participants were grouped according to the four socio-geographic zones (northern savannah, transition, forest, and coastal savannah). In the regional/zone workshops, participants were grouped according to sectors and livelihood groups. Results from district workshops were summarized during the national workshop to enable a broad-based informed analysis of issues for the nation.

APPROACH TO DATA ANALYSIS

Combinations of qualitative and quantitative analytical methods were applied in data analysis. Qualitative analysis involved pattern and consensus building from the participatory workshops in both the communities and at the regional level. Qualitative data analysis in a participatory research paradigm appreciates the analytical abilities of the participants with interpretations by researchers to fit the categories and research questions. Hence, we try as much as possible to present the voices of the people from both the local level and the expert level. The quantitative analytical tools have been limited to descriptive statistics as the sample size is too low for complex statistical analysis. Also, the purpose of the study is met with minimal quantitative inputs. The integration of qualitative and quantitative data provides complementarities and confirmations that increase the validity of the findings. The data has been disaggregated along three main lines to reflect the voices of the people by agroecological zones, gender, and vulnerable groups. The analysis by zones shows the nexus of socioeconomic vulnerability/ poverty as well as climate hazards. The analysis along gender, age, minority groups, and type of livelihood activity shows the typology of livelihood profiles in order to characterize the main types of climate-related vulnerability and their manifestations within the livelihoods of vulnerable groups.

INTERACTIONS WITH OTHER EACC SECTOR STUDY TEAMS AND BANK STAFF

For a number of reasons, there was limited collaboration between the PDA, as the lead on the social component, and the Ghana EACC study sector specialists with regard to joint analyses so as to ensure full integration

of the social and sectoral analyses. First and foremost, the Ghana EACC sector specialists' team did not provide inputs into the selection of communities for investigations. While the inception report for the social component, the field findings and findings from the PSD workshops were ready, the other EACC sector study teams were deliberating on methodology issues; hence there was not enough synchronization between the social and sector methodologies, implying that findings from the field work and the PSD workshops might not integrate well with the other sectoral analyses as was intended. But the different perspectives could be useful in terms of complementarity.

LIMITATIONS OF STUDY

There was a delay in executing the field work according to schedule, which affected the mobilization of people and logistics. Persons who were originally asked to participate in the field baseline study, and who had PRA experience, were not available since they were engaged with other commitments due to the change in

time. This had cost implications since new facilitators/resource persons had to be recruited and trained. The timing of interviews was not good for the rural sites, since the months of May–June are the peak farming season. The field teams therefore had to spend longer hours waiting for the community members to return from their farms for the interviews.

Another challenge had to do with limited funds. Due to limited financing, the training and preparation of field staff, which was supposed to take about five to six days, was reduced to three days. This affected the quality and homogeneity of the research process and data generated. The number of study sites visited was reduced to two in each agroecological zone instead of three per zone. The PSD workshops were conducted in only three out of the four zones. Luckily, Care Ghana assisted in funding the PSD workshop held in Tamale for the northern savannah Zone.

Despite the above limitations, the study succeeded in eliciting most of the needed data for the required tasks.

4. FIELDWORK RESULTS

OVERVIEW AND INTRODUCTION TO AREAS OF INVESTIGATION

The overall objective of this study was to capture people's knowledge and experience in coping with climate variability and environmental degradation by identifying appropriate strategies for adaptation to adverse impacts of climate change. Information presented in this section is therefore purely perceptual in nature, reporting on communities' and individuals' perceptions, with a few comparisons with instrument records. Communities and individuals are reporting on how they view their circumstances and situations.

Specifically the study sought to:

- Identify robust adaptation strategies and options at the local level.
- Provide a basis for understanding how to structure adaptation interventions so as to benefit the most vulnerable households and communities within vulnerable regions.
- Assess the impact of socioeconomic status, gender, and poverty in shaping a range of types of vulnerability of different social groups to climate change.

Household Asset Base

Household assets constitute an important dimension of internal vulnerability and define the adaptive capacity of household members and livelihood systems (Chambers and Richards 1986; Chambers 1989). Household assets

are outcomes of social processes and relations emergent from contextual local cultures. Different combinations of assets suited to the demands of various zones are distinguishable. But commonalities run through all zones. Land is the most important household resource in all the zones as the main livelihood activities—such as farming, harvesting timber, wild fruits, and non-timber forest products—are dependent on it. The distribution of land among households is not uniform, reflecting differential access granted by institutions. Access to land is easier in the Guinea savannah zone, with lower population density and non-commercialized systems. The forest and the transition zones have commercialized transactions in land involving sharecropping and rental arrangements.

Communities have important water resources—such as rivers, wells, boreholes, and lakes—that are used for both agricultural and domestic purposes. These are community resource pools, but individualized ownership of wells is common among wealthy families. The communities in the transitional and forest belts are endowed with forest resources, including timber, bat and monkey sanctuaries, and forest reserves.

Individual household assets considered during the survey include implements and equipment that support the economic activities of the people. Other assets hitherto considered luxury items—such as the bicycle and cell phone—are now important in enhancing livelihoods and the well-being of the people. The survey results show that about 30 percent of the respondents owned a bicycle, while as many as 60 percent owned a cell phone. In the fishing communities, every fisherman owned fishing nets, whereas about 60 percent owned a boat.

The possession of hoes, axes, and cutlasses is common for everyone in the farming communities. Some more expensive farm implements are rented by the poor, while the rich seek labor services from the poor for a fee to help weed their farms.

Wild resources on individual and common access lands constitute important assets for households and provide an outlet for coping during periods of stress. Within the forest and transitional belts, the cola plant and canes are important sources of income, just as the dawadawa and shea trees are to the savannah zone. Several wild fruits and non-timber resources such as mushrooms, snails, and other wildlife resources are available to households, depending on the rules governing resources in their communities.

Though these resources are uniformly available in these zones and communities, the mechanisms for accessing them lead to social exclusion of vulnerable groups.

These social processes that mediate resource access are relevant in understanding how assets can act as buffers to the challenges of climate change.

Resource Access and Land Tenure

Access to resources and the form of land tenure system vary from community to community. Within the forest communities studied, the ability to sustain and or cater for household necessities is dependent on the size or number of cocoa farms that are owned or have access rights. Land for farming in the communities has become very scarce. This is because some land is being reserved to sustain forest culture. The communities agree that there are no lands for farming unless lands are offered for sale; otherwise, land is only acquired on the basis of “ye ma yenkye” or “abunu” (this is a share cropping arrangement). Community lands are controlled by the *Akyekyerebene*, who is the custodian of the land. However, the community chief and elders could assist in acquiring private land(s) for farming by leading interested persons to the *Akyekerebene*, who in turn allocates the land, or link persons with landowners prepared to engage in “abunu” or “ye mayenkye.”

The systems practiced in cocoa farming are the “nhweso”, “abunnu”, and “ye ma yenkye.”

- The “nhweso” is a system whereby a caretaker is engaged on the cocoa farm(s) and is responsible for the maintenance of the farm on behalf of the landowner for some income.
- The “abunu” (halves) is a system where a person cultivates cocoa for a landowner or farm owner and is entitled to half of the farm’s proceeds and land.
- The “ye mayenkye” system employs similar practices as the “abunu,” except proceeds and land are shared on agreed proportions with the farm/land owner.
- Migrant land owners pay levies to the akeykyedie stool and local government for the use of lands.

The men revealed that most of the farmers in the community own the land they farm. They inherited the land from their forefathers. For the settler farmers, however, those who need land rent them from the owners at 400 cedis per acre for three years, and must abide by the terms of the agreement.

In the coastal belt, the youth claim that fisherfolk within the community have the sea available from which to fish and are under no obligation whatsoever to make any payments to anyone for the use of the sea. They indicated that some fishermen inherited some fishing implements from their fathers and grandfathers. These implements include nets, canoes, and outboard motors. Fishing is allowed throughout the week except on Tuesdays.

At Buoyem in the transitional zone, the chief, who is assisted by a number of subchiefs, has the overall authority and controls all natural resources in the community. At the family level, it is the family head who steers affairs and controls all family resources. Land is accessible to everybody, provided one does not have any questionable character. Land is not sold here; it can only be leased out. The chief is the only one who has the right to sell the land. However, family members or migrants who require a piece of land for farming can access land through the family heads.

Dzatakpo is an island inhabited by a migrant fishing community from Marfi and Anlo in the Volta region. The land is owned and controlled by the chief, who charges residents a monthly rent of 2 Ghana cedis and an additional yearly contribution in kind and cash determined by the chief.

In the savannah zones, the Tindanaa is the custodian of the land. Other secondary land custodians are the clan and family heads. Land is given out to members of the community to farm for free. There are no fixed terms or agreements for using someone's land. However, the person renting would give either some farm produce or a token gift as an appreciation for the use of the land. Such wild resources in the community as Shea nut trees, dawadawa trees, and other wild resources can be harvested by anyone except those on the farms of people. Any member of the community can use the river for economic and domestic purposes. But the lands around the river are owned by specific landlords. One cannot use river/valley beds unless you seek permission from the landowners. The various rights granted to different people as dictated by social norms informs the translation of the asset base into resources for these people to engage in livelihood strategies.

Commercialized production in the cocoa regions has produced several social classes, while traditional norms in the savannah maintain a patriarchal system with easy access to minimal resources. Socioeconomic status is therefore an important indicator of access to assets and freedom of usage of these assets to carve out livelihoods.

Existing Livelihood Activities

Within the forest communities, the ability to sustain and or cater to household necessities is dependent on the size or number of cocoa farms that are owned or accessible. Cocoa farming is therefore the major economic activity in the community. Everyone in the community has either a cocoa farm or is engaged as a laborer on cocoa farms to earn income. Food crop farmers are mostly women, even though every cocoa farmer also grows basic food crops for subsistence and as a diversification strategy. Food for household consumption is from the backyard farms or gardening done to supplement what is also cultivated on the cocoa farms as the cocoa plants mature. The farming systems practiced in the community have a bearing on the economic well-being of community members. Cola is in abundance on farmlands; about 10–20 bags of cola nuts can be harvested monthly by households from their farmlands. They are stored and sold during periods of good pricing or periods when households need urgent cash. These are controlled by farm/landowners.

The major crops grown in this belt in order of importance in terms of income and relevance to household food needs are cocoa, cassava, maize, tomatoes, plantain, garden eggs, yams, and coco yams. There is an adequate availability of canes, which the community members use for roofing (thatching) homes and in making traps for fishing. These are found on marshy farmlands owned and controlled by farm/landowners. The choices that people make with regard to food and commercial crops are defined by access to land, profitability of crops grown, level of risk in farming, and others depending on the perception of gains by landowners and power holders in the community. Sharecropping systems tend to constrain the ability of the landless to make meaningful livelihoods. Wages of agricultural laborers (\$2–3 dollars a day) are woefully inadequate, since the landowner does not allow the cultivation of food crops by workers on the farm for subsistence. This perpetuates poverty among migrant wage earners, who get sick and are unable to return home. Similarly, women and youths who have not been lucky enough to inherit landed property or do not have financial resources to invest in landed property ultimately lose out. Assets alone are not enough, but the social and economic conditions that allow people to use these assets to earn a decent livelihood are.

The coastal belt is dominated mainly by fisherfolk, fishmongers, and farmers. There are a few civil servants and teachers who also double as farmers and fishermen, like the assemblyman in Anyakpor, though on a smaller scale. Most women are fishmongers and buy fish from the men at the sea shore and smoke them for sale. Most community members who indulge in farming cultivate crops like onion, tomato, pepper, corn, water melon, cassava, okra, and garden eggs. They all agreed that onions fetch them more money than any other crop, as it can be stored for longer periods of time compared to others like pepper, tomato, and okra. About 10 percent of women indulge in trading activities to supplement their income. They include the more vulnerable women in the community who are into “table-top” petty trading, selling items like sugar, gari, tinned fish and groundnuts among others, to make a living. In the urban slums, the major livelihoods are located within the informal sector, composed mainly of trading, laborers, shop assistants, petty traders, urban gardening, and illegal coping activities. There is a high level of poverty,

as migrants continue to pour in by the day while employment avenues and housing needs are not met. Patrons are very important in the urban economy as they provide accommodation and initial contacts for migrants. Subsequently, these migrants owe allegiance to the patrons and can be used and manipulated. Not all patrons are exploitative, as many of them are relatives who seek the genuine development of their kin. Lucky wards are trained in skills and financially assisted to start up businesses, while unlucky ones work for patrons and may be physically abused and exploited economically and sexually.

The transition zone is a major food crop zone and a migrant receiving region. The major livelihood activities in this zone are cash crop farming (cocoa, cashew), food crop farming (cassava, yam, maize), and inland fishing. Within the zone there are two distinct communities, with one being a typical farming community and the other being predominantly a fishing community. In the farming community, everybody ranked crop farming as the main activity for the households. This was followed by animal husbandry and trading. Apart from crop farming, all the other activities that were engaged in by people in the farming community were largely perceived as secondary or supplementary activities. These livelihood activities were engaged in by both men and women. The major crops cultivated include cassava, tiger nut, cocoa, cashew, tomato, and maize. Cassava is widely cultivated because it is the main staple food of the people who live in this community. The other crops—including tiger nut, cocoa, cashew, tomato, and maize—are also popular for commercial purposes. Both men and women said that most of their land is not fertile any longer due to excessive use of fertilizer, which has in the long run reduced its fertility. In terms of access, anybody can acquire land to farm in this community provided he has satisfied all the necessary conditions and has the money to rent the land. Women also have equal rights as men and can cultivate as large a piece of land as possible provided they have the money to hire the land if they or their family do not possess family land. Migrants can also acquire land to farm provided they have money. Monetization of the economy seems to be altering social structures, but the beneficiaries remain the same. Older men with titles (chiefs) to resources appropriate benefits to the neglect of their kin (Amanor 1999; Amanor 2001; Amanor

2002; Amanor 2005). This process is reverberating throughout the country, whereby people with financial resources are given priority over indigenes, who hitherto were said to possess some birth rights to land. For wealthier women, this is a positive development, while for the poor of both genders a new dawn of social relations that disenfranchises them is in vogue.

With regard to the fishing community, inland fishing is the major activity for the households, with almost all the households engaged in fishing and its related activities, including, cleaning, drying, smoking, and selling of fish. There are also other minor activities, including crop farming and animal rearing in the fishing community. However, the fishing activity is the preserve of the men, while crop farming is carried out by both men and women. The social differentiation of work roles in fishing communities leads to labor of women categorized under domestic rather than commercial, with consequent loss of revenue. Since women have to process fish and sell and account to their husbands, they lose their labor component. However, social change has led to most fishermen now selling directly to commercial fish buyers, who are able to also exploit these men as they are forced as “price takers” to accept whatever price is offered to them.. The rising cost of fuel for venturing deep into the oceans, coupled with the number of men on each fishing expedition and the element of luck due to low fish densities, make these livelihoods a “coping” business.

The major livelihood activities in the communities of the savannah belt are crop farming, animal rearing, dry season gardening, processing of shea nuts and dawadawa, petty trading, and charcoal production. There is cultivation of a wide range of cereals, including some legumes. Crops farmed include maize, early millet, late millet, guinea corn, groundnuts, sorghum, yam, bambara beans, beans, soya beans, onions, okra, and tomatoes. The rearing of animals—such as poultry, guinea fowl, goats, sheep, and cattle—is a very important activity dominated by men. They sell these animals in times of hardship to buy food to feed the households. Picking and processing of shea nuts and dawadawa is a major activity as it supports communities to feed their households, especially during the lean season. In the Guinea savannah, it is essentially women who pick and process these nuts with a little support from their

husbands, while in the Sudan savannah it is both men and women who do the picking. The picking of dawadawa is done in the dry season, while the shea nut is done in the rainy season. The Shea nut season coincides with the hunger gap period, so they virtually pick the nuts and prepare them for sale and then use the proceeds to buy food.

The burning of charcoal is mostly by women to support the upkeep of the household, especially during the farming off-season, is an important livelihood activity in all the zones. In the Sudan savannah, it is strictly controlled as there are few trees. There are laws regulating the burning and cutting of trees. Livelihoods in the savannah are highly dependent on patriarchal values, as seniority in lineage ascribes assets to a few who are supported by the rest of the family in the production process. Wives and youths work on the farms of the family head and may be given small parcels of land to grow commercial crops to meet their personal needs. Women are allowed in the northern region to plant vegetables on their husbands' farms, which are sold when the harvest is higher than household needs. This trend is changing for many daring women, who now access lands from subchiefs to grow commercial crops such as groundnuts and vegetables. But they still have to first help out on the family lands before they move on to their own farms. This has led to many hiring young men to cultivate and weed for them. This is often funded from income from non-farm sources and "food for work" arrangements based on social capital harvesting. Unfortunately, women venturing into farming and non-farm activities has led to "absconding" by men, who shed their responsibilities as providers of the home, thereby leading to higher workloads and stress on women. This is a paradox of emancipation and empowerment.

Migration Choices

Migration is an important strategy for both the poor and non-poor in Ghana. As a reaction to the threat of climate change and other stressors, migrants tend to leave environmentally fragile areas for ecologically better places or to urban areas where they join mostly the informal sector. The northern savannah has the highest rate of out-migration, mostly to the transition and forest zones. The incidence of migration is quite

high in the savannah zone, with 45 percent of respondents migrating on a temporary basis, and 40 percent opting for permanent migration. During the long dry season, most of the youth migrate to the southern part of Ghana in search of job opportunities on farms and in urban areas. Of late, the migration of women to urban areas to work as head porters is on the rise.

The forest and transitional zones are home for migrants from the northern part of the country and also from the Volta region. These areas have such pull factors as cocoa farms and mineral mining activities that attract people to this zone. Migration from these zones is normally to the urban areas of Kumasi and Accra and outside the country. Temporal migration for educational purposes is the highest, while poor employment opportunities and the poor quality of social amenities in smaller towns in these zones lead to outmigration to the cities.

In the coastal zone, about 25 percent and 40 percent of households reported that their members migrated temporarily and permanently respectively, mainly to the capital city of Accra. This involves a diversification of livelihoods from mainly fishing and farming to informal trading, artisanship, and laborers for most of the migrants who are unable to secure formal sector employment. Ghana's history of economic growth has been one of neglect in rural areas and areas outside the timber, mining, and cocoa sectors, with a high concentration of investments mainly in the "golden triangle" covering Secondi-Takoradi, Tema, and Kumasi in the forest and coastal zones (Dickson 1968; Plange 1979; Destombes 2006). Plange (1979) argues that within the colonial context, and in relation to plantation, public, or mine labor—with particular reference to northern Ghana between 1900–40—the individual cannot be conceived of as having made a rational decision, within sometimes an infertile and overpopulated environment, to maximize his economic interests in response to market forces by migrating southwards. Indeed, in many situations his rational and free decision was always contrary to those forces. This precipitated the use of extra-economic mechanisms, first to encourage and then to enforce migration, which then became an induced activity in captivity—indeed, an institutional creation to complement the demands of labor in the general process of capital accumulation.

There has been a post-colonial entrenchment of the thesis that the underdevelopment of the north and other peripheries in Ghana was a necessary corollary of development of the colony (referring to southern Ghana) (Songsore 2003). Structural adjustment policies and associated poverty alleviation programs have entrenched the north-south divide and brought little equalization of opportunities (Kraus 1991; Rothchild 1991; Songsore 1992; Bofo-Arthur 1999; Konadu-Agyemang 2000; Konadu-Agyemang and Adanu 2003). The migration patterns of Ghana are therefore conscious livelihood decisions based on a repertoire of forces, including history, politics, economics, environment, and culture.

Experience with Past Climate Variability and Hazards

There are indications of significant environmental changes in the Sudan and Guinea savannah zones. In Tetauku and Boayini in the Savannah zone, there is a clear understanding of such environmental changes. According to an educated elderly man in the focus group of men in Tetauku:

“At first we used to plant in April and it would rain up to November, but now it starts in May to November.”

The rainy season has been shortened by about 2 months, thereby increasing the length of the dry season. These changes were also confirmed by a focus group of women, who added that the current nature of rains is highly destructive, causing floods and drought. They indicated that the early rains were associated with good yields, but now the rains usually stop before crops mature. In the past, the rains came down at regular intervals and allowed them to perform their different activities on the farms. This is confirmed by the normal high rainfall distribution between 1951 to 1970 and the declining and poor distribution of the period 1980 to 2000 identified by Owusu and Waylen (2009).

The rains are now so unpredictable that they have a negative impact on farming activities. Crop production is therefore the most affected in relation to climate change. Floods are also becoming an annual ritual in the communities. Just last year (2007), they indicated, there was a flood in the community and many people

lost their farms to the water and many houses were destroyed. Most areas of the northern savannah are low-lying, mostly in the Volta Basin. These are very fertile valleys, but potential risky investments, since heavy downpours occurring within short periods cause massive damage physically and through soil saturation which prevents aeration for plants.

Cocoa cultivation used to be widespread in the transitional zone, but years of depletion of accumulated soil fertility and the unreliable weather patterns has led to its abandonment by most farmers (Gyasi et al. 1995). This was affirmed in Buoyem, a farming community in the transition zone, as well as Kamaso and Gonukrom in the forest zone. The elderly men in a focus group discussion observed that about 20 years ago, there were thick forests with abundant fruits due to high rainfall. There were also lots of cocoa trees. But now the forest had diminished and the greater parts of the cocoa trees have been wiped away. This is obviously the result of poor investment in cocoa farms when trees are old. The communities are also vulnerable to strong winds preceding rains, with adverse impacts on life and property. This is a result of deforestation, which opens up the landscape to winds and also the global environmental change associated with frequent stormy weathers. Specifically, participants observed the following changes:

1. Thinned forest transiting into shrubs; about 2,000 acres of forest lost for the past 30 years.
2. Less and delayed rainfall season. The rainy season, which used to start in late February or early March, has now changed and starts in mid-March, with highly erratic patterns.
3. Extreme hot weather conditions; the sun is very hot these days compared to some years back.

There could be continuous rains for about four days, and at other times it could rain for about eight times in a day. This they referred to as “yooyo,” explaining that during this period, there could be showers for about an hour, a little sunshine, and then more showers all through the day. Though the period of heavy rains ends in September or October, there were still some light rains in these months, mostly in the evenings. Over the past couple of years this phenomenon is not being observed, as was the case some years back.

The community members indicated that signs of imminent rainfall could be determined by looking at cloud formations in the atmosphere. One could predict how heavy or long the rains will fall by just looking at the gathered clouds. These days they see the clouds gather, yet it passes by with no rain. About 10–20 years ago, the rains always came when the clouds gathered.

It was also noted that there was a lot of sunshine in March and as a result temperatures are normally high. However, temperatures in March this year have been higher than in past years. There is still a lot of sunshine in May, when more rains are expected. The low rain affects food crop production, which will have negative impacts on food security. A woman participant in a focus group discussion expressed her fears of food shortages should the sunny conditions prevail throughout the period of heavy rains:

“This year the sunshine has been too much. When the sun shines like this the crops wither and do not do well. When this happens, one hardly gets any food from the farms and it brings a lot of ‘ahokyere’ (suffering) to the family.”

These climatic changes further impact on agriculture and natural resources as follows:

- There are crop failures as a result of high temperature and low rainfall.
- Increased land degradation affects arable land for farming.
- There is an alteration of vegetation structure from thick forest into thin forest and shrubs.
- There is greater incidence of alien diseases and pests as a result of changes in temperature and humidity.
- There is continuous loss of non-timber forest products; for example, cocoyam, which used to sprout a lot in the forest, is now progressively decreasing in density.
- Some rivers dry out completely, sometimes making water for household activities scarce.

Meteorological data for Wenchi in the transition zone does not bear out the assertion of the farming season starting in February but rather in March, with an average of 50 mm rainfall recorded from 1950 to 2000. Of

course, some land clearing might begin in February, which is not synonymous with the wet season. There is therefore a little confusion of terminology regarding the rainy season, farming season, and wet season that needs clarification in any fieldwork. Rising temperatures are borne out by the instruments in Wenchi as by an upward movement of 1.3°C between 1976 and 2000, but with a few years registering below the mean used. (Appendix 9 presents rainfall data for selected stations in four zones.)

In Dzatakpo, an island and a fishing community on Volta Lake located in the transition zone, both men and women noted general variations in rainfall patterns as evidence of climate change. In particular, they observed the longer dry seasons; less rain leading to drought; lower water levels in the Pru and Volta rivers, particularly during the dry season; and strong heat waves, which were associated with the decreasing water level in the river. This is consistent with findings (Owusu et al. 2008) of rainfall patterns in the Volta Basin. These negative climatic conditions translated into the loss of biological diversity. Migratory birds used to visit seasonally to indicate the presence of fish in the river. There is a disruption of fishing activities due to the progressive reduction in water levels and pollution of freshwater resources. Of course, these occurrences have human-induced dimensions involving inappropriate fishing methods, such as the use of chemicals for fishing and smaller gauged nets, which disrupt the natural regenerative capacity of the Volta Basin (Rubin et al. 1998).

The coastal savannah is the most vulnerable to sea erosion resulting from rising sea levels due to melting glaciers and rising sea temperatures. In the field study in Ada-Anyakpor, the men claimed that some 20 years ago, the distance between the seashore and the houses was about a mile. These days some houses are actually at the seashore due to sea erosion; these houses easily get flooded with every high tide. The chief and elders lamented that the rainfall pattern has changed considerably. Some 20 years ago, it used to rain for a longer period, but these days it hardly even rains normally. They attributed these changes to the intense heat being experienced today. The youth intimated that about 10 years ago, signs of a cloudy sky were accompanied by rainfall, but this is no longer the case. Most of the infrastructure along the beach has been destroyed, while fishing is becoming dangerous with the turbulent waves at sea using the traditional canoe.

These climatic changes have a variety of impacts on marine ecosystems and coastal livelihoods. For example:

- Sea level rise such as coastal inundation and erosion has displaced the population along the coast.
- There is disruption of livelihoods based on fishing due to saltwater intrusion into freshwater resources.
- The declining fish catch is leading to livelihood diversification and impoverishment.
- The invasion and destruction of coastal wetlands and beaches in the communities along the coast has affected tourism in the area, coupled with the loss of migratory birds and marine turtles.
- Food crop yields are declining, and farmlands are being lost.

While it is known that climate change is adversely affecting fish migration and reproduction patterns in Ghana, these factors are really just the “final straw,” in that climate variability comes on top of prolonged and very heavy overexploitation of fish stocks; widespread use by artisanal fishers of destructive fishing techniques, including DDT, dynamite, and carbolic acid; and the use of very small-gauge fishing nets. With regard to marine fishing, the collapse of the Gulf of Guinea’s large marine ecosystem is not the product of climate change, but of overfishing not by Ghanaians, or West Africans more generally, but by EU trawlers working in international waters (Cromwell 2002). In other words, this cause of vulnerability can be attributed to forces in the global economy driven by consumption in the advanced economies, but cannot be easily connected to climate change. The declining fish hauls are another source of vulnerability that could be exacerbated by the effects of climate change. This recognition is very important in terms of identifying sound and balanced adaptation strategies. In the fisheries sector, for example, such strategies could include educating communities about more sustainable practices, instituting and enforcing international laws on marine resource exploitation, and providing alternatives based on aid from the business world.

In Nima, a slum in Accra located in the coastal savannah zone, the women said the community rarely experiences cold winds (sea breeze) these days, which are necessary to keep temperatures low. The rains come very late, whereas the rainy season used to start from

late March. Day-time temperatures are very high. The men said that the impact of climate change affects mainly human health and the settlements. Extreme temperatures are coupled with seasonal floods, which are enhanced by the lack of proper site engineering and planning. This leads to the increasing incidence of vector diseases, especially malaria. There is also continuous deterioration in infrastructure because most of the structures in the slum are built of wood, while the block houses are progressively affected by erosion caused by frequent flooding. The slum dwellers of Nima recount the ordeal they have undergone during recent flooding due to poor urban planning and inadequate provision of drains. The destruction of property by floods is common to all the zones, but more serious in the coastal and savannah zones.

Reliance on bush meat as a source of income and household protein needs is an age-old practice in all zones. However, there is a crisis in the bush meat industry. With small game increasingly scarce in the southern forest, most hunter families in the savannah zone have been converted into farmers. The failure to procure antelopes for the Aboachire Festival in the central region—part of the customary practice where young men in several groups compete in the grasslands and forest to capture a live antelope—is testimony to drastic declines in these resources. Some studies (Brashares et al. 2004) argue that the pressure on food supplies caused by the collapse of the Gulf of Guinea’s fishery has led to the overhunting of many terrestrial species. Expanding the agricultural frontier (Gyasi et al. 1995) and bush burning practices of the savannah (Korem 1985) have also been blamed for declining bush meat supplies. Declining and disappearing game is a major source of vulnerability, as it deprives many of an important source of livelihood and survival.

The traditional building technology of the past that withstood the test of time in all zones has given up under these extreme conditions. Table 4 shows the challenges associated with current climatic change and variability in three ecological zones summarizing the narrative above.

Findings from the field validation survey show adverse impacts of climate change on both groundwater and surface water availability. In Boayini, in the Guinea

TABLE 4. SOME PREVAILING CLIMATIC IMPACTS IN THREE ECOLOGICAL ZONES IN GHANA

<i>Savannah</i>	<i>Transition</i>	<i>Coastal</i>
<ul style="list-style-type: none"> • Stormy weather and destruction • Top soil erosion and soil infertility • Long drought and flooding • Increased food insecurity and malnutrition • Competition between humans and animals for water • Increasing conflicts around resources, especially land • Increased migration 	<ul style="list-style-type: none"> • Reduced water volume • Changes in rainfall patterns (late start, stops early), thus affecting planting seasons • Water stress is also leading to declining soil fertility • Thick forest now transiting into shrubs • Extreme heat and disease burden • Waterborne diseases increased 	<ul style="list-style-type: none"> • Massive erosion displacing settlements and livelihoods of people along the coast • Dwindling fishing stock • Drastic reduction in the volume of water • Severe flooding along the sprawling urban cities and towns • Higher risk and exposure to disasters • Nexus of poverty, poor infrastructure, and climate impacts

Source: Field validation, Focus Group Discussions, 2009

savannah, the men stressed that, although in the past, at the peak of the dry season, the river in the community shrank, yet it was enough for drinking and for other purposes. The impact of climate change became clear to them when the community did not only lose water from the river, but also dug four wells and did not hit water. The water spring up during the rainy season and disappears in the dry season. In Tetaku, in the Sudan savannah, two river valleys were enough to meet their water and fish requirements in the past. The valleys contained water throughout the year, but now dry up from March to April, so they depend on wells.

In Kamaso in the western region, in the past the rivers provided enough potable water throughout the year. There was no need for boreholes and wells. The community has had to construct boreholes and wells to complement the rivers. Some individuals have also constructed wells in their homes. Periods of extreme heat from too much sunshine also affects how the water is drawn from the wells and boreholes. As one participant indicated:

“During times when the water level in the well falls, community members queue into the night to draw water for home use. Women sometimes fight at the well over the water.”

In constructing the wells, the community has had to dig deeper to strike water. The first well the community dug in 1992 was about 18 feet deep. The second was about 22 feet, and the third—which is almost complete—is about 29 feet deep. The men partly attributed the depth differences to the water table, which they believed had gone low due to poor groundwater recharge.

In Buoyem (Transition zone), an elderly woman stated that:

“About 20 years ago, the water we fetched from the streams for domestic purposes was naturally very cool like iced water and was also tasty than pipe borne water. But now the taste has changed and it is not as cool as it used to be. I think the persistent warmness of the weather coupled with farming along the river banks had affected the coolness and taste of our stream water.”

They have also observed that the Bibiri River, which is the biggest river in the community, used to be deep (about 4 to 5 feet deep) but is now barely 1 foot deep.

In Dzatakpo (transition zone), the community says there is a low level of water in the Pru River and the Volta River compared to 20 years ago, particularly during the dry season. In their view, the low water level in the rivers was a result of progressive rain deficits experienced over the past 10–20 years in the community (Owusu et al. 2009).

According to the women in Ada-Anyakpor (coastal zone), the sea erosion and its attendant flooding of houses has caused well water to become salty. The men said river patches dry up very quickly due to the intense heat, making it very difficult for those who rely on river water for their livelihood.

Also in Nima-Maamobi (urban slum in the coastal savannah zone), according to the focus group of women, although there is the supply of pipe borne water, this

has become rather unreliable in recent times. As a result, several households resort to the use of poly-tanks to harvest and store water, while others also sell water from similar receptacles. The cost of water in Accra is too high for the poor.

The differences in the perceptions of community members and the readings by instruments as shown by the literature and statistics from the meteorological services are a matter of degree and accuracy of dates. All the perceptions of the people with regard to environmental change are real, but when such incidents such as droughts and floods occur are often a matter of controversy and inaccuracy. Also, exaggerations of the extent of sea erosion and saltwater intrusions are common. Other explanations underpin the occurrence of these changes rather than just climate. Fish stocks in rivers might not necessarily be declining on a yearly basis as perceived, but rather the number of fishermen is increasing and therefore leads to lower catches on the average, and not on the total absolute catch. The extent to which these environmental changes are attributable to economic policies, human extraction methods, and reflections of social relations are not easily elicited by anecdotal data. However, we need to take these

perceptions seriously as they influence the adaptations that result. This suggests the importance of sensitization and advocacy on climate change that takes on board a political economy perspective to capture the interlinked causal structure of vulnerability.

Table 5 provides a summary of the hazards of climate change on the studied communities.

Autonomous Adaptation Practices and Household Decision Making

The households have adopted a number of strategies to cope with the adverse impacts of the changed climatic conditions and their hazards. These strategies range from the application of agricultural techniques to diversification of livelihood activities. Household strategies should be seen as responses to wider socioeconomic and environmental influences.

In the forest and transitional zones, most of the strategies adopted by households largely fall within the application of agricultural techniques. The majority of households resorted to adapting planting dates as a way of diversifying their risk against the adverse variability

TABLE 5. HAZARDS ENDANGERING LIVELIHOODS BY ZONES

Hazards	Year of Event	Frequency				Percent			
		Forest	Transition	Savannah	Coastal	Forest	Transition	Savannah	Coastal
Less rainfall leading to droughts	2006, 07, 08, 09	7	6	4	10	35	30	20	50
Periods of prolonged drought, leading to crops drying out or livestock not having sufficient water	2000, 20 05, 2006, 07, 08	4	2	3	2	20	10	15	10
Excess rainfall leading to floods	2007, 2008	3	0	5	N/A	15	0	25	N/A
Too heavy showers leading to damage to crops, livestock, and property	2007, 2008	1	4	6	N/A	5	20	30	N/A
Periods of extreme temperatures, leading to scorched crops	2006, 2007, 08, 09	5	8	2	8	25	40	10	40
Total		20	20	20	20	100	100	100	100

Source: Household Survey, 2009

of the climate. This strategy was followed by diversification of crops planted; that is, planting of minor crops—such as cashews, tiger nuts, and tomatoes—rather than the traditional major crops of cocoa and oil palm. Households also resort to crop selection and adapting to cropping densities by choosing crops with shorter gestation periods (such as tomatoes) and drought-resistant crops (such as cassava). Households also use irrigation farming when they are close to river banks as a way of surviving the long drought conditions. Most of these are also responses to market influences determined by structural adjustment policies.

On the farms, farmers are also planting trees to act as shading for their cocoa plants. Some are also turning to the cultivation of teak plantations, which produce logs used as electricity poles to augment income or make efficient use of depleted soils. The farmers also use fertilizers to improve the soil fertility and increase yields of their crops. Cocoa seedlings are planted closely at small intervals so that some can survive when others are unable to survive. Some farmers indicated that they had resorted to using different varieties of cocoa seedlings that are drought-resistant. Some individuals disclosed that they have to move into other nearby communities in search of lands to expand their farming activities. They indicated that they were not migrating into those communities to settle, but were just interested in acquiring land. Some households have also constructed sheds to store maize for lean periods. These strategies reflect wider influences and are shaped by social relations, which determine the degree of success in adapting or diversifying.

In Kamaso particularly, there is a community initiative to have houses roofed with roofing sheets instead of thatch or raffia, which are susceptible to heavy storms. According to the community members, the roofing sheets provide some comfort and safety from storms and heavy rains. The domestic water problem is attended to through the construction of hand-dug wells and boreholes, which guarantee some amount of water in the dry season. Apart from the community boreholes or stand pipes, some individuals have also dug wells in their homes. Other strategies employed include redirecting gullies to carry water out of the communities; engaging the services of community volunteer fire officers to manage bushfires, while the women engage in

petty trading activities; fish smoking and mongering; road side catering services; and small shops.

In the coastal zone, according to the men, most farmers who previously were into cultivation of cassava and maize have now changed to onion cultivation, since onions are easier to store and sell later for more money. The settler community also stated that fishermen now resort to the use of light and some chemicals to attract the fish into their nets. This is because Chinese fishermen have been engaging in pair-trawling activities. Some fishermen also have migrated to Atakpame in Togo to ply their trade. The chief pointed out that many of the youth in the community have resorted to traveling to Accra in search of alternative livelihoods like working as drivers or drivers' mates. Most of them start off as mates and eventually become drivers. Some manage to become car owners after some time and therefore think it is better than staying back at home to engage in either fishing or farming. Most vulnerable and poor people in the community usually help on the farms of other people. The women help with planting and harvesting, while the men do clearing and tilling of the land on the farms for a fee. The men also help to drag the fishing nets, while the women help sort out the different species of fish caught. Through these activities, they earn some income. The gender dimension of livelihoods is a reflection of a division of labor informed by a history of patriarchal relations that prioritize men over women. Most activities in which female labor is appropriated are referred to as family work. These activities take a lot of time, leaving women with only limited time for their own activities. Interestingly, some well-to-do women have sponsored the activities of male fishermen, who are forced to sell their produce to these women at agreed upon low and stable prices. This is risky for the women, but highly profitable when there is a good catch. Hence, commercialization of the Ghanaian economy is creating some new opportunities for a few women.

In the urban slum of Nima, the women asserted that there are a growing number of poor people who cannot provide for themselves and their children. As a result, young children are made to engage in street-selling to supplement family income. According to the chiefs, a lot of young people are resorting to trading as their major activity. They buy cheap merchandise from Togo and sell

it in Ghana. Others also engage in motor bike and bicycle rental businesses. More elderly men have been involved in changing money at the black market rates to earn a living. Some young people have traveled to other parts of Africa and Europe, where they hope to make a living.

In the savannah belt, communities have come up with many strategies to cope with variability in climatic conditions. One form of adaptation is an increase in the size of farms. Women who used not to farm/weed on only family farms now farm individual plots to supplement the efforts of the men. They also employ the services of tractors and bullocks instead of just hand tilling. There is also a shift in the variety of crops cultivated; for instance, from a four-month maturing maize variety to a three-month maize variety. There is also a shift away from guinea corn and late millet to more soya beans, groundnuts, and beans. In the Sudan and Guinea savannah belts, groundnuts and soya beans are fast becoming main crops cultivated by everyone. Farmers now resort to the use of fertilizer or manure and other chemicals like herbicides and insecticides to improve their crop yields. Dry season gardening has become very important, especially along the river beds and using hand-dug wells. In the case of the community from the Sudan savannah, some of the community members commute to the banks of the White Volta, which is about ten miles from the community. They cultivate vegetables like onions, tomatoes, okra, and alefu, which gives them a good source of income. Selling charcoal and fuelwood is a major source of income, although the practice is limited in the Sudan savannah due to the scarcity of trees. There is intensification in picking and processing of Shea nuts and dawadawa by women, while the men cut grasses for sale. Animal rearing is a dominant activity by community members. This is predominantly championed by the men, although women also own some animals. Most houses have structures for rearing pigs, while some members have Fulani herdsmen who take care of their cattle. At the peak of the hunger period, people depend on the use of Shea butter and the leaves of some edible plants. They boil the leaves and then add Shea butter, which enables them to cope until the early crops are harvested. Migration has become a major adaptation strategy in the northern part of Ghana. Many community members, especially youths, migrate to southern Ghana to work. In the case of men, they work on other

people's farms for a fee ("paa"). This was dominated by men, but has since become suitable for both males and females. There is an increasing redirection of migration from rural-rural to rural-urban, especially among young women. The men lamented that the practice is affecting family unity and progress, as many of the females pick up bad attitudes when they migrate, endangering both the peace and health of the family.

Existing Community Policies, Laws, or Practices that Hinder or Facilitate Adaptation

The traditional authorities are putting in place and adapting old laws and practices to check activities that harm the environment. In Boayini, in the Guinea savannah belt, a committee has been set up to check the cutting of trees. The traditional authority ensures that they advise the youth not to practice bush burning and also ask the youth not to use chemicals (DDT) in the water bodies. They punish those who violate the various rules and laws binding the community. In Tetaku, in the Sudan savannah, there are also strict laws governing burning and cutting of trees. These were the key comments that came up in the women's focus group discussion at Tetaku:

- "We are not allowed to cut down economic trees such as dawadawa, and shea trees."
- "Before we sell the fuel wood, it is inspected to ensure that they are not economic trees."
- "We are not allowed to fetch wood more than one donkey cart at a time to the market."
- "This year (2009), a bylaw prohibiting the cutting of trees has been passed. We can only cut shrubs or dead trees."
- "One cannot pick shea nuts on another person's farm. The trees on the farm belong to the owner of the farm."

In Buoyem (transition zone), the traditional and kinship structure in the community requires that at the family level, it is the family heads (usually men) who have control over the allocation and use of all family resources, particularly land. Land is the basis for most livelihood activities. In some cases, the land is allocated such that only the marginal land goes to the women, who are perceived as lacking the capacity to cultivate large portions of land. This situation further worsens the

vulnerability of women, as they end up having small portions of less fertile lands that are less productive. Because land is generally not sold, migrants find it difficult to plant crops that have high commercial value—such as cocoa and cashews—but long gestation periods. This is because they do not have permanent use of the land. They are therefore limited to cultivation of only crops with short gestation periods, which unfortunately have low commercial value compared to cocoa and cashew.

A migrant farmer from the northern region captured this problem in the following statement:

“Though I wish to, but I could not plant crops which have long gestation periods particularly of high commercial value like cocoa and cashew. This is because land is generally not sold here. Since I do not have permanent use of the land leased to me, I am limited to cultivating only crops with short gestation periods with low commercial value compared to cocoa and cashew. I believe I would have been better off if I am granted permanent use of the land.”

The Buoyem community also has a policy that protects some part of the forest as reserves where people are not allowed to carry out any livelihood activity. There is also an ecotourism project that seeks to preserve parts of the land, caves, and water bodies for generating income for the community. There is a bylaw that farming activities should be at least 20 meters away from river banks.

In Dzatakpo, a fishing community also in the transition zone, residents are not allowed to either hit the river with a stick or cut the river stumps in the river as it will stir the fish away and affect the catch of the fishermen. Going to fish and farm on Tuesdays is also prohibited. This is to ensure some breaks in fishing so that the fish stocks, particularly the fingerlings, are not depleted. This policy is also tied with another that bans the use of very close-woven fishing nets in fishing, so that the fingerlings in the river are not depleted.

According to the women in Kamaso in the forest zone, a number of policies hinder or enable their adaptive capacity. Those most affected include the “ahokyerefo” (those in difficulties or most vulnerable) and the “modenbofo” (those trying hard). The community pools its human

resources together through communal labor to undertake community projects. Every able-bodied community member is expected to participate in communal labor activities set for the day. They have also instituted what is termed “Adim” (resting day), a three-day rest period during which community members are forbidden to engage in farming activities on their farms except to gather food for the household. Adim occurs on the third Wednesday, Thursday, and Friday in each month. In recent times, its observance has not been very strict due to the influx of faith-based organizations, particularly the Christian faith in the community. To protect the natural resources of the area, between January and March of each year, bathing in the Sure River is prohibited. Fishing is allowed in the rivers, but they frown on the use of chemicals such as DDT in the river, while farming or entry into forest reserves is also prohibited.

They highlighted the following as policies/practices:

- *Observance of “adim” (day of rest).* During lean periods where food and family cash flow is low, the observance of adim contributes to food insecurity as one cannot engage in active farm activities.
- *Prohibition on the rearing of sheep/goats.* According to an elderly woman, the regulation not to rear sheep or goats in the community is hindering their adaptive capacity. She noted that sometime back, a man used to rear sheep and goats, which he sold when he needed money. If they were allowed to rear sheep and goats, community members and households could get protein supplements from the meat and also extra cash.

According to the chiefs in Anyakpor, there are no norms or practices hindering adaptive capacities of the community people. Due to the transformation from traditional to the belief in Christianity, there are a lot of beliefs and norms that are no longer observed. The men said keeping fowl, goats, and sheep in the community was forbidden due to the destruction caused to crops. This policy has been revised, and these animals are permitted provided they can be well-kept in their pens. Offenders are made to repair the damage caused by their domestic livestock and fined appropriately for any inconveniences caused to the victim. The chief and his elders revealed that no farming was allowed on Thursdays and Fridays for reasons they could not give, but this practice has been discontinued for the past 10 years due to the

people's new belief in Christianity. According to them, there is a regulation against the frying of fish at the seashore. People are also not allowed to go to the seaside in bathroom slippers. These measures were to ensure that the beach was kept clean at all times. It was revealed during the meeting with the women's group that carrying head-pans to the seaside to fetch water is not permitted. Pots are rather preferred. This regulation was in line with the rituals performed to enhance their fishing business. However, this regulation has also been affected by Christianity. The coming of Christianity has seriously affected the traditional system and social practices of the people of this community.

Nima-Maamobi, which is located in the capital city of Accra, is affected by the policies of the Accra Metropolitan Assembly (AMA), which influenced the adaptive capacity of community members. They cited the policy against indiscriminate siting of shops as a key inhibiting policy. In addition, most people hardly have access to enough capital to enable them to engage in new forms of livelihood activities. Another is that if anyone reports any wrongdoing in the community, the AMA does not take any action. Poor enforcement of laws and regulations by local government is a major hindrance to adaptive capacity, especially of the poor.

The rules of the game in each zone are socially negotiated and transformed with inputs from different interest groups, normally dominated by the powerful who seek to maintain their status quo. However, state rules enforced by institutions translating the country's constitution seek to bring a balanced and equitable system of access. Modern institutional arrangements may tend to constrict rather than enable livelihoods and adaptive capacity. The conflict between modern religion and African traditional belief systems is both a blessing and a curse to the management of resources and guidance of social relations. This is a gap that needs to be filled by conscious negotiation, rather than allowing market notions to influence decisions that are more inimical than traditional patriarchal systems.

Decentralization, Local Governance, and Participation in Formal Organizations

Local governance by traditional institutions is in the hands of chiefs and subchiefs, with the ultimate

execution of laws and policies in the hands of family heads. These traditional hierarchical power systems interact with the district assembly, which is the decentralized formal institution in each geographical zone. Local governance results from the interaction of the traditional system, district assemblies, and sector ministries. The most visible sector ministries are the Ministry of Food and Agriculture, Ministry of Education, and the Ministry of Health. The district assemblies have the responsibility for the day-to-day running of the district, but with limited resources compared to the sector ministries.

Each of the communities in the forest zone has a chief who is recognized as the leader of the community. The leadership in both communities include the chief, an *Mmerantebene* (youth leader), a queen mother, a group of elders, and a unit committee member representing the institution of national governance at the community level. However, in Gonukrom, there are chiefs or leaders of the various ethnic groups represented in the community. These leaders play a supporting role to the community chief in providing leadership to the community. They are also responsible for settling all ethnic-related disputes within their areas of influence.

The coastal community is headed by the overall chief, who is assisted by leaders of five clans, namely Dangmebiawe, Adebawee, Korgbor, Lomobiawe, and the Tekpebiawe. All the leaders are involved in the decision-making process regarding issues involving the people in the community.

In the savannah belt communities in northern Ghana, two clear leadership structures emerged from the study. First is the hierarchical structure practiced by the Mamprusis. Although the other three tribes in the community have their leaders, they report to the Mamprusi chief, who is at the top of the hierarchy. There are many other subordinates involved, including the Tindana as the custodian of the land, and the magazia (women leader), who is part of the leadership structure of the community.

At Tetauku in the Sudan savannah, there are clan heads. Although there is a chief, he is not resident in the community and therefore not the dominant authority in the community, but rather it is the tindana. The chief, tindana, magazia, and assemblyman were identified as

those who can facilitate their adaptation. An elder contends that *‘These people all enhance and support our activities. The chief listens to us and attends our meeting when we invite him.’*

Participation in formal organizations has been on the increase in the recent past due to decentralized and participatory governance introduced by the government. The district assembly system has unit committee members in addition to the assembly representative, who together with the community deliberate about the community’s needs, problems, and possible desired solutions. These issues are translated into strategies, which are communicated to the assembly and sector ministries for action. It is easier dealing with the assembly system as it is claimed to be more democratic and fair in sharing proceeds and projects than the sector ministries, where power and connections are the key to eliciting support. This finding means that support for climate change adaptation would be better allocated by the district assemblies, but with technical support from the ministries, since the assemblies do not have the expertise to handle them.

Local Assessments of Existing Public Investments and Access to Services

The adaptive capacity of communities to climatic hazards is highly dependent on the level and quality of public investments in both economic and social infrastructure and services. These enhance both the physical/ economic capital and the human capital of the communities. These two forms of capital in turn influence the ingenuity of people and facilitation in adapting livelihoods and livelihood practices. Public investments are understood here as resources produced by external organizations such as NGOs and the state.

In the savannah zone, the most dominant institutions that provide support are nongovernmental organizations (NGOs). In Boayini, the Presbyterian Agricultural Station located at Langbinsi provides different support services to the community members. It provides the latest varieties of seeds (Bambara beans, beans, maize) and also supports them with training programs in planting and other farm management practices. In Tetauku, the Zuri Organic Vegetable Farmers Association (ZOVFA) is providing support to the community members. As a result, ZOVFA was ranked

very high in the institutional analysis conducted with the men and women groups in the community. As they indicated:

“ZOVFA builds our capacity to improve upon our indigenous knowledge; ZOVFA supports us in taking important decisions such as adopting new farming methods to improve our harvest and in taking proper care of our live-stock; and ZOVFA involves us in decision making and they are highly reliable, always doing their best to meet our needs.”

Other institutions and personalities mentioned included:

- Nutrition mothers club established by Ghana Health Service in Bawku. The club provided a grinding mill.
- MOFA – they provide us with seeds for planting and support us in solving our farming problems.
- CARE International – They support ZOVFA with resources to also support the community.
- John Bugri – He is a native of the community and an opinion leader who supported the community with a motorable road.
- The Ghana Association of Conservation of Nature (GACON) provides acacia trees and creates fire belts to prevent fire from destroying the forest.
- SARI – Build our capacity on new crop varieties and also provide us with seeds.
- District Assembly – local development; for instance grades/ rehabilitates our road at least once every year.

In Buoyem, in the transition zone, both the men and women explained that there was little government support extended to them with regard to climate-related hazards. Though the unit committee argued that they do mobilize disaster intervention groups to support the community in the case of disaster, the community members said that this was not the case since they do not recall benefiting from any intervention at the household level. However, they agreed that government provides social services such as schools and clinics and rehabilitates these facilities during climate-related disasters.

In the Dzatakpo community, both the men and women explained that they receive no support from any institution

with regard to climate-related hazards. One of the subchiefs in the community made the following comment:

“We lacked all social amenities necessary to sustain lives here. We have to send our children across the river every day or stay with relatives on the other side of the river so that they could go to school. If the government could not provide us any social amenities how would any institution know that we also exist here and extend any help to us?”

Table 6 shows the institutional assessment in Kamaso in the forest zone. The scores for formal institutions were low; this is because according to the people, they have little or no contact with them. However, they identified institutions such as the family, Mmranthene (youth leader), the church, and Odikro (chief) as very important. Individual and community struggles are seen as more important than the input from the state, as these are very limited.

In Anyakpor, in the coastal savannah, the chiefs mentioned the Adventist Relief Agency (ADRA), which previously provided the farmers with fertilizer to improve their soil as an important institution. Agricultural extension officers have also helped by supplying women with chicks and piglets to rear. Also identified is the Trusty

Food Company in Tema as having helped with the provision of tomato seeds, fertilizer, and insecticide and also arranged to buy the farm produce. However, they lamented about the unfavorable terms of the arrangement, which left some members heavily indebted.

In Nima-Mamobi, some institutions that exist within the community and who, according to the youth, are supportive of livelihood strategies included, in order of ranking, the Muslims Family Counselling Services (MFCS), Legal Resources Centre (LRC), Mothers' Club, Federation of Youth Clubs (FYC), National Disaster Management Organization (NADMO), and Mankind Awareness. Though much is expected, the Accra Metropolitan Assembly is not doing much, as drains are poorly constructed, garbage collection is poor, and public schools and community schools are overcrowded.

The response from the communities in the transition, coastal, and forest zones with regard to institutional support seems to place emphasis on the importance of mainly NGOs. Public investments and services from the state are static, as schools, clinics, roads, and other infrastructure is old and not being expanded. The capacity of the state to meet the increasing demand for social and economic infrastructure is weak and being taken over by NGOs who also provide palliative measures since their reach is often low.

TABLE 6. INSTITUTIONS THAT PROVIDE SUPPORT IN KAMASO (FOREST ZONE)

<i>Institution</i>	<i>Trust</i>	<i>Provides help when needed</i>	<i>Effective</i>	<i>Reliable</i>	<i>Have a say in decision making</i>
Scoring over 50					
District assembly	10	10	—	3	10
Extension officers/ cocoa service division	5	—	—	—	—
NGO	25	25	30	30	25
Member of Parliament	20	25	20	15	20
Mmranthene (youth leader)	50	50	50	45	50
Chief/ odikro	45	40	50	40	45
Family	50	40	40	50	45
Church	45	35	30	45	35
Unit committee member	1	10	15	20	30
Police	5	15	20	0	5

Source: Field validation, Focus Group Discussions, 2009

Policies and Institutional Capacities needed to Facilitate Adaptation

Several suggestions were made with regard to improving livelihoods and increasing adaptive capacity. According to the women's focus group discussion in Tetauku (Sudan savannah), new and improved seed varieties that withstands the current climate conditions should be provided. The men also mentioned a reliable source of water for irrigation, such as dams and wells for dry-season gardening. They also stressed the need for cheap and subsidized farming inputs, such as bullocks, tractors, fertilizer, and improved seeds to facilitate their farming activities. There was also the suggestion that women should be provided with loan facilities to do petty trading, as this would help them to further support their families.

In all the study sites, the following areas were advocated for future policy to target:

- Irrigation facilities to enhance farming during poor raining seasons, dry seasons, and also to help avoid farming close to the river banks.
- Financial support for all livelihood activities in both rural and urban areas.
- Regular interactions between community members and with the state and NGOs on emerging problems and best solutions.
- Improvements in social services, especially water and sanitation facilities, health, education, and infrastructure.
- Modernization of building technology to deal with floods and winds.
- Mechanization of farming and more use of modern inputs.
- Improve access to markets.
- Encourage tree planting and conservation of biodiversity.
- Human capacity building through training and education on different activities used in each zone.
- Improve governance systems by making rules work for all.
- Curb rural-urban migration through improvements in rural livelihood activities.

Policies need to target sectoral and locational circumstances. The integrated approach emerges as a necessity

because pushing resources into one sector—such as improving crop yields—without concomitant improvements in roads and marketing facilities would be counterproductive. Policies need to be crafted using the sustainable livelihoods framework with climate change as a major threat.

CROSS-CUTTING OBSERVATIONS: COPING STRATEGIES VERSUS ADAPTATION

The mix of coping and adaptation strategies is necessary for the survival of the poor. Past climate hazards and trends or perceptions of these hazards influences adaptation strategies selected in terms of crops planted, diversification, and household labor distribution. Climate-induced contingencies such as crop failure due to drought have to be dealt with using coping strategies such as drawing down assets, which is usually livestock in the savannah and other zones. Coping strategies in this case are not bad or associated with negative outcomes, as the literature seems to suggest (Davies 1996), but an important temporal measure to allow people to reorganize and put in place long-lasting adaptation strategies such as wells for irrigation, diversification of livelihood activities, and a division of labor among household members. Similarly, formal organisations—such as relief NGOs and NADMO—engage in public coping strategies when disasters strike, while sector ministries plan strategies to climate-proof future livelihoods in their sectors.

Coping strategies buy time for people to effectively plan the future based on the past and imagined scenarios of what trends will occur. Local governments often cope with infrastructural collapse—such as roads washed away by torrential rains—by simply leveling with graders, while the next year's budget is tuned toward re-graveling with materials that can withstand the new threat. Due to financial constraints, some local governments end up coping year-in and year-out until there is some foreign assistance to undertake the massive investments needed. Similarly, at the household level, the poor are not able to carry out the needed adaptation measures such as erosion control bunds, wells, diversification, and intensification of crop and animal farming because they do not have the assets needed for such investments. They therefore continuously cope with all

old and new climate hazards on a daily basis. Even long after the hazard, most poor people continue to suffer the long-term indirect effects of climate hazards in a typical downward spiral of poverty.

Local/Community Adaptation Mechanisms/Actions

Local responses to emerging climate impacts has been spatially variable, depending on the different vulnerabilities. In the northern savannah, the main responses include:

- Cultivate larger farms as an insurance mechanism.
- Women are now full-time farmers as opposed to a limited role in sowing and harvesting in the past.
- Higher use of mechanization such as tractors, bull-ock/donkey plows, and carts.
- Adoption of new varieties of crops with shorter gestation periods, with higher commercial values.
- Increasing use of fertilizer or manure and other agro-chemicals to increase yields.
- Dry-season gardening with small irrigation systems using hand-dug wells and pumps along rivers.
- Engaging in off-farm activities such as charcoal and fuelwood harvesting, or intensification in picking and processing of shea and dawadawa.
- Out-migrate to improve livelihoods or reduce burden on household.
- Animal rearing as major asset to buffer seasonal hunger.

In the transition zone, the following actions are important:

- Cultivate versatile crops like cassava, which tolerates high variable weather conditions.
- Adoption of new varieties of crops with shorter gestation periods with higher commercial value; maize and tomatoes are the favored.
- Planting along the river banks and streams for irrigation purposes (common only among vegetable farmers such as tomatoes, peppers etc.).
- Adapt planting dates according to timing of rains.
- Phasing of cultivation as insurance by planting at different dates on same land.
- Very early morning farm work to avoid excruciating heat from the sun.

Actions in the forest zones included:

- Increasing use of hand-dug wells rather than rivers for water.
- Farmers resort to planting more trees to act as shading for their cocoa plants.
- Cocoa seedlings are planted closely at small intervals so that some can survive when others are unable to survive.
- People are diversifying into silviculture, with teak plantations preferred.
- Increasing use of use fertilizers to improve soil nutrients for crops.
- High use of improved drought-resistant cocoa varieties.
- Extensification of agriculture for both cocoa and food crops.
- Construction of barns to store maize for lean high-price periods.
- Employing erosion control measures by redirecting gullies.
- Engaging services of community volunteer fire officers to manage bushfires.

Actions in the fishing community included:

- Adapt to night fishing and exploring deep into the lake and rivers.
- Using foreign fishing nets which are able to cast deeper.
- Diversifying to other activities during the rains and the lean fishing season.

Actions in the coastal community included:

- Move from cereal cultivation to vegetables (onions) with higher commercial values.
- Resort to illegal methods of fishing such as the use of lights and some chemicals to attract the fish into their nets.
- Adapt boats by using outboard motors to venture deeper into the sea.
- Fishermen migrate to other West African countries to fish (Atakpame in Togo).
- Poorer people help on the farms of other people, drag the nets of incoming boats, and sort out the different species of fish landed for a fee or small share of the harvest.

- Migration is a major strategy to declining fish stocks and unviable agriculture.

Community actions/strategies that need urgent attention and support in the savannah community are:

- Early maturing and drought-resistant varieties of crops, regular extension services to improve farming practices, and affordable farm inputs, especially agro-chemicals.
- Support for small-scale irrigation, especially dams for dry-season gardening.
- Farm inputs/implements such as bullocks, plows, and tractor services
- Improve livestock farming for income and manure for farming.
- Loans for women to ensure profitable non-farm activities.

Community actions/strategies that need urgent attention and support in the transition community are:

- Irrigation to enhance farming and maintain the two rain regimes.
- Financial support to enable necessary investments in farm and other activities.
- Create a platform to share ideas between elders, the youth, and government experts on best local farming practices and how to adapt to weather variability.
- Improve water and sanitation facilities such as boreholes and pipe borne water.

Community actions/strategies that need urgent attention and support in the forest community are:

- Provision of agrochemicals for both cocoa and food crops.
- Incentives to encourage tree planting and protection of biodiversity.
- Construction of the community's access road.
- Harnessing of underground water.
- Financial facilities to support livelihoods of the poor.
- The settlers agreed that there is a need for training for fishermen, fishmongers, and farmers on new techniques to adopt within their chosen careers to enhance their businesses.

Community actions/strategies that need urgent attention and support in the coastal community are:

- Financial facilities to aid investment in fishing, farming, and non-farm activities.
- The provision of electricity is paramount to the success of livelihoods, such as the use of cold facilities for fish.
- Skill training for the youth to enable diversification into the expanding urban systems of the Accra-Tema conurbation.

These are not just a wish list, but interventions that can help build on local resilience and improve livelihoods whether as assets or social processes. Pro-poor interventions seem to abound, showing that the interest of the poor was prime in the deliberations as many community members recognize the debilitating effect of fending for poorer relatives. Making services available, providing scientific and technical help, and building capacity through micro-finance are key components of any community intervention with regard to climate vulnerability.

KEY CONCLUSIONS FROM FIELDWORK

Livelihoods and Climate Change Adaptation

Adaptation to climate change within the various livelihood systems in each agroecological zone constitutes an important means to obtaining sustainable livelihoods. Both ex ante and ex post strategies are used by people of different socioeconomic status. The investment required to carry out any adaptation determines to a large extent whether it will be put in place to guard against climate impacts, or whether people will wait until hit by a climate-induced hazard before adopting the strategy. The wealthy can easily invest in anticipatory or proactive adaptation strategies—such as wells and pumping machines for irrigation—as noted in the northern savannah sites and coastal areas. Due to widespread poverty and the variable nature of climate, many people are sensitive to climate-related shocks, which result in ex-post coping and adaptation. Adaptation responses to climate change are disaggregated by the type of livelihood strategy used by various categories of people. Adapting the livelihood activity to specific climate shocks in order to avoid failure of livelihoods is

the major option pursued. The popular adaptation strategies range from livelihood diversification, adapting to planting dates, and changes in crops planted. The increasing diversification of livelihoods, especially among women, is particularly relevant in meeting climate challenges. In all the zones, women were the first to absorb the environmental fallout from climate change by diversifying from natural-resource-based activities into non-farm activities, especially trading. Farming is no longer the main livelihood source for people in rural areas. Multiple livelihoods are important in all the zones as a realistic adaptation strategy. However, the number of activities used by an individual should not be interpreted as correlated to high adaptive capacity. In some instances, a single livelihood strategy by a resilient household is more useful than a sensitive household struggling between jobs.

Axes of Social Vulnerability and Social Exclusion

Vulnerability to climate change is not uniform, but differs according to the sociocultural axes of a society. Social differentiation and access to resources—as enabled by both formal and informal institutions—accounts for the differential adaptations people face in their communities. The nature of the inheritance system, governance systems, and land tenure relations are important in this regard. Socioeconomic processes lead to the exclusion of some people from mainstream society. Climate-enhanced social exclusion is increasing, as evidenced by the increasing number of “environmental refugees” generated by each climate hazard. The northern floods of 2007 created a large number of socially excluded refugees, as the social capital in communities is often based on reciprocity rather than on pity or traditional rights. If you happen to fall into the asset-less category, you invariably become socially excluded as people form alliances where they can also be supported when they are in need. Coastal communities face a similar fate as their homes are now sitting on inundated coastlines that destroy their livelihood assets. The inability to diversify due to ill health and lack of investment capital leads to social exclusion. Though it is possible to access land and off-farm income in the forest zone, being sick or physically weak—such as from old age and high dependency burdens—leads to high vulnerability with poor adaptive capacity. Social vulnerability is a function of social processes and relations

defined by patriarchal and gendered norms of each society. The relevance of most traditional norms, practices, and institutions to modern trends is beginning to be questioned. The challenge is how to adapt these in line with principles of fairness, equity, and basic rights, while at the same time maintaining authority capable of ensuring the smooth functioning of society in terms of good governance.

Gender

Vulnerability is higher among women than men due to inheritance rules and land tenure relations. The patriarchal system of Ghanaian society limits access patterns of women to productive resources and in some instances social justice. In the Guinea savannah, women traditionally only assisted with farming rather than being considered farmers in their own right due to the taboo on women's ownership of land. Similarly, in the transition and forest zone, even though the matrilineal system enables some amount of female access to land, male siblings are given priority over their female counterparts. The emerging commodification of land tenure relations is a good sign for women, as they now participate on an equal basis as their male counterparts, as seen in the example of the forest zone above. But even in this case, years of subordination of women means that they cannot compete on the same level as men, who already have some access to social networks, assets, and financing. In the southern part of the country, more women than men are becoming environmentally vulnerable since they cultivate small parcels of land and depend on non-timber forest resources, which are dwindling with the changing climate. This explains the higher rate of diversification among women than men. In northern Ghana, there are more men in single-livelihood activities than women, who now also own small parcels of land for vegetable or groundnut cultivation in addition to natural-resource-based off-farm activities such as shea nut, dawadawa, and fuelwood gathering.

Ethnicity and Migrant Status

The nature of vulnerability among migrants and different ethnic groups is changing in Ghana. Migrants used to suffer discrimination and were more vulnerable than indigenes. However, with the commodification of land in the forest zones, migrants with sufficient financial

resources and human capital are actually better off than their non-landowning indigene counterparts. As noted in the results, most landowners and chiefs charge as much as 40ghc for leasing an acre of land. This is far above the ability of poor indigenes, especially women. Most migrants start by working as agricultural laborers; saving money enables them to rent their own lands. Also, the new system of “share-land-cropping” rather than the well-known sharecropping system, which used to disadvantage migrants, now enables them to own land over some years when tree crops reach maturity and they are given a third of the farm as compensation. This practice is currently in vogue in the western region of Ghana. In the rest of the forest and transition zone, migrants still constitute the vulnerable group as they are opposed to social practices that limit their progress. Migration introduces the factor of ethnicity as migrants become minorities in the destination areas. However, ethnicity in itself does not pose new vulnerability challenges, except those presented by location.

Occupational Grouping

Natural-resource-based activities are more prone to climate-related vulnerability than non-farm activities. Hence, rural areas tend to be more vulnerable than urban areas because over 90 percent of rural residents depend on rainfed agriculture and the harvesting of non-timber resources for food, herbs, shelter, etc. Unfortunately for rural dwellers, the failure of farming is invariably linked to the failure of nature-based resources, such as forest products, grassland resources, and water resources. Poor rainfall in the savannah affects both pasture for livestock production and wild fruits, which women depend on for income. Likewise, this impact reduces fresh supplies of food for fish in lakes and rivers, thereby affecting fisherfolk. Non-natural-resource-based activities now offer better prospects, as globalization enabled by the country’s macroeconomic policy direction has made informal sector trading activities more profitable. Among the low earners, traders in food crops are better off than farmers, while traders in imported commodities are joining the mass of the urban middle class. However, there is a growing lower underclass of petty traders in both rural and urban areas, as typified by the poor in Nima. The low investments in poor yielding activities are often located in places where urban institutions refuse to give

permits or extort rents, making many migrants in poor slums exposed to all kinds of vulnerabilities. Similarly, petty traders in the villages with poor clientele—due to high levels of self-provisioning and low purchasing power—makes these groups vulnerable. However, it is not merely a category that determines one’s livelihood outcomes, but the enabling processes—such as ease of access, relations with family members, societal expectations, formal rules and mechanisms, and above all political capital. Among women traders, some are very rich, while others are poor. What level of support do they get from their spouses, community, and financial institutions? And what idiosyncratic constraints do each face? Holistically, groups face similar problems and opportunities, but sustainable livelihoods are outcomes of idiosyncratic circumstances.

Typologies of Vulnerable Groups and Driving Factors

Typologies of vulnerable groups are identified at individual and group levels. The main categories of vulnerable groups include widows, disabled, aged, children, youth, and divorced women. These vulnerable groups depend on other people or on single livelihood strategies that do not procure the necessary basket of goods and services for survival. They lack the major resources needed for maintaining sustainable livelihoods and are normally at risk of losing the little they have to climate-induced hazards. The survival of these groups is contingent on dwindling social support systems, both traditional and modern. In urban areas, the poor without adequate shelter and jobs constitute the most vulnerable group. In coastal settings, poor fisherfolks living close to the shoreline constitute the most vulnerable. And in the farming communities in all ecological zones, the poorest landless farmers, especially women, are the most vulnerable. At the individual level factors such as age, disability, gender, and governance explain the risks of exposure and magnitude of impact. The aged who are abandoned by their poor kin are vulnerable. Children in poor families in the absence of state shelters are vulnerable, as they are malnourished and uneducated. The disabled are often perceived as a burden on families and society and may be left on their own. Traditional governance systems may malfunction due to commercialization of values that leads to the exercise of perverse political capital and disenfranchises

people of their assets, thereby exposing them to climate contingencies. The failure of the state to put in place safety nets or the rent-seeking behavior of disaster organizations may allow people to fall into structural vulnerability.

Urban and Rural Livelihoods and Pro-Poor Adaptation

The relationship between the rural and the urban is becoming more complex than hitherto imagined by development theory. There is a flux between urban and rural due to migration and the exchange of resources between the two. In addition, urbanized norms now pervade rural areas as monetization and commodification transform rural social relations. Renting of land at exorbitant rates is a reflection of these trends. Pro-poor adaptation strategies need to build on existing practices that straddle the two divides. The era of the rural being associated with farming and urban with industry is eroding. Good practices in urban and rural areas that ensure efficiency in resource utilization and survival are adopted and adapted in both environments. Circular migration has become an important adaptation strategy that enables people to adopt a range of livelihood activities and learn skills that are used to mitigate the impacts of climate-related hazards and enhance adaptive capacity. Public adaptation strategies—such as provision of wells, boreholes, road infrastructure, processing equipment, land tenure administration reform, and educational campaigns on climate-related risks—should be aimed at the poorest and most vulnerable groups.

Role of Formal and Informal Institutions

Both formal and informal institutions have an important role in mitigating climate change and enhancing the adaptive capacity of communities. Social services are important in determining the internal resistance of communities to climate hazards. There is poor provision of education, health, infrastructure, and aid response in all the communities. Indirect impacts of climate change—such as diseases and polluted water—are difficult to handle in district hospitals, while the village water committees whose manpower, equipment, and financial requirements are hardly met cannot provide adequate and safe water. The poor subscription

rates to the national health insurance by rural agriculturalists is a major problem. Given the fact that both NGOs and state institutions are cash-strapped, the best way of making these institutions useful in building the adaptive capacity of communities would be to collaborate and integrate their functions rather than the ad hoc and piecemeal services they currently provide. Also, formal institutions need to work with informal institutions, which mostly regulate landed property. Here the role of education and persuasion is important. Modernization has led to the perversion of most informal traditional institutions that need correction. Moral persuasion is important in this regard, but it should be done without incurring the displeasure of the powerful in society, who can subvert institutions to the disadvantage of the poor.

External Influences: Market Integration and Policy Regimes

The degree of vulnerability of the communities isn't just related to their internal inadequacies, but also to the external political, social, and economic systems at the regional, national, and global levels. The biophysical environment alone does not define the vulnerability of people since they are not insulated from the effects of globalization and policies that affect services. The dependence on the market for selling their products and procuring basic necessities of life defines the livelihood outcomes even after nature has awarded them with their harvest. In addition, the ability to diversify into non-farm activities depends on macroeconomic policy. Ghana's neo-liberal regime has imposed hardships on the agricultural population and opened up new opportunities in informal sector activities. Even in rural areas, the informal trade sector is making significant contributions to the lives of women. The external dependence of the country on global networks of trade obviously has its own set of drawbacks, as seen with the recent food price hikes that reduced many poor urban households into structural poverty. Market integration is not necessarily bad, as seen by the emphasis on cocoa production that lifted many families in the forest out of poverty. This example points to the fact that programs directed at a wider agricultural rejuvenation and the non-farm sector would increase the adaptive capacity of rural Ghana, which currently bears the brunt of policy regimes.

5. PARTICIPATORY SCENARIO DEVELOPMENT (PSD) WORKSHOP RESULTS

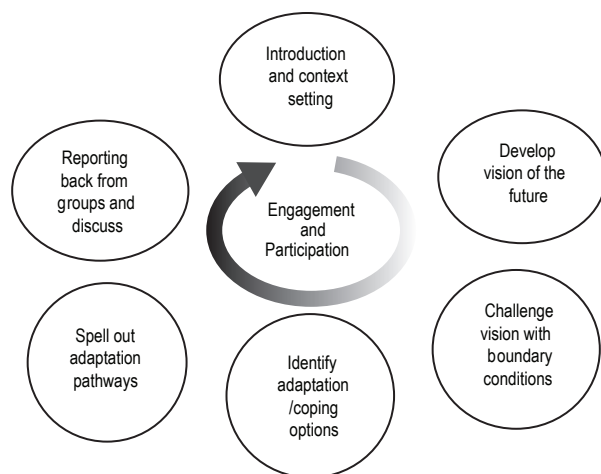
PSD WORKSHOPS: DESIGN OVERVIEW

An important aspect of this applied research program is to determine how different groups of stakeholders view the range of possible adaptation options open to them, and what forms of public policy or investment support are needed to facilitate effective autonomous adaptation. To facilitate this, participatory scenario development (PSD) workshops were designed for multiple stakeholders, including local experts and representatives of social groups particularly vulnerable to the consequences of climate change. The workshops provided a participatory forum for “future visioning” and then mapping out alternative, robust adaptation pathways that combine a variety of adaptation options in plausible sequences. Each of these alternative pathways, in turn, is likely to have different implications both for the overall costs of adaptation and for the distribution of costs and benefits among groups within society. The PSD Workshop Design followed a series of steps as illustrated in Figure 3. Each new session was preceded by a presentation by the facilitator in order to put the exercise into perspective. The PSD workshops were organized at two levels, namely national and regional (zone) levels. Based on lessons from the first national-level workshop with regard to time constraints, both the regional and the second national PSD workshops were redesigned for one-and-a-half days instead of the initial one day (Appendix 8). The second national workshop saw a

revised workshop structure that incorporated results from the previous ones. In each of these workshops, day 1 started by outlining the key elements and the objectives of the workshop to the participants. Three of the exercises—developing a vision of the future, subjecting the vision to climate and socioeconomic impacts, and identifying adaptation options—were done on day 1. On the second day, participants outlined adaptation pathways and prioritized them in terms of short, medium and long terms.

In the national workshops, participants were divided into groups based on their interests and knowledge of

FIGURE 3. KEY ELEMENTS OF PSD WORKSHOP DESIGN



the zones—namely the northern savannah zone, the transition zone, the forest zone, and the coastal savannah zone—with the help of facilitators. In the regional workshops, each group was constituted such that it represented the diverse stakeholders who were in attendance. The stakeholders at the regional workshops included livelihood groups, mainly comprising farmers and fishermen, officials from local government institutions, and civil society groups. Participants were encouraged to vision along the identified themes and any others they deemed important to their zones, such as energy, education, health, land management, local governance, food security, and social cohesion.

Before discussions by participants, there were presentations on current climate change challenges and their impacts and existing adaptations in Ghana. Participants produced their visions and subjected these to climate and other socioeconomic impacts. The essence here was to estimate the extent to which identified impacts will inhibit the smooth attainment of the visions. The groups then identified adaptation options that will mitigate the adverse impacts of climate change, focusing on vulnerable groups. Clusters of adaptation options were developed into adaptation pathways prioritized into short (2010–15), medium (2015–30), and long-term (year 2030–50) periods. This final exercise took the participants into plenary, where each group reported back on their findings, thus concluding the workshop.

OVERVIEW OF RESULTS FROM LOCAL AND NATIONAL WORKSHOPS

This section combines the outcomes of two national PSD workshops completed in Accra in June and October (Bizikova and Baily 2009), plus the outcomes of three regional PSD workshops completed in September (Ahiabile and Salam 2009). We first present the current direct and indirect challenges created by climate change and variability, then we provide the visions for each zone and the nation as a whole, and finally the climate and other related threats to achieving this vision as perceived by the participants.

Overview of the Current Situation

Understanding the current situation and current challenges the different sociogeographic zones in Ghana are

facing is important for planning future development and designing policies for building adaptive capacity and identifying potential future challenges. Table 7 outlines the issues and challenges of three sociogeographic zones as identified during the regional workshops. The following summary details the areas of concern:

- Rapid depletion of natural resources, especially rivers, forest, and land.
- Increased number and severity of disasters in the last decade (droughts and floods).
- Significant erosion, especially in the coastal areas, which has impacts on cultivated land, housing, and infrastructure.
- Increased incidence of diseases such as sexually transmitted diseases, malaria, and other waterborne diseases coupled with limited health care services.
- Loss of soil fertility as a result of overuse and unsustainable agricultural practices.
- Increasing vulnerability of livelihoods that rely heavily on the environment; for example, agriculture is highly sensitive to fluctuations in temperature and rainfall, especially subsistence and rainfed agriculture.
- Trees are being cut indiscriminately, leading to negative impacts on local livelihoods and biodiversity, as well as exacerbating the effects of drought, erosion, and bush fires.
- Rapid and uncoordinated urbanization.
- Increasing rates of migration – lack of basic services, income poverty, unemployment, underemployment, and limited access to resources, including food, water, and shelter.

The major groups that are impacted by the identified development challenges—and who are also sensitive to impacts and /or that have low capacities to respond to changes—included food-crop farmers, especially in rain-fed areas; fisherfolk; people in flood-prone areas; and migrants, mostly living in slums of greater Accra. Participants also identified groups considered vulnerable because of their social situation, regardless of impacts of changing climate, including widows, the handicapped, women who don't own land, and people living in places with weak social networks and conflict-prone zones, especially in the northern regions.

TABLE 7. OVERVIEW OF CURRENT SOCIOECONOMIC ISSUES IN THREE SOCIOGEOGRAPHIC ZONES IN GHANA

<i>Transition Zone</i>	<i>Coastal Zone</i>	<i>Savannah Zone</i>
<ul style="list-style-type: none"> • Rapid and massive depletion of natural resources, especially forests, rivers, and land • The existence and practice of old methods of farming among some farmers • Disasters over the last 10 years have increased, with more severity • Unequal resource distribution between the urban and the rural centers, resulting in increased rural-urban migration, child trafficking • Unplanned urban cities and towns • Overreliance and overexploitation of forest resources, resulting in the rapidly accelerating loss of plant and animal species • The bondage between man and the environment that existed long ago is broken, as people now have little or no passion for the environment 	<ul style="list-style-type: none"> • There is a decrease in fishing stock in the sea as fishermen continuously experience decreasing harvest • Massive coastal erosion has taken away most of the land and coastal communities; this has also resulted in a reduction in coconut stock along the coast, which is a major livelihood resource • Massive sea and river pollution as a result of lack of toilet facilities within households and inadequate sanitation facilities within communities • There is evidence of malnutrition among children along the coast as a greater proportion of the fish is sold to raise money, with very little reserved for families • Incidence of disease—such as sexually transmitted diseases and other weather-related diseases such as malaria and other water borne diseases—has increased • Increase in pockets of poverty • Increase in natural resource livelihood-dependant activity 	<ul style="list-style-type: none"> • Increase in population size resulting in slums • Erratic weather condition • Droughts, floods, and other weather-related shocks/disasters has increased • Increase in the length of the hunger gap. • Migration has taken a different dimension with women migrating more than men; there is also an increase in child migration and child trafficking • Agricultural farm lands becoming poorer in nutrients as a result of overuse of farm land without replenishing lost nutrients • Drastic reduction in vegetation cover • Pressure on land has resulted in people shifting to lands not demarcated for agricultural purposes for crop cultivation • Loss of agricultural lands for massive construction and mining projects • Diversion of food crop lands into cultivation of crops such as jatropa, which is threatening food security

Source: Regional/Zone PSD Workshop (2009)

The results indicate serious direct and indirect climatic threats to livelihoods in all sociogeographic zones and impacts on the general development of the nation as a whole. The burdens of these emerging and intensifying threats are disproportionately distributed depending on the level of sensitivity and resilience of different occupational, social, and gender groups, as shown in the last section.

Future Development Priorities

Based on the current climate challenges enumerated above, the participants defined the visions and goals for the future based on a realistic assessment of the strengths, potentials, and weaknesses/threats present. When identifying adaptation options, it is important to consider future development priorities in order to explore synergies between responses to climate change and the desired development pathway. To better understand long-term development priorities, the first activity was focused on creating a desired development pathway for each zone. During the development of the future vision in both the national and regional-level

workshops, participants were encouraged to focus on vulnerable people. The identified future priorities included improvements in resilience among the poor by improving basic living conditions such as improved access to health care and health insurance, safe water, and affordable energy.

The participants anticipated increased competition over different types of land uses between agriculture and forestry, specialization in planted species, and increases in farm sizes. Further, not only changes in agricultural production and infrastructure development were important elements of future visions, but also changes in land, water, and natural resource management and governance systems. This included sustainable land use management for diverse purposes such as mining, logging, agriculture, secure tenure, and democratic control of land, including gender balance in access to power and resources. Strengthening democratic governance and access to resources, supported with capacity building and training activities, were recognized as key elements for exploring future opportunities outlined in the visions.

TABLE 8. FUTURE VISIONS FOR EACH ZONE FROM NATIONAL WORKSHOP

Sector	National			
	Forest	Transition	Northern	Coastal
Livelihood	<ul style="list-style-type: none"> Better food security 	<ul style="list-style-type: none"> Improved access to support systems 	<ul style="list-style-type: none"> Increased specialization in farming (rice and maize) Increased access to market 	<ul style="list-style-type: none"> Alternative livelihoods for fisheries Adaptation of new technologies in relevant sectors, including fishing
Land and Water management	<ul style="list-style-type: none"> Sustainable land-use management (mining, logging, agriculture) Secure tenure Social and democratic control of land Integrated water resource management 	<ul style="list-style-type: none"> Increased efficiency of water resource use Increase in timber plantations and less deforestation 	<ul style="list-style-type: none"> More irrigation basin development Sustainable water resource management Intensified livestock production 	<ul style="list-style-type: none"> Enhanced irrigation through water harvesting Gender balance in access to resources
Governance, institutions, and participation	<ul style="list-style-type: none"> Strong intersectoral linkages and coordination Incentives and alternatives for behavioral change 	<ul style="list-style-type: none"> Increased capacity of technocrats and experts More balanced development (urban and rural) to avoid increased urbanization 	<ul style="list-style-type: none"> Savannah accelerated development authority persists Urbanization – growth centers in region Public transfers to poor via safety nets 	<ul style="list-style-type: none"> Education and capacity building to create relevant skilled labor to fit the job market Development of efficient early warning system

Sources: PSD II (2009).

Table 8 presents the future visions for the different zones elicited during the national workshops. Specific priorities identified for each zone included issues focused on agricultural development, such as maintaining current-level production using organic practices and increasing farm sizes in the transition and northern savannah zones. In the forest zone, the importance of biodiversity protection was identified along with support for improved land management practices. The need to manage migration was a key concern to both sending and receiving areas. Sending areas want the deprivation that pushes people to migrate to be addressed, while receiving areas called for both a reduction in migration and provision of infrastructure and improvement of livelihood conditions. Also, improving the conditions of women's livelihoods was a key focus considered to have multiple benefits for general development in all sectors.

Table 9 summarizes key elements of the future visions showing multiple desires that are best achieved by improvement in livelihoods, land and water management, and improving governance and institutional structures. Improving the livelihoods of households

using the resources and opportunities in each zone is key to achieving the millennium development goals and ensuring environmental sustainability. Improved livelihood well-being is directly related to efficient management of land and water resources, which are threatened by climate change and variability. In order to achieve sustainable livelihoods, the governance of natural resources is of prime importance. These need to be addressed by both traditional and state institutions responsible for the management of political, social, and economic spheres of society.

Current and future impacts of changing climate and variability

In general, climate impacts in Ghana will differ from the northern savannah zone to the coastal areas in the south.

The northern savannah zone is expected to be mostly affected by the increased occurrence of drought. Similarly, the rest of the country is expected to experience increased variability of precipitation and hotter

TABLE 9. KEY ELEMENTS OF THE FUTURE VISIONS FOR GHANA

<i>Issues/sectors</i>	<i>National priorities</i>
Livelihood	<ul style="list-style-type: none"> • Improved safe water supply • Access to credit • Improved access to basic services including health care and school • Access to clean affordable energy • Reduced outmigration to south
Land and Water management	<ul style="list-style-type: none"> • Maintain land for agriculture • Biodiversity conservation • Reduced rate of deforestation • Sustainable water resource management • Community-based land management systems and secure tenure
Governance, Institutions, and participation	<ul style="list-style-type: none"> • Planned urban development • More balanced development (urban and rural) to avoid increased urbanization • Balanced land management for different purposes (mining, logging, agriculture) • Strong intersectoral linkages and coordination • Incentives and alternatives for behavioral change • Education and capacity-building to create relevant skilled labor to fit the job market • Development of efficient early warning system

Source: Regional/Zone PSD Workshop & PSD II (2009)

temperatures. Most of the coastal regions are susceptible to tidal flooding and sea erosion. Table 10 outlines major climatic impacts by zones in Ghana. The indirect effects of climate change are enormous in all zones. Of immediate concern is the migration triggered by climate change. This reduces land pressure in northern Ghana and increases production pressure in the transition and forest and coastal urban areas, with consequences such as land tenure conflicts, resource degradation, and slum development.

Based on these impacts, participants identified a number of specific climatic impacts that could affect the

attainability of future visions (including available resources) and create further stress, especially on already fragile natural and human systems. Major impacts include decreases in yields and fluctuation in crop production, increased risk due to agricultural specialization, decreases in fish productivity and species disappearance, and increased soil degradation. Groups highlighted increases in vulnerability of the poor due to climate change caused, for example, by decreased water availability and quality, which would create a burden on women, increase the occurrence of diseases and related mortality, decrease food and income security, and threaten livelihoods dependent on forestry and fishing.

TABLE 10. MAJOR PAST/PROJECTED CLIMATIC IMPACTS BY ZONES IN GHANA

<i>Zones</i>	<i>Major Climate Change Impacts</i>
Northern Savannah	Increased occurrence of drought Less rain, and also highly variable precipitation often causing flooding of communities in river basins Consider also significant increase in wind speed potentially causing health problems (dust)
Transitional	Decreasing amount and increasing variations in rainfall and increasing temperature Consider forest and land degradation because of climate change impacts
Forest	Decreasing rainfall and increased variability of precipitation on food and exports crops High humidity and high temperatures that will be harmful to agriculture and sectors Consider migration from other zones
Coastal Savannah	Dry climate with increasing rainfall variability and hotter temperatures Sea erosion and tidal flooding Consider these impacts on poor people (in slums)

Source: PSD I (2009).

Finally, migration and increasing social tensions were identified as potential social impacts of climate change, especially in the coastal savannah, northern savannah, and transition zones.

Table 11 also shows the main key impacts identified by participants based on the provided information about future climate projections and observed trends. Basically, all impacts are perceived as negative with consequences such as reduction in human welfare and environmental sustainability. Reduced water stress is the pivotal challenge around which all other impacts emanate. It affects agriculture; water availability to domestic, energy, and industry sectors; floristic life; temperatures; and eventually the decision to migrate.

According to the participants, these impacts are felt most by subsistence farmers planting mostly cassava and plantain, and to some extent cash crop farmers growing cocoa and coffee. Farmers practicing monoculture (which seems to be the current trend for cash crops) have their production levels and profits in jeopardy due to climate variability. There is a reduction in interest in agriculture among youths, which has led to migration becoming a cross-cutting issue affecting all agroecological zones, with significant consequences for the receiving areas in urban and agricultural frontier zones.

Migration leads to the increasing concentration of populations in slums, potentially causing further vulnerabilities; increasing incidences of diseases; unemployment; limited availability and access to basic services; increased pressure on infrastructure; and finally, loss of labor in the out-migration areas. In addition, surplus labor in receiving areas has led to exploitation and increased involvement of children in productive activities

Climate change impacts are often enhanced by lack of proper infrastructure, leading to increasing incidence of vector diseases, especially malaria, which affects productivity of people in the suburbs of Accra. In the rest of the country, flooding could lead to loss of infrastructure such as roads, irrigation systems, and human settlements. Floods could also have negative impacts on crop production and livestock, causing negative impacts on food security.

Some impacts are unique to each geographical zone due to their different physical and socioeconomic characteristics. Climate change impacts and consequences are directly linked to unique geographical conditions, specific social vulnerabilities, and to specific sectors. Serious impacts were indentified in urban and peri-urban areas in Greater Accra in the coastal zone,

TABLE 11. AREAS OF HIGH IMPACTS AND THEIR CONSEQUENCES

<i>Key impacts</i>	<i>Consequences of these impacts</i>
Reduced water availability and droughts	<ul style="list-style-type: none"> • Fluctuation in cereal and root crop outputs (cassava, plantain and cash crops: cocoa and coffee) leading to less revenue, less food for storage, malnutrition, food insecurity, and migration • Migration – increased population in slums, pressure on infrastructure, social services, loss of labor in the out-migration areas
Soil degradation	<ul style="list-style-type: none"> • Loss of land for crop cultivation and reduction of soil fertility and crop yields
Wild fires	<ul style="list-style-type: none"> • Forest degradation, loss of biodiversity, loss of property, GHG emissions; could be worsened by, or caused by, charcoal burning, high biomass, and construction
Flood	<ul style="list-style-type: none"> • Settlements and farm land and crop production are affected • Reduced access to markets – no way of getting the products to market, loss of revenues, farmers are discouraged subsequently, increased poverty
Coastal Erosion	<ul style="list-style-type: none"> • Salinization, land degradation, loss of settlements and agricultural land for production; impacts on coastal areas with higher population densities
Occurrence of Diseases	<ul style="list-style-type: none"> • Spread of diseases such as cholera, malaria, guinea worm, diarrhea leading to loss of man-hours, stress on health facilities, and economy as whole • Livestock diseases and pests
Changes in fish availability	<ul style="list-style-type: none"> • Reduced fish catch, changes in fish species, undermining of livelihoods of fisherfolk

Source: PSDII (2009)

especially for areas such as coastal flooding and erosion, soil salinization, saltwater intrusion to freshwater, and loss of settlements. These are associated with potential increases in disease and food insecurity, related to increasing migration and the growing concentration of people in poor living conditions.

Impacts of climate change on agricultural production and water availability with direct consequences on food security were listed for both the northern savannah and the transition zones. Increasing food insecurity is also attributed to increasing soil exploitation, poor farming practices, limited food storage, and food processing opportunities. Also, the potential impact of climate change on fish populations was identified as significant in the transition zone among fishing communities, where most of the local fishermen have limited access to other sources of income.

The above threats from climate change and variability, and also from the vulnerability of the zones, present challenges to achieving the visions. In order to achieve the visions, considerable efforts need to be put in place to reduce the impacts or internalize the externality through adaptation and mitigation strategies.

Range of Stakeholders and Key Preference Criteria for Options

In the national workshops, participants came from government sector ministries, educational and research institutions, and civil society groups. The regional workshops were composed of stakeholders from different livelihood groups, mainly comprising farmers and fishermen, officials from local government institutions, and environment and water-related civil society groups.

During the final stages of the workshop, there was a brief discussion about the key criteria that need to be applied to choose and prioritize adaptation options. The participants identified the following list of criteria:

- Options create other benefits on people's lives, especially poverty reduction.
- Feasibility of the options, including availability of needed human resources.
- Options promote sustainable practices.

- Options are familiar, because they build on past experiences.
- There is political will and leadership to support the options.
- Costs of doing nothing and experiencing impacts are higher than costs of adaptation.

At both the regional and national levels, the need to improve well-being for the current generation and those of the future underlie the different adaptation options presented for adoption and support. Trade-offs between different options depended on vulnerability conditions of zone and individuals and the output/outcomes of the adaptation option. People would choose options that their resource entitlements allow, while at the same time examining those with optimum benefits. Also, adaptation options are laden with conflicts as the deployment of any action can increase the threats or impacts in other sectors or experienced by other people. A place-based analysis of the impact of adaptation options become an important criteria. Participants were particularly concerned by the use of migration as an option which ends up creating further threats in both sending and receiving areas.

ADAPTATION OPTIONS: KEY SECTORAL THEMES

General Adaptation Options

Adaptation entails a process by which measures and behaviors to prevent, moderate, cope with, and take advantage of the consequences of climate events are planned, enhanced, developed, and implemented (UNDP 2005; IPCC 2001). Building on the identified future visions and impacts of climate change, the groups identified and characterized adaptation options for each zone based on existing and proactive measures. They distinguished between overall changes and restructuring in the sectors toward sustainability and specific measures to improve the situation of vulnerable people. Participants identified changes in the farming systems that included changes in planted species (choosing early-maturing, drought-resistant crops and trees), crop diversification, and adoption of new technologies as existing and effective options needed in farming zones. Identified changes in agriculture are reflections of impacts of climate change on water availability and soil

degradation. Participants suggested improving irrigation infrastructure, especially with a focus on diversified water storage and small-scale irrigation systems, as well as increases in water efficiency, rainwater harvesting, and groundwater recharge. This would also require improvements in infrastructure planning and development in areas such as transportation to ensure market access.

Moving beyond specific adaptation actions in agriculture and irrigation, the participants expressed the need for changes in water and land governance. This would require moving toward more integrated watershed-based management of water resources. The participants were also concerned with negative impacts of current land tenure on capacities for adaptation. They suggested that as a precondition for increasing capacities for adaptation, secure land tenure and community-based land administration systems (democratic control) should be put in place. Finally, identified responses to climate change were also focused on improving the situation of poor people (see Table 12). Furthermore, they also emphasized the need for assistance in developing alternative and additional livelihood

opportunities and skills training, especially for people depending on fisheries and agricultural production who will diversify in the near future. The suggested adaptation options reflect the importance of a holistic adaptation strategy.

Social Services: Health and Education

There is a connection between production-related vulnerability due to climate and other environmental threats to the inability of the poor to access health, education, and other social services. The other side of the equation is the poor, inadequate, and expensive services provided by the state. Poor output by a farmer implies poor nutrition and exposure to malnutrition, which translates into low income that is incapable of paying for health and education. Inability to access these services produces negative feedbacks to adaptive capacity. The stress on health and education is seen in Table 13, which sequences adaptation measures from the short term to the long term. Participants considered options such as social protection, social services, and safety nets as high-cost options exceeding resources available in current budgets in all analyzed zones.

TABLE 12. KEY CLIMATIC IMPACTS AND ADAPTATION ACTIONS FOCUSED ON POTENTIALLY VULNERABLE GROUPS

<i>Zone</i>	<i>Climate Impacts</i>	<i>Adaptation Options</i>
Northern Savannah	<ul style="list-style-type: none"> • Increased morbidity and disease prevalence • Increased vulnerability of the poor • Increased outmigration loss of human capital 	<ul style="list-style-type: none"> • Strengthening traditional social security support systems • Strengthening public healthcare delivery and preventive care • Targeted social transfers and safety nets • Increased investment in urban social services and infrastructure
Transition	<ul style="list-style-type: none"> • Increased demand – water, energy and basic services • Decreased income security for people in fish industry • Increased outmigration • Increased food insecurity • Threats to forest-based livelihood • Potential conflicts and social tensions 	<ul style="list-style-type: none"> • Public-private partnership in service provision • Increased capacity building for experts and technocrats • Develop early warning systems and awareness raising • Promotion of conflict management mechanisms • Provision of social safety nets for communities and migrants • Develop alternative and additional livelihoods
Forest	<ul style="list-style-type: none"> • Decreased food security • Pressure on land 	<ul style="list-style-type: none"> • Improvement of social services to poor people • Security of tenure • Community-based land administration system
Coastal Savannah	<ul style="list-style-type: none"> • Decreased water availability and quality • Higher burden on women • Increased migration • Increased measles • Increased cholera 	<ul style="list-style-type: none"> • Recycling and total rain water harvesting • Improvement in formal and informal safety net • Social protection for immigrants • Skills training • Economic diversification in secondary towns • Increased accessibility of health care • Education and awareness rising-health issues

Sources: PSD II (2009).

TABLE 13. ADAPTATION RESPONSES—SOCIAL: HEALTH SERVICES AND EDUCATION

<i>Current issues</i>	<i>Short-term 2010–15</i>	<i>Medium-term 2015–30</i>	<i>Long-term 2030–50</i>
Limited social Services	Improvement in health services	Including migrants in the social safety nets	Further development of social policies
Limited access to health services	Supporting social nets	Services for resettled displaced people	Safety nets for communities and immigrants
Increasing concentration of people in urban areas	Supporting social nets Programs for areas of outmigration	Alternative skill training for migrants	Managing social tensions and conflicts Education and skill training development

Source: PSD II (2009).

However, these are necessary to rid the current structural vulnerability in which many rural farmers and urban poor find themselves.

Water Management, Agriculture, and Social Security

The improvement in governance of water resources by moving toward sustainable and integrated management of water resources is strongly linked to agricultural production and other measures dealing with livelihood improvements. The overall improvements in the enforcement of laws and regulations, increasing skills and capacities of personnel, and incentive/payment options for environmental services are important measures to combat climate change threats. This would

require decentralization of government authority, strengthening of civil society, engaging traditional authorities in planning, and building on existing platforms for community engagement.

Table 14 shows the importance of water management, modernization of agriculture, managed migration, and social safety nets as adaptation options in improving livelihoods across the board. The role of research institutions is important as they need to come out with socially and economically appropriate designs, methods, inputs, and evaluation and monitoring systems to enable adaptation in each sector that eliminates adaptation deficits and ensures win-win scenarios.

TABLE 14. ADAPTATION RESPONSES: WATER MANAGEMENT, AGRICULTURE, AND SOCIAL SECURITY

<i>Current actions</i>	<i>Short-term 2010–15</i>	<i>Medium-term 2015–30</i>	<i>Long-term 2030–50</i>
Local water harvesting	Increasing the extent of current programs on water harvesting		
Programs of water harvesting are already a priority	Small-scale water harvesting programs (household community)	Rainwater harvesting (run off capture) and building dams	Flood proof roads and railways to ensure market access for the products
Changes in planted crops		Building dams for irrigation (small scale community management dams)	Market research and product development support
Migration to urban areas	Post Harvest management (Silos, food banks, training to learn ways processing)	Social safety nets and food banks to elevate significant impacts on food production	Developing crops and livestock that are pest and drought resistant, early yielding and culturally acceptable
	Access to microcredit		
	Land-tenure security (including access to land for women)		

Source: PSD II (2009).

ADAPTATION PATHWAYS

Sequencing and Leveraging among Options

With regard to sequencing adaptation pathways (See Tables 13 and 14 above), developing and strengthening early warning systems, climate education and advocacy, and capacity building for government officials and technocrats were identified as short-term actions. In agriculture and fisheries, the short-term activities included promoting changes in agriculture to plant drought-resistant species and assistance for changes in fisheries sectors that will be significantly impacted in the future. Actions that could improve social safety nets and health extensions were identified as short-term actions in the coastal savannah zone. For the forest zone, ensuring democratic control over land and secure land tenure were identified as major short-term priorities.

Adaptation options that were identified over medium-term time horizons included actions needed to move toward changes in agricultural production, including enrichment planting and promoting activities that create added value and improved agricultural processing; support for innovative technologies; and strategic reserves development and the introduction

of sustainable and integrated resource management practices, such as integrated soil and water resource management. These actions also include development of needed capacities and training activities.

Finally, moving toward sustainable and integrated resources management and improving social policies and protections are the key suggested actions for the longer time frame after 2020. Social policies include both improving the status of the local communities and also addressing the potentially growing number of immigrants between zones in the country and probably from other countries as well.

In the short term, low-cost adaptation options involving building on existing best practices in each ecological zone is the norm (Table 15).

However, high-cost measures are recommended for the coastal zone since the severity of impacts there demand more “hard” adaptation measures, which are usually expensive. In the medium term, the progress in institutional integration would enable a wider reach and consolidation of efforts. Hopefully, the initial individual short-term proactive adaptations would build individual capacities and enable organizations promoting

TABLE 15. OVERVIEW OF ADAPTATION PATHWAYS FOR GHANA BY TIME HORIZON AND BY ZONE

<i>Time horizon</i>	<i>Northern Savannah</i>	<i>Transition</i>	<i>Forest</i>	<i>Coastal Savannah</i>
2009–2012 short-term actions	<ul style="list-style-type: none"> • Early warning systems • Agricultural diversification: research, promotion, adoption 	<ul style="list-style-type: none"> • Education • Early warning systems • Awareness raising • Capacity building for technocrats 	<ul style="list-style-type: none"> • Security of tenure • Drought-resistant crops and trees 	<ul style="list-style-type: none"> • Safety nets • Health extensions • Fishery assistance • Revising and adapting fishery regulation • Adaptive technology and services
2012–2020	<ul style="list-style-type: none"> • Strategic reserves development • Strengthening the National Disaster Management Organisation NADMO • Social services 	<ul style="list-style-type: none"> • Investment and promotion of innovative technologies • Integrated water resource management, small-scale irrigation 	<ul style="list-style-type: none"> • Enrichment; Planting • Added value and improved agricultural processing 	<ul style="list-style-type: none"> • Recycling and improved water catching • Training off-farm employment • Integrated soil and water management
2020–2030–2050	<ul style="list-style-type: none"> • Social protection • Water resource management, including diversification 	<ul style="list-style-type: none"> • Sustainable land management • Social policies – safety nets for communities and immigrants, managing social tensions and conflicts 	<ul style="list-style-type: none"> • Integrated water resource management, small-scale irrigation 	

Source: PSD I (2009).

innovations to modernize agriculture, improve water collection, provide social services, and implement workable insurance schemes. In the medium term, it is anticipated the initial focus on reducing structural vulnerability would reduce the number of the vulnerable and enable organizations such as NADMO to specifically target the most vulnerable with programs that build resilience. Most infrastructural developments are anticipated to be consolidated in the medium term to long term, focusing on social services, productive infrastructure such as irrigation and roads, and flood control structures.

Interventions to catalyze effective adaptation are important at multiple levels (termed points of leverage), which exists at the household, community, and sociogeographic zone levels. At the household level, individuals need capacity building through education, sensitization, and demonstration programs. They also need enabling institutions—both traditional and formal—and infrastructure to sustain the livelihood activities within which adaptation strategies are implemented. At the community level there is the need to strengthen and put in new institutions to provide financing, enable access to land, spawn a local processing industrialization or canoe/boat repair, and provide and maintain socioeconomic infrastructure. The sociogeographic zone level is important because a common policy framework would apply to a larger area and can be sustained by the national government and external financing such as is suggested for the Savannah Accelerated Development Authority for the northern savannah zone. Specific research is needed on improved crops and farming practices, as well as investments in appropriate technology development in terms of climate-proof roads, bridges, adapted machinery, markets, banking and credit systems, and policies that enable people to commute or migrate. These potential points of intervention may allow effective action to be initiated at highly localized levels while also encouraging macro level processes to guide the process in a decentralized framework, thereby obviating the delays and red tape associated with current systems of governance.

Synergies and Trade-offs among Options

The key adaptation priorities identified for the different zones have synergistic relationships. However,

some strategies will require trade-offs due to cost implications and conflicts. We consider the key ones identified above.

The construction of roads ensures market access and opening up of areas for effective resource management. This is regarded as an important action that would have growing significance over time on livelihoods, though a very costly option. Roads reduce the cost of production, eliminate locational exclusion, and increase accessibility to social services and provision of relief during disasters. However, the construction of roads result in opening up protected natural resources to exploitation, which may reduce mitigation strategies. This dilemma has to be carefully managed, as sustainable livelihoods are achieved only under good governance of resources.

Irrigation and improvement in modern farming techniques will make water readily available for domestic and industrial uses and greatly improve the livelihoods of the poor, provided institutions allow them access. Irrigation systems over the past have been associated with negative consequences such as flooding of hitherto rich valleys, salinization, use of chemicals, and deprivation of communities that live downstream. What alternatives would be provided for communities downstream? This is where boreholes become important, and therefore suggest different adaptation strategies for achieving the same sectoral goal in different communities.

Effective early warning systems have growing importance over time. This would require investing in technology for the meteorological offices and other monitoring agencies, supporting extension services (health and agriculture), and investing in ways of disseminating the information. In the short term, early warning systems are important for the agricultural regions and areas currently experiencing floods and droughts, especially in the northern savannah and the transition zones. Effective monitoring and evaluation of programs are also premised on good early warning systems, which in turn emanate from these monitoring systems.

Options such as social protection, social services, and safety nets are important in improving the situation of vulnerable groups. These actions were identified as

high-cost options exceeding resources currently available. Participants envisioned gradual investments into social and health services and safety nets with stronger emphasis over longer time horizons by adding migrants and potentially displaced people to the systems over time. This slow progressive approach will sustain vulnerability of many even into the long term. A robust pathway is one that combines options best suited in optimizing resources in each geographical zone, while enabling many to partake in its benefits. As suggested for the forest zone, without addressing the land tenure issues that define resource access, social safety nets might reduce the capacity to engage in long-term proactive initiatives.

Improved governance of water and land over the medium and long term was identified as a necessary precondition for effective management of investments—including infrastructure, dams, and dykes—and also for the success of community-based activities. Who should be responsible for managing the envisaged infrastructure and resources? The tension between sectoral and district level remains to be solved, just as that between the district level and local authorities and civil society groups. Participation is needed for effective governance and coordination of actions. Strengthened civil society, using decentralized structures, engaging traditional authorities in planning, and using existing platforms for community engagement were identified as crucial for addressing governance issues. These included improving the security of land tenure, regulation enforcement, increasing the capacity and awareness of personnel implementing policies and carrying out monitoring, providing alternatives and reward systems for people rather than only restricting resource use.

In order to be effective in responding to climate change and in fulfilling future development priorities, not only identifying adaptation actions are needed, but we need to examine key issues and challenges for their implementation. The participants listed the following challenges as major barriers for promoting adaptation options:

- Political will and vested interests
- Availability of funds
- Institutional capacity

- Inter-institutional coordination
- Poor prioritization by government
- Poor research and development
- Poor market potential for new technologies
- Poor enforcement of regulations

RELATIVE PREVALENCE OF “HARD” VERSUS “SOFT” ADAPTATION OPTIONS

“Hard” adaptation measures usually imply the use of specific technologies and actions involving capital goods, such as dikes, seawalls and reinforced buildings, whereas “soft” adaptation measures focus on information, capacity building, policy and strategy development, and institutional arrangements. Hard adaptation options are relatively more expensive to execute than soft adaptations. In addition, hard adaptations are inflexible, while soft adaptations are more dynamic as they change with the nature of the impending threat and the internal characteristics of the adapter.

At both the local and national levels there is a stress on a mixture of both hard and soft adaptation measures. Soft adaptation measures dominate the short-term suggestions, while hard adaptation measures are suggested for medium and long term in all zones except for the coastal fishing community. The farming communities want to have irrigation systems in place in the medium term after pertinent issues such as land tenure, input supply, and improved seeds and extension services have been provided in the short term. The long term has a combination of both measures, since the initial two phases would have stabilized the local and macro socioeconomic context. In providing social services, both measures are needed, but there is a chicken-and-egg argument as to which one comes first—hospitals and schools versus human resources and institutional regulations. Some hard adaptation measures require first soft measures such as knowledge on erosion control for farmers to enable them to implement hard measures such as soil and water conservation strategies. To improve water availability, participants suggested rainwater conservation and also building dams to have more water available for irrigation. They also stressed that small-scale dams with completed environmental impact assessments should be supported. To reduce negative consequences of severe climate impacts on food production, building grain silos and

small agro-processing facilities for conservation of food surpluses and for help in maintaining food security were suggested. Participants also suggested changes in planted species to move toward drought-resistant and early maturing crops, changes in farming practices by promoting sustainable agriculture, and organic farming to limit further soil depletion. Actions are also needed to improve capacities of farmers and their families to engage in market activities in selling their products, as well as improving entrepreneurial skills to generate non-farm income. This could lead to increasing levels of self-employment, especially in food processing, thereby increasing household income. There is also a need to develop extension services for information

dissemination and skill development on issues such as water harvesting, suitability of planted species, post-harvest techniques, and loan and microcredit information.

Tables 16 and 17 both show the predominance of hard versus soft adaptation measures. There is a relative predominance of hard versus soft adaptation measures because of the low investments in social and economic investments over the years, which have led to an adaptation deficit in infrastructural developments. The high cost of these investments would require substantial external support in order to reduce the adaptation deficit.

TABLE 16. IMPACTS AND IDENTIFIED HARD AND SOFT ADAPTATION MEASURES (AGRICULTURE & WATER)

<i>Key impacts</i>	<i>Hard measures</i>	<i>Soft measures</i>
Reduced water Availability Droughts Soil degradation Erosion	<ul style="list-style-type: none"> • Erosion control by encouraging contour farming • Irrigation facilities: dams and wells • Improved post harvest technologies: grain silos and small-scale agro processing industries • Promoting sustainable agriculture: compost manure production and biogas plants • Drought-resistant and early maturing crops • Water collection facilities for households • Artificial fertilizer usage 	<ul style="list-style-type: none"> • Sustainable water management • Farmers' education—water harvesting and contour farming • Microfinance • Skills for off-farming season activities • Vocational training—especially for youth, in places with high in-migration • Creation of markets and training in other sector skills, including hairdressing, sewing, carpentry • Developing agricultural extension services • Intensify education on water harvesting • Funding and more research for improved varieties • Integrated decentralized resource governance systems

Source: Regional/Zone PSD Workshop, PSD I & II (2009)

TABLE 17. AREAS OF HIGH IMPACTS AND IDENTIFIED RESPONSES (OTHER IMPACTS)

<i>Key impacts</i>	<i>Hard measures</i>	<i>Soft measures</i>
Wild fires	<ul style="list-style-type: none"> • Wildfire control—creating fire belts • Mechanize agriculture 	<ul style="list-style-type: none"> • Enforcement of laws • Public education and sensitization
Flooding	<ul style="list-style-type: none"> • Flood-proof roads • Construct drains • Reservoirs to absorb increased volumes of water • Build flood gates to control water levels • Building dykes embankments—sea defense walls 	<ul style="list-style-type: none"> • Improve social services— providing • Flood-displaced victims with assistance
Occurrence of diseases	<ul style="list-style-type: none"> • Health facilities • Sanitation facilities • Emergency response teams/equipments 	<ul style="list-style-type: none"> • Health education on personal hygiene
Emergency preparedness and forecasts	<ul style="list-style-type: none"> • Early warning system—equipping meteorological stations • Food banks • Disaster response equipment for NADMO 	<ul style="list-style-type: none"> • Development of communication mechanisms and agencies • Monitoring and evaluation

Source: Regional/Zone PSD and PSD I & II (2009)

LOCAL LENSES AND NATIONAL PRIORITIES: DIVERGENCE AND CONVERGENCE

There are multiple similarities and differences in the challenges and pathways suggested by the PRA exercise and the workshops, which reflect a divergent knowledge base, perceptions, interests, geography, and collective versus individual actions. The goals and desires of both levels are the same and relate to improving living conditions through sustainable livelihoods. The nature of the impacts and the appropriate adaptation options, however, vary in terms of prioritization. Both hard and soft measures are advocated by both groups. It is important to realize that the workshops were dominated by bureaucrats with western lenses, while the PRAs were with local people who work with tradition, experience, and perception.

The challenges experienced at the local level were related directly to their livelihoods. The impacts of climate change on agriculture, water supply, heat, housing, income, expenditure, and how these translated into transforming social relations between men and women, migrants and indigenes, elderly and youth, landless and landlords, the wealthy and assetless, skilled versus unskilled, and so on highlighted the impact of climate change on local livelihoods. Local people in the zones are more concerned with declining living standards associated with depleting natural resources and poor inaccessible social services. They do understand the holistic nature of livelihoods and so engage in multiple livelihoods, which are socially constrained by financing, inadequate skills, and rigidities in local economies.

The challenges at the national level relate to impacts from the local level that prevent achievement of national goals. These are seen at an aggregate level with modern lenses that still see the traditional as inferior to the modern and stress national priorities of increasing GNP, conserving the environment, improving social amenities, and modernizing agriculture. The challenges therefore mimic threats to national income growth, future sustainability, and the relevance of organizations participants represented.

Adaptation options chosen by the local level are often straightforward, simple, practical actions that counter or

reduce impacts. These are both innovative positive actions and destructive unsustainable actions. Positively, actions incorporate improvement of natural resources, introduce new assets, reduce drudgery of work, and increase income earning possibilities. Negatively, actions that intensify mining of natural resources, increase inequalities in society, lead to land grabbing, and exclude access to hitherto common access resources result in unsustainable resource management and the erosion of the social fabric of communities needed to ensure sustainable livelihoods.

National-level options identified by the workshops are more scientific and influenced by analysis at a higher level, which incorporate some concerns of the local level. They reflect sectoral capacities and responsibilities that ultimately should be favorable to the individual efforts at the local level. Options listed by experts are often expensive, with limited inputs by local communities.

The similarities and differences in conception of the challenges and adaptation options pose challenges to successful adaptation. This calls for carefully selected options at the national level that provide complementarities to local-level actions. Research into drought-resistant crop varieties would be a demand-driven national-level option with important synergies with the local level. Small-scale irrigation would provide alternatives to cultivating close to waterbodies which causes silting and eventual water source degradation. Microfinance is of holistic importance as it straddles all sectors and leads to incremental building of individual and local capacities when well-planned.

POLICY PRECONDITIONS AND INSTITUTIONAL BASE

There are a number of necessary preconditions and institutional requirements needed to ensure adaptation to climate change and variability and other vulnerabilities. A premature engagement with strategies without these conditions in place could entail certain risks with potentially huge economic costs and failures. Significant improvements in governance— including decentralization, increased participation, sustainable resource management, and secured land tenure—were listed as needed preconditions to increase the adaptive capacity of communities.

Currently, sectoral planning is the responsibility of the Ministry of Finance and Economic Planning rather than the National Development Planning Commission, which is now orphaned. An umbrella organization is needed to incorporate climate and other concerns into national development planning. National policies can only be translated into action when short, medium, and long-term perspectives are taken rather than the current short focus based on the length of time political parties stay in power. A development agenda needs to transcend political parties and ideologies and endure through both central and local level planning, which is flexible enough to incorporate dynamism from emerging trends and shocks.

National and regional level policies need to mainstream climate change issues into their development visions. Luckily, the dependence on natural resources makes climate change an integral part of the development landscape of both rural and urban locations. Some preconditions include an enabling macroeconomic environment, external stability, legal authority granted by the government to implementing organizations, and effective supervision involving internal control policies and procedures.

However, further institutional requirements need to be established in support of policy at the national and regional levels. These institutional elements should include effective governance, transparency, sound financial management, systems for monitoring and evaluation, improving professional capacities, political will, non-interference by the ruling party or operational independence, local participation, endogenous development, appropriate technology, and collaboration between implementing agencies and local communities.

Overall, the process of adaptation appears to depend on multiple layers of incentives, institutions, and infrastructural availability, which are in turn created by national and global policies. Getting the right climate-proof policies and ensuring an effective institutional base is necessary for Ghana to meet the challenges to adaptation.

CONCLUSIONS FROM WORKSHOP TRACK

In general, climate impacts in Ghana will differ significantly between the northern savannah zone and the coastal areas in the south. The northern savannah is expected to be mostly affected by increased occurrence of drought; the rest of the country is expected to experience increased variability of precipitation and hotter temperatures. The transition zone may develop a unimodal rainfall regime. Most of the coastal regions are susceptible to tidal flooding and coastal erosion. These aspects are already manifest in the zones and may be exacerbated in the future. The main key impacts include reduced water availability, droughts, and soil degradation. Social ramifications of these impacts vary according to the capacities of the population, but in general they pose a significant threat to food security and resource-based livelihoods, including rainfed agriculture, fisheries, and forestry. These impacts have the potential to increase migration and to increase the concentration of population in slums, potentially causing further vulnerabilities. There will likely be significant social impacts, such as increased disease and unemployment; limited access to, and significant increase in the need for basic services; pressure on infrastructure, including roads, housing, drinking water, and sanitation; and labor shortages in the out-migration areas.

Adaptation pathways are sector and locational specific according to the vulnerabilities and resources of these sectors and locations. Adaptation pathways tend to stress both hard and soft measures, but the poor state of Ghana's *landescapitale* makes hard strategies predominant, at least in the medium term. The main constraints to the ability of sectors and zones to adapt relate to the cost of implementing measures, poor institutional base, poor political commitment, and lack of independence of implementing agencies. There is the need to put in place some policy preconditions and build a strong institutional base to guide and ensure the effectiveness of adaptive strategies.

6. SYNTHESIS AND DISCUSSION

OVERVIEW OF EMERGING THEMES

Ghana is at serious risk from climate change and related risks. The country is exposed to climate hazards such as drought, flood, and rising sea level, which indirectly reduce the viability of livelihoods in agriculture and destroys infrastructure, thereby reducing both household and area resilience. The poor modernization of the agricultural sector, which still relies on outmoded methods and practices of cultivation, has widespread implications for the vulnerability of people in different zones. Zones with higher levels of their population engaged in food crop cultivation where modernization is the lowest are particularly vulnerable and tend to transfer their vulnerability to neighboring zones by migration. Prioritization of the zones and specific hotspots becomes an important prerequisite to enable policy planning processes to mainstream these issues according to severity and institute measures that prevent people from lapsing into structural vulnerability, which most developing countries have limited capacity to reverse. The failure to consider the adaptation needs of the poor will impinge on Ghana's general development of in terms of mobilizing the resources of all regions for the improved well-being of its citizenry.

This study emphasizes the need for adaptation support mechanisms tailored to the risks, needs, prioritization, and particularities of different vulnerable groups and communities and sociogeographic zones. Existing adaptation strategies are limited both in scope and potential

due to poverty, poor skills and knowledge, demographic variables, and other non-climate drivers of vulnerability. Our results show the need to institute support mechanisms in the areas of protecting or building household assets, adapting traditional institutions to grant access to vulnerable groups, developing infrastructure that increases community resilience, and—of great importance—improving the skills of people to enable them to survive in the current economic context of multiple livelihoods.

There is a need for a well-coordinated, integrated climate-proof development pathway for the country since climate change affects all aspects of life. Considering the activities of humankind as one interconnected/organic whole therefore leads to advocating that sectoral planning be discarded in favor of an integrated framework that allows the activities of all sectors and the development community to feed into each other. Not only will this reduce the inefficiencies and redundancies of disaggregated planning, but it will enable stakeholders with different expertise to fine-tune the planning process and minimize the externalities that result from different adaptation strategies.

The role of the state is paramount in adapting to climate change. A minimalist state is a recipe for disaster in developing countries, where community resilience is low due to inadequate social amenities and economic infrastructure. As discussed previously, household resilience can be offset by poor community resilience such as inadequate water, health, educational, and road infrastructure. In addition, the macroeconomic situation is the domain of the state, which institutes policies that

translate into incentives, opportunities, and disincentives. This becomes an important avenue for the state to direct and reconfigure the current architecture of adaptation to fit the desired visions of each zone. Policies and programs for adaptation will be useless without some preconditions, among which are enforcement of legislation at both the community and national levels. Given the poor capacities of the state in Ghana, international assistance becomes necessary in financial, technical, and human resources to enable the state to carry out its core functions.

KEY FACTORS IN HOUSEHOLD AND AREA RESILIENCE

Household resilience or adaptive capacities are dependent on a range of factors and conditions. Of prime importance are household assets, which form the foundation for any livelihood strategy but which are results of social processes and relations. The range of household assets include both tangible and non-tangible assets such as land, houses, equipment, livestock, and human capital. The type and amount of household assets defines the capacity to adapt and engage in sustainable livelihoods. These are in turn determined mostly by traditional land tenure and inheritance systems in rural locations, and by a combination of these and state laws and institutions in urban areas. New social processes emerge as culture is dynamic and responds to environmental and economic changes. Access to resources determines the livelihood strategies and success of these strategies. The northern savannah has easier access to land by mostly men than in any other zone. However, the constraints of the physical environment and past state discriminatory policies reduce the success of households using natural-resource-based activities. The commercialization of land transactions makes land available to those who can afford it, thereby leading to inequalities that create large vulnerable groups, including women, youths, and the poor. Women generally have poorer access to land as a resource, but not the wild products found on land. The dynamics of access to productive resources in urban areas is much more complex as both state and non-state actors use different institutional rules in granting these. Having the right connections is important in urban settings, since the competition for space, permits, business links, and social services is extremely

high due to population growth and migration and limited institutional capacities to deal with these. Urbanites with access to institutional resources have higher resilience than those not favored or who have no access to them. The role of social capital is of utmost importance in both urban and rural areas. Social processes are influenced to a large extent by political capital. Patron-client relations still flourish, but in a modern disguise, and these influence sustainable livelihood outcomes.

The human capital base of households determines contemporary resilience. Human capital is determined by size of household, sex composition, dependency ratios, literacy, skills possessed, and physical ability. These are important dimensions of internal vulnerability of households because they determine even the asset base, labor availability, quality of the labor, diversity of skills, household burdens, and level of enlightenment and ability to appreciate trends and react appropriately.

Differential zonal resilience relates to physical attributes, social systems, and politico-economic forces. There is a reduction in natural physical luxuriance and physical infrastructure and investments as one moves from the urban coast to the rural savannah. These natural and economic deprivations increase northwards and therefore reduce resilience northwards. The neo-liberal export-oriented development path adopted by Ghana gives prominence to more ecologically endowed regions, which increases their resilience due to the social services and economic infrastructure provided by the state in addition to the business investments by locals and expatriates. The social systems in the zones privilege certain groups, mostly landlords, males, and the wealthy, against others such as females, the landless, the sick and weak, and the poor.

Adaptive capacity among households is conditioned by assets and capital, which are a function of local institutions that define social processes and relations. These eventually influence the resilience of the area/zone in which they live. Area resilience is the outcome of macroeconomic policy and the physical environment, which interact with household resilience as enabled by local institutions. Building resilience therefore entails building household assets, fine-tuning local and formal institutions, providing social and economic

infrastructure, and above all ensuring equity in national development that combines inward-looking and outward-looking paradigms.

DRIVERS OF VULNERABILITY IN CLIMATE CHANGE CONTEXTS

Ghana's vulnerability to climate change is in large part defined by its vulnerability to natural hazards. Vulnerability in all sectors of the Ghanaian economy and among households results from both climate-induced and socio-politico-economic drivers. The interaction between environmental and socioeconomic drivers of climate change results in structural vulnerability conditions for different people in different sociogeographic zones. The three main climate drivers of vulnerability in Ghana include droughts, floods, and coastal erosion. Droughts are a major problem for the northern and southern savannahs, with increasing significance for the transitional zone. Climate variability in terms of fluctuating weather conditions increases the vulnerability of the bulk of the population who depend on natural-resource-based activities for their living.

Environmental change emerging through the driver of climate change inflicts harsh and extreme environmental conditions upon rural smallholder farmers and therefore has direct implications for creating unsustainable livelihoods. Farmers have their investments washed down the drain by floods and droughts almost every second year, especially in the northern savannah zone. High temperatures affect crops, water availability, and the productivity of farmers. There is reported withering of crops all over the country due to extreme heat, and an emerging high disease burden on crops, livestock, and people. Heat waves have led to the outbreak of cerebro-spinal meningitis all over northern Ghana and even in the transition zone due to migration.

Vulnerability in the context of climate change is the consequent fall in well-being attributed to the change simply because people are unable to cope and adapt positively without adverse effects. Two sides of vulnerability are worth noting: the first is the extent to which an area is susceptible to unfavorable weather changes, and the second is the adaptive capacity of local population. Within each of the ecological zones different people with different characteristics exhibit different

vulnerability profiles attributable to socio-politico-economic drivers.

Poverty reduces the capacity of people in meeting climate challenges and leading sustainable livelihoods. Poverty in Ghana is highly spatial and increases as one moves north. Generally, rural areas compared to urban areas harbor the bulk of Ghana's poor. Drier areas such as the savannahs, which harbor the majority of the poor in Ghana, are more risky and vulnerable to climate change and variability than wetter areas. However, the drivers of vulnerability due to climate change are gradually penetrating the better ecological zones aided by non-climate drivers of vulnerability. Adaptation to climate change therefore has to tackle both types of drivers as they determine the external and internal attributes of vulnerability.

LOCAL AND NATIONAL DISCOURSE ON CLIMATE AND HAZARDS: INPUTS TO DECISION SUPPORT SYSTEMS

The need to mainstream climate change into national development planning and processes is long overdue. Climate change is necessarily a development issue as physical climatic and human systems interact with synergistic feedback effects. This study brings to bear the necessity for integrating climate concerns into the development agenda in order to ensure the long-term achievement of the Ghana development goals, in particular the Ghana Poverty Reduction Strategy (GPRS). Mainstreaming climate risks into the national development agenda reduces the devastating consequences of unanticipated climate-related hazards, including costs that constitute significant drains on national resources, thereby stifling the achievement of set goals. Local and national discourses on climate change need to mainstream proactive policies that seek to build the resilience and readiness of their populations and their livelihood systems. Though climate change is an additional vulnerability, it has overarching implications for all other vulnerabilities and should constitute the focal reference point for policies. Climate-proofing is best achieved at the national policy level, where most of Ghana's local-level financing and decisions come from. Decisions at the national level should aim at achieving sustainable development by supporting broad-based local-level actions to strengthen the capacity of the poor to cope with climate vulnerability.

The sectoral bias of the development process in Ghana means that sectoral policies are relevant entry points. The agricultural, water, road, and communication sectors are identified as critical to the well-being of a majority of Ghanaians. Policies to enhance agricultural production, harness water harvesting and provision, provide weather-proof infrastructure, and an implementation framework that ensures that programs are implemented well needs urgent attention. In the social sphere, improving human resources, strengthening institutional systems, and putting public finances on a sound financial footing are important inputs. Policies must aim at ensuring that the natural resources most sensitive to climate hazards—such as water, soil, forest, and coastal systems—are sustainably managed.

The National Adaptation Strategy (NAS) under construction will serve as an important instrument mainstreaming climate change issues into the development process. The overarching goal of policy is to reduce the vulnerability to climate hazards in the future. The goal of the National Adaptation Strategy (draft version) is to future-proof developments and to build in resilience to climate change impacts now and in the future in order to reinforce and increase the capacity of Ghanaian society and ecosystems to adapt to climate change. Ultimately the NAS is to position Ghana to reduce the risks of climate change impacts and realize any opportunities that climate change provides for sustainable development.

SCALE: LEVERAGING NATIONAL AND SUBNATIONAL POLICIES AND INVESTMENTS FOR PRO-POOR ADAPTATION

The main spatial points of attention for policy focus should be the national, sociogeographic, district, and community levels. Sectorally, the most important are agriculture, water, roads, energy, and health and education. The need for leveraging is due to both resource constraints and the effectiveness of concentrating on a few select points that will produce general effects over the whole system.

Spatially, the impacts of climate change are different, which calls for different measures to be instituted in different geographical zones to reduce the impacts and increase the resilience of the people.

The criteria for leveraging should be based on the nature of climate change impacts, number of people affected by a particular impact, cost of implementing policy, sustainability of measures by local people and district assembly, likely multiplier effects of policies, balance of negative and positive effects, the resilience of the policy measures, and replicability. These criteria should be applied to both spatial leveraging and sectoral programming; that is, both the where and what. The proposed adaptation pathways point to agriculture, water, infrastructure, and social services forming the fulcrum sectors around which robust adaptation measures must swing.

In the short term, specific interventions are needed in hotspots to improve the situations before general policy measures can be effective. Households and coastal communities ravaged by coastal erosion cannot wait for the long and painful processes that policy planning takes. Likewise, communities in the Sudan savannah zone are living at the margin of existence with starvation, disease, and squalor resulting from and competing with climate vulnerability. “Quick and dirty” programs can be very effective in increasing and generating robust adaptation strategies and increasing resilience over time. Also, policy interventions at these places should be justified based on the opportunity cost of “doing nothing.” This will involve degradation of the environment to delay peoples’ own destruction, relocating vulnerability to other zones, creating empty spaces that actually need people for effective eco-management, competition and conflict over resources, and above all constituting a scar on national developmental achievement.

Generating robust coping and adapting strategies to climate change requires incremental steps rather than discrete ones. Incremental steps should build on existing structures and processes and the establishment of new ones based on the principles of participation, empowerment, resilience, sustainability, and cost-effectiveness. In this regard the mainstreaming of climate change issues into national-level policy is a first important step. The translation of this action into area development activities is a second step, and the specific targeting of vulnerable groups by safety nets and specific programs should be the last step. This ensures that the ultimate objective of adaptation is anthropocentric well-being.

At the national level, policies should focus on general macroeconomic stability and meaningful growth in all sectors to be useful to different social and economic groups. At the district level, the visions of the area should be achieved by actions that protect their valuable resources, opens access to livelihood resources to all, improves the well-being of people, and enables the vulnerable outside the market system to eventually get onboard. District-level planning should aim at increasing area resilience, especially in infrastructure, and translating national policy goals into reality.

Community-level policies should aim at eliminating debilitating practices and laws, as well as building social capital and community support mechanisms to improve social resilience. Particular concerns include the land tenure system, which disadvantages women and the poor; inheritance systems, which are important for intergenerational wealth transfer; conflict resolution using alternative dispute resolution mechanisms based on tradition; and ownership of community adaptation measures. The various social processes that constrain productivity and marginalize people need radical overhaul, often with negative political fall-outs that will be disastrous in the current democratic dispensation. The internal capacities of communities determine the success of external interventions by area development initiatives and national-level policies. The community and individual actions already in place need to be supported and enhanced.

The overall goal of national and area development policy should improve the adaptive capacity of the individual at the household level. At the household and individual levels, policies need to aim at eliminating the structural rigidities and helping the most vulnerable overcome their own problems by enabling access to land, markets, credit, and social services. These require new sets of social relations that can be manipulated from cultural, economic and environmental policies, rules and norms. Progressive local leadership is needed to translate national laws and policies to the benefit of the individual.

Policies and investments must be pro-poor not in the sense of giving handouts, but concentrating on long-lasting investments that will buffer the poor from climate challenges and other drivers of vulnerability.

Concentrating only on measures that mitigate climate disasters will be counterproductive to achieving overall sustained development. Rather, a focus on building the resilience of the poor, their communities, and balanced equitable national development should be the goal of policies and investments.

MULTISECTORAL ANALYSIS AND PROGRAMMING

There is a general consensus that achieving progress in adapting to climate change can only be achieved through an integrated approach that brings onboard multi-stakeholder involvement. This is needed to rid Ghana of the duplication of functions and inefficient use of national resources. Mainstreaming climate change in the national budgetary process certainly needs a coordinated integrated approach to the use of resources. An integrated approach means sharing of ideas, generating strategies, developing plans, implementing strategies, enforcing rules, shared responsibility, and enlivening the spirit of integrated development. Adopting an integrated approach should involve multi-stakeholder consultations and be based on participatory scenario development and planning, which this study aptly shows to be very useful in building consensus and eliminating the fears different sectors and civil society have about each other's organizations.

Understanding the integrated nature of climate change is key to designing robust adaptation strategies. Multi-stakeholder discussions are the best in unraveling the linked processes of impacts on different sectors of an economy.

An integrated planning process that mainstreams climate change has benefits of leveraging at the best points, and making trade-offs that ensure sustainability of different livelihood options and the environment. The poor capacities of the different sectoral ministries in Ghana would benefit where the few experts merge to create a larger body and capacity for designing and effectively implementing robust actions. Over time, the capacities of each of the sector ministries will grow, following conscious efforts to either recruit and/or educate existing staff. An integrated approach in the context of Ghana should not be limited to only the integration of sector ministries, but must involve civil society

groups and local government departments who are already working on diverse sectoral issues. Civil society was instrumental in detailing the local-level impacts and appropriate micro level interventions that have worked from experience. These interventions can be mainstreamed into national and district-level plans in zones where they are appropriate. An integrated planning process necessitates participation. Fortunately, the decentralization program instituted to strengthen local governance and the activities of civil society have inculcated the spirit and purpose of participation into collaborative activity planning. Adherence to participatory planning and a bottom-up approach to planning processes that start at the community level will enable the capturing of robust, practicable, and well-sequenced adaptation strategies. Multisectoral programming resulting from joint analyses needs to transcend advocacy, capacity building, hard interventions, and monitoring and evaluations. Programming should therefore involve participatory development of tools and management guides that

ensures effective development, implementation, and coordination of cross-cutting interventions that transcend different sectors. Trade-offs become important in the process as different sectors assess the outcomes of specific interventions of their systems. Choices need to be made out of these conflicting circumstances that reflect both human security and environmental sustainability. In a developing country where these two are direct opposites, the critical factor in the choice of interventions should be synergy. To what extent does a program contain activities that have multiplier effects across sectors? How sustainable are activities and their results? And what form of resilience is built with what capacities for both individuals and communities for dealing with new threats emerging from adaptation? Certainly, an integrated system involving agriculture, water, infrastructure, and the social services provides better avenues for coordinated robust adaptation than individual sector programs with unintended consequences that are difficult to internalize holistically.

7. CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF FINDINGS

This study has assessed the key impacts, vulnerabilities, and robust adaptation strategies and pathways for achieving sustainable future outcomes for all sociogeographic zones in Ghana. The climate of Ghana is changing, with ramifications such as a reduced amount of rainfall and higher incidences of rainfall variability, higher temperatures, frequent occurrence of floods, and coastal erosion along the east coast. Impacts of climate change are therefore categorized into direct and indirect. The direct impacts relate to productive activities and effects of climate disasters, while the indirect effects are consequences of these direct effects, which are often spin-offs from initial impacts.

Vulnerability to climate change is not uniform but varies from person to person, from place to place, and by type of activity. Social differentiation defines access to resources for coping and adapting to climate-related vulnerability. The main categories of vulnerable groups with poor capacities include widows, disabled, aged, children, youths, and divorced women. These groups are disadvantaged by social processes such as inheritance rules, land tenure systems, and lack of support from formal institutions. In terms of occupational groupings, those depending on natural resources—especially food crop farmers—are more vulnerable than those in non-agricultural activities. Hence, rural areas tend to be more vulnerable than urban areas because

over 90 percent of people depend on rainfed agriculture and the harvesting of non-timber resources. Activities that are not based on natural resources now offer better prospects, as globalization enabled by the country's macroeconomic policy direction has made informal sector commercial activities more profitable. However, poor investments in the non-farm sector do not translate into high resilience, but rather transfer of vulnerability from farm to non-farm via palliative diversification. Generally, the northern savannah and the coastal rural locations have lower resilience than the forest and transitional zones. This is due to the severity of impacts in these locations and the low adaptive capacity of the people, caused by poor state interventions and their poor internal capacities.

The study enumerates several existing robust adaptation strategies at the local level with the potential to enable sustainable livelihoods and sustained development of the nation. Some of these actions need urgent state support to avoid a livelihood collapse. These local-level robust adaptation strategies include:

- Developing drought-resistant short gestation crops
- Developing small-scale irrigation systems
- Increasing the knowledge base and supporting integrated farming
- Promoting woodlots and mangrove regeneration with incentives
- Research into appropriate less expensive building technology
- Enhancing mechanization of agriculture and encouraging productivity using agrochemicals
- Refining arrangements for access to land

- Provision of microcredit and skills for diversified livelihoods
- Encouraging aquaculture, restocking our rivers and lakes with fingerlinks
- Provision of community social and economic infrastructure, including insurance
- Providing early warning information
- Targeting the poorest with starter packs and access routes for livelihood resources

Adaptation interventions should be systematically structured so as to benefit the most vulnerable households and communities within vulnerable regions.

Interventions need to be considered on short, medium, and long terms. Short-term interventions are less expensive and constitute advocacy, relief, and support of existing strategies. Medium-term interventions are planned involving more infrastructures and institutional capacities needed to build area resilience, which is identified as the weakest link in Ghanaian adaptive capacity. Long-term interventions are a continuation of hard strategies of infrastructure and technology, but with a focus on management capacities to ensure sustainable integrated resource management. Adaptation strategies need specific leveraging, especially beginning with the agriculture, water, and services sectors, which have synergistic positive relationships with each other and other sectors. Locationally, interventions should be distributed according to the nature of threats and impacts and vulnerability characteristics and history of discrimination in national development programming. This calls for leveraging at zonal levels involving the use of district assemblies or establishments of special authorities such as the Savannah Accelerated Development Authority.

The identified future priorities included improvements in resilience among the poor by improving basic living conditions such as improved access to health care through health insurance, safe water, and affordable clean energy. Adaptation options and pathways are assessed based on the synergies between responses to climate change and the desired development pathway. Specific priorities identified focused on improving agricultural production, improved land management practices, managed migration, improved conditions of women, improved governance, and functional institutional structures. The choice of adaptation options

should be premised on the following: its multiplier effects on general livelihoods; feasibility of the options; sustainability; familiarity; and the political will and leadership to support options. The main constraints to adaptation include the cost of implementing measures, poor institutional base, poor political commitment, and lack of independence of implementing agencies. There is a need to put in place some policy preconditions and build a strong institutional base to guide and ensure the effectiveness of adaptive strategies.

RESPONDING TO DIRECT AND INDIRECT IMPACT OF CLIMATE CHANGES

The direct and indirect impacts of climate change have posed great challenges to Ghana's developmental agenda. The responses to these challenges have been at different levels from the individual to community and national levels. The responses can be categorized as being coping and adapting strategies. Responses at all the levels are instrumental in meeting climate challenges and actually internalizing these externalities. However, the experience of Ghana shows that the strategies at the individual level are more prominent than the other levels. This does not mean that individual level strategies are more effective. It simply points to the poor area resilience of the Ghanaian landscape due to crumbling social support and institutional governance at the community levels and the poor support from the state due to financial inadequacies and capacities. Ultimately, the burden of responding to climate change falls on individual households who maneuver within community and national systems to cope and adapt to climate and other challenges. Livelihood diversification, especially by women, is an important response in all zones studied. This calls for a focus on alternative livelihood programs. Migration has been an avenue for spreading the risks of climate change and judiciously using the country's resources as population moves from climate ravaged and economically neglected zones to new opportunity zones. This is both an individual and a national response strategy that needs management by fine tuning institutions, especially in receiving areas.

Responses in the agricultural sector and rural environment generally have been an age-old way of living. Farmers have responded to climate threats by coping with shocks and adapting to trends within the

constraints and opportunities of wider dynamic physical, social, and economic conditions. Local farmers have coped with shortfalls in crop production by relying on other natural resources for food and income, or diversified livelihoods temporarily to procure basic necessities of life. Due to the limited nature of most rural economies, the most vulnerable resort to extreme measures such as rationing of food, avoidance of modern medical care, and other costly social services. These measures have negative consequences by pushing them into structural vulnerability. Social support systems—the sharing of food among community members, communal labor to rehabilitate destroyed property, lending of money and resources without interest, fostering of children by other relatives for the most vulnerable, and psychological healing and moral support—are important in communities as responses to climate hazards. These social processes and how they change over time are crucial to the success of sustainable livelihoods in terms of adaptation to climate change. Of great importance in traditional societies is the governance system, which should ensure that these support mechanisms work. Many of these mechanisms are based on moral encumbrances rather than strict legal requirements in modern judiciary cycles. Community support systems and individual capacities define the coping and adaptation strategies that are unleashed as responses to climatic challenges. These are couched in terms of social relations that ultimately provide people with access to specific adaptation options.

State responses to climate change and other threats are interwoven into the developmental activities spawned to increase the resilience of people. Apart from the sectoral measures that aim at providing support to agriculture, water, health, sanitation and general infrastructure, the state also responds to idiosyncratic events such as floods and famine through its principal organization NADMO. The district assemblies have also become agents of coping by providing palliative measures such as fixing washed-away culverts and dirt roads, roofing public buildings after storms, assisting in providing relief during disasters and generally stabilizing the damage scene. Due to financial constraints, the state has not been effective in long-term adaptation to climate challenges. Climate-proofed bridges and roads are built at a very slow pace and often in urban areas rather than rural areas, where such hazards have debilitating effects

on agriculture. Research into climate-proof crop varieties has been quite successful by the Crops Research Institute, Savannah Agricultural Research Institute, and the Cocoa Research Institute. More could be achieved from these organizations if funding and a broader mandate is given to them. In addition, their activities need to be guided by the farmer-first approach rather than technocratic dictates of mainstream science, which wastes research money on high-yielding inappropriate varieties of crops and methods of farming.

SOCIAL RISK MANAGEMENT: ASSET DEVELOPMENT AND SOCIAL PROTECTION

The magnitudes of climate impacts are very high in Ghana and will increase over the coming decades, showing a high probability of occurrence. The social risks associated with climate change need proactive management measures aimed at increasing the resilience and adaptive capacities of individuals and communities. Social risk management consists of public interventions to assist individuals, households, and communities better manage risk, and to provide support to the critically poor. Climate risk management involves proactive “no regret” strategies aimed at maximizing positive and minimizing negative outcomes for communities and societies in climate-sensitive areas such as agriculture, food security, water resources, and health.

Asset protection and asset building are age-old risk management strategies whose relevance has been increased by climate change risks. Both tangible and intangible assets, including modern insurance schemes, are important buffers. In the northern savannah and in many other places, livestock play important roles in mitigating the effects of direct and indirect impacts of climate by providing income and food to households. Other household equipment and savings are of relevance as buffers to climate-induced stress. The challenge is to sustainably manage these risk management strategies as they have their flip sides such as overstocking of livestock and environmental degradation. Modern insurance schemes in agriculture and health are effective, but will meet challenges due to the poor functioning of existing insurance schemes and the legal tussles that people go through to make claims and their associated additional financial burdens. State-backed insurance systems should be instituted based on the adaption

of recommended, tried, and acceptable practices in other parts of the world. However, assets are not politically neutral. They are the results of conscious societal engineering defined by the rules and norms that ascribe different rights regimes and access patterns. Changes in these institutions are necessary for asset building and effective strategies.

Social capital as a risk-pooling support mechanism is important for community resilience in both urban and rural areas. Both state and civil society need to focus on programs that strengthen local organizations and traditional support systems to effectively provide the needed support to their members to cope and adapt to climate change. Advocacy and introduction of new climate-proof technologies, for instance, can best be achieved by contagious and expanded diffusion mechanisms using these existing networks. It is important to form farmer/livelihood groups to develop their own agri/business activities, where climate information is used as inputs for making better plans, strategies, and decisions.

State social safety nets are inevitable, as there are a growing number of structurally vulnerable people who are left out by traditional networks of support based on family, friendship, and occupational solidarity. Also, state social safety nets are needed to cater to the large number of people who are affected by disasters and need time to adjust. Shelters, food, and sanitation are the major challenges facing NADMO when there is a disaster. Strengthening the capacities and services of the different sectors providing productive and social services is crucial in building adaptive capacities of the vulnerable groups.

Opportunities for social risk management are rife in the Ghanaian landscape, but tapping these necessitates a clear policy focus that seeks to mainstream climate risk and builds on existing support systems while adapting new options using preventive, mitigation, and coping interventions from other places.

INPUTS TO ADAPTIVE CAPACITY TO SUPPORT VULNERABLE GROUPS

Policy Design and Implementation

Policy design and implementation processes need cautious and collaborative crafting that takes on board

the concerns of vulnerable groups with regard to climate and other challenges. Mainstreaming climate change issues into wider policy should aim at building adaptive capacity at household, area and national levels. The phases of the policy cycle should aim at reducing impacts of climate change and increasing adaptive capacity. A policy cycle usually starts from an identification of policy issues. This process typically should be participatory by eliciting the voices of concerned citizens and stakeholder groups, political pressures and inputs from the research community, and other experts. Deliberations should feed into a definition of broad policy objectives that mainstream climate change. Policies should not only be stated at the broad level but be translated into operational objectives, or operational policy targets/visions as envisaged by different stakeholders and deliberated upon by experts and politicians. This process should bring several advantages, such as fueling a consultation process involving both potential gainers and losers, anticipating the spinoff effects of adaptive mechanisms, determining appropriate adjustments and solutions to potential hurdles, and finally informing program formulation and implementation.

Main areas of concern should focus on enabling farmers to adopt efficient farming practices, providing irrigation systems, ensuring the stabilization of incomes by effective market regulations, facilitating the rehabilitation and restoration of degraded lands, reducing effects of droughts and floods, supporting alternative livelihoods, ensuring sound environmental management, and providing general infrastructure in all sectors.

Prioritization among the numerous competing objectives needs an incremental policy framework that sets objectives according to designated adaptation pathways designed over time. Measures should assist vulnerable groups affected negatively (environmental refugees) by climate change to exit current livelihood systems, especially agriculture into alternative livelihoods. Also, those remaining in natural-resource-based livelihood systems need support to make them viable and profitable enough to enable endogenous adaptation. Increasingly, a mixture of different livelihood activities is adopted by local people with proven advantages over single livelihoods. Policies encouraging people to spread their risk are appropriate using multiple livelihood systems. A twin objective framework targeting the building of

adaptive capacity and reducing vulnerability of social groups and sectors to climate change should be the focus of policy.

Adaptation to climate hazards in Ghana therefore necessitates multiple policy objectives that are sequenced incrementally and leveraged at points with maximum spin-off positive effects.

Program Design and Implementation

Translating policies into reality necessitates programs and well-managed projects. Contrary to past program designs that were crafted within specific sectors, there is a growing agitation for cross-sectoral planning to ensure synergistic benefits. An integrated versus single sector programming involving agriculture, water, roads, and communication and social services is imperative in the current situation. Harmonized adaptation interventions should be developed by a participatory stakeholder process involving people across different sectors. These programs should be managed by a competent cross-sectoral team with effective coordination of activities by the different sectors and actors.

Program design should focus on increasing resilience, building adaptive capacity, reducing vulnerability and poverty, enhancing productivity, ensuring environmental sustainability, sustainable livelihoods, and enhancing national capacity. The activities of programs need to focus on supporting the farmers in the agricultural sector to minimize the threats of climate change to their livelihoods and their ability to manage the environment sustainably. Activities need to lead to the provision of social services that define the internal vulnerability of people and their livelihood systems. Activities that provide infrastructure—such as water supply systems, irrigation systems, sea defense or new settlements for the displaced, roads and railways, and equipment for farming and processing—are prerequisites for any effective defenses against climate change.

Building the capacities of both local people and technocrats in climate-proof behaviors should be achieved by advocacy and capacity building programs.

The sequencing and prioritization of programs and projects in specific locations is as necessary as the programs themselves. Stand-alone projects have a poorer chance of achieving the desired outcomes unless the general development trajectory is well-sequenced with incremental synergistic links between parallel and build-on projects. The nature of state organizations in Ghana calls for a twin approach to program design and implementation. The consultative processes must be participatory by all stakeholders from which jointly designed projects are implemented collaboratively by a number of organizations. The second approach should consist of sector-specific projects implemented by specific sectors with inspections and advice from allied sectors. The second stream must consist of projects that run parallel in two or more sectors so as to minimize the unintended fallout of projects. The failure of most projects in the developing world is often attributable to the absence of supporting services. Projects to improve farmer productivity would fail in the absence of complementary services such as credit and insurance schemes, efficient markets, processing and storage facilities, and good extension services. Programs for climate change should therefore consider the chain of activities and processes that affect the achievement of desired policy visions.

Obviously this holistic program framework demands resources beyond the scope of the Ghanaian state. Fortunately, various mechanisms of financing are supposed to be operative soon on the international scene to enable poor countries to carry out climate-proof development-oriented programs. The success of Ghana in meeting the challenges of climate change and variability hinges on its own internal organization and the fidelity of the international community in honoring their promises and pledges.

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APPENDIXES

APPENDIX 1. HOUSEHOLD QUESTIONNAIRE

1. Village and household characteristics

a. Village Name:						c. Household code:	
b. Village code:							
1 2 3 4 5 6							
d. Respondent name:						e. Sex of respondent:	
						Male Female	
f. Relation of respondent to household head							
1. Household head 2. Wife of household head 3. Other							
g. Number of years the family of the household members is living in the village: _____							
h. Number of years, household occupies this residence: _____							
i.1 Rank occupations of the household in order of importance							
(1 = most important, ..., 8 = least important; 0 = no source of income for any of the household members;							
* use cards indicating the possible activities and ask the respondent to order them from most important to least important, with a separate pile for activities that are not performed;							
* alternatively, they can indicate the importance of each activity by allocating stones over the seven items, for which they allocate more stones to the more important activities)							
i.2 Indicate whether the activity is especially performed by men or women; if there's no difference, tick both answers.							
(i.1) Main activities of the household				(i.2) Performed by men or women			
				Men		Women	
Crop farming							
Animal husbandry							
Fisheries							
Day labor within agriculture							
Off-farm labor (non-agricultural)							

Trade and commerce			
Civil servant			
Other:			

Observations:

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2. Household composition and household characteristics

This question deals with the household members who are currently living within the household and those who migrated for less than 12 months.

- a. What is the sex of the household members? Tick male or female.
- b. What is the age of the household members?
- c. Did the household member migrate for a period of less than 12 months during the last year? Tick yes or no.
- d. How many years of education did the household member receive?

Household member	Sex		Age (years)	Temporarily migrated		Years of education
	Male	Female		Yes	No	
1						
2						
3						
4						
5						

- a. Are there any household members who belong to the household but who have migrated permanently? Note that these do not refer to household members who left the household to start their own household somewhere else. It refers e.g. to husbands or wives who have migrated permanently with the objective to sent cash to the village.

yes	no

If the answer was yes: ask which people migrated permanently?

Observations:

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3. Crops cultivated last year

- a. Did you cultivate any of the crops listed below during the last 12 month (tick if the crop is grown)
- b. How much land have you cultivated with each of these crops?
- c. From which crops harvested during the last 12 months did you sell a part? (tick 'yes' or 'no'). If crops are sold, ask whether the money earned is managed by the men or women. If the household budget is managed equally by the men and women, tick both cells 'men' and 'women'.

Crop code	(a) Crops cultivated during the last 12 months		(b) Land cultivated		(c.1) Sold		(c.2) Income managed by whom?	
			Amount	Unit	Yes	No	Men	Women
1								
2								
3								

- d. How much land do you own or have permanent or for?(unit)
- e. How much land do you rent or sharecrop in?(unit)

Observations:

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4. Livestock

- a. Does the household own livestock or animals?

Does the household own livestock?	Yes	No

Continue with question 4b-d only if the household owns livestock!

- b. How much livestock does the household currently own? (mark the category indicating the number of live-stock owned)
- c. How much livestock did the household own 12 months ago (mark the category indicating the number of livestock owned)

(b) How much livestock does the household currently own?

Livestock	1-2	3-5	6-10	More than 10
1. Cattle				
2. Dairy cattle				
3. Traction livestock (e.g. mule, horse, oxen)				
4. Goats/sheep				
5. Poultry				

(c) How much livestock did the household own one year ago?

Livestock	1-2	3-5	6-10	More than 10
1. Cattle				
2. Dairy cattle				
3. Traction livestock (e.g. mule, horse, oxen)				
4. Goats/sheep				
5. Poultry				

Observations:

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5. Fisheries

a. Does the household engage in fishing activities?

Does the household engage in fishing activities?	Yes	No

Is the household a member of a fishing group?	Yes	No

Continue with question 6b-d only if the household engages in fishing activities!

- a. Which type of fish do you catch?
- b. Did you sell any fresh fish during the last 12 months?
- c. Did you process (clean, dry or smoke) and sell any fish during the last 12 months?

Fish code	(b) Fish species	(c) Sold		(d) Process and sell	
		Yes	No	Yes	No

Observations:

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6. Major Assets Owned

- a. Which of the listed assets does the household own?
- b. If you own these assets, how many do you own?
- c. If you own these assets, how many years ago did you purchase them?

<i>Item</i>	<i>(a)</i> <i>Assets owned</i>		<i>If (a) is yes:</i> <i>(b)</i> <i>Number of assets owned</i>
	<i>yes</i>	<i>no</i>	
plow			
Hoe			
Axe			
Sickle			
Shovel			
Fishing equipment			
Jewellery			
Cart			
Improved stove			
Radio			
Bicycle/moped			
Iron roofed house			
Kitchen house			
<i>Item</i>			<i>If (a) is yes:</i> <i>(c)</i> <i>When purchased?</i>
Gas/petrol stove			
Refrigerator			
Stable for livestock			
Cellphone			
Television			
Boat			
House built of bricks			
Car			
Other.....			
Other.....			

Observations:

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- f. For those climate related hazards that you have experienced, to what extent did you experience effects in your activities? (0 = not applicable, 1 = a lot less, 2 = less, 3 = no change, 4 = more, 5 = a lot more)
- g. Which household members are affected more by the hazard; the men (m), the women (w) or no difference between them (tick both)?

(f) Effect of hazard on livelihoods	(f.1) Crop produc-tion	(f.2) Area cultiva-ted	(f.3) Live-stock owned	(f.4) Fish landed	(f.5) Assets owned	(f.6) Cash income	(g) Gender effect	
							Man	Women
Less rainfall during the rainy season leading to droughts								
Periods of prolonged drought, leading to crops drying out or livestock not having sufficient water.								
Excess rainfall leading to floods								
Too heavy showers leading to damage to crops, livestock and property								
Periods of extreme temperatures, leading to scorched crops								

- h. Rank the hazards given below from the least important (1) to most important (10) (use cards describing the hazards; if necessary use pictures or use stones in which the number of stones given indicates the importance)
- i. If you compare the situation in the last five years with the period before. Have the hazards become more threatening in the last 5 years?

Hazards	(h) Hazard ranking	(i) More or less threatening than in the past?	
		Yes	No
Drought due to less rainfall during the rainy season			
Drought due to periods of drought during the rainy season			
Floods due to excessive rainfall			
Damage due to excessively heavy showers			
Changed average and extreme temperatures			
Human diseases			
Animal or crop pests and diseases			
Decreasing soil fertility			
Problems with input purchase or output sales			
High food prices			
Other:			

Observations:

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8. Institutions

- With which organizations or groups does your household have contact?
- If you have been in contact with an organization, how often do you have contacts? (1 = never; 2 = occasionally; 3 = during the growing season; 4 = a few times per year; 5 = a few times per month; 6 = every week)
- If you have been in contact with the organization, since when have you been contacting the specific institution? (1 = this year; 2 = last year; 3 = five years ago; 4 = ten years ago; 5 = more than 10 years ago)
- Is it possible to link the date since when households are in contact with an institution with the data since when a hazard is experienced as discussed in question 7a (numbered 1 to 5). (1 = Drought due to less rainfall during the rainy season; 2 = Drought due to periods of drought during the rainy season; 3 = Floods due to excessive rainfall; 4 = Damage due to excessively heavy showers; 5 = Changed average and extreme temperatures; 6 = other)
- If you have been in contact with the organization, has the help or assistance obtained been helpful to prepare your household for hazards which are a danger for your household?

Organization Hazards	(a) In contact		(b) Frequency of contacts with institutions	(c) Have been in contact since	(d) Link to hazards in question 7	(e) Helpful for adaptation	
	Yes	No				Yes	No
1. National Authorities							
2. Regional Authorities							
3. Local authorities							
4. Extension Agency							
5. International Donors							
6. Non-Governmental Organization							
7. Cooperatives							
8. Schools							
9. Banks							
10. Village communities							
11. Religious communities							
12. Women's groups							
13. Micro-finance groups							
14. Self-help groups							
15. Unions							
16. Other.....							
17. Other.....							

9. Major strategies of the household to cope with hazards

- Do you apply the adaptation options given below in order to adapt to the hazards given in the previous question? Who decided about the strategy change; one of the men or women of the household?
- If the adaptation strategy is adopted, which of the hazards are reduced? (1 = Drought due to less rainfall during the rainy season; 2 = Drought due to periods of drought during the rainy season; 3 = Floods due to excessive rainfall; 4 = Damage due to excessively heavy showers; 5 = Changed average and extreme temperatures; 6 = other)

Strategy type	(a) Strategy adopted				(b) Which hazards are reduced?
	Yes	No	Men	Women	
A. AGRICULTURAL TECHNIQUES					
A1. Crop selection					1 2 3 4 5 6
A2. Adapt planting dates					1 2 3 4 5 6
A3. Adapt cropping densities					1 2 3 4 5 6
A4. Adapt fertilizer/pesticide application					1 2 3 4 5 6
A5. Adapt tillage practices					1 2 3 4 5 6
A6. Change the pastoral system (distance and frequency of mobility)					1 2 3 4 5 6
A7. Change the herd composition					1 2 3 4 5 6
A8. Apply different feed techniques, like e.g. zero grazing					1 2 3 4 5 6
A9. Change from pastoral to sedentary agricultural system					1 2 3 4 5 6
A10. Improve food storage facilities					1 2 3 4 5 6
A11. Other					1 2 3 4 5 6
B. WATER MANAGEMENT TECHNIQUES					
B1. Use water harvesting techniques: roof water collection, tanks....					1 2 3 4 5 6
B2. Improve, construct or rehabilitate terraces					1 2 3 4 5 6
B3. Use irrigation					1 2 3 4 5 6
B4. Improve watering sites in pastoral areas					1 2 3 4 5 6
B5. Other.....					1 2 3 4 5 6
					1 2 3 4 5 6
C. DIVERSIFICATION					
C1. Temporal migration to urban areas or abroad					1 2 3 4 5 6
C2. Temporal migration to other rural areas (e.g. plantations)					1 2 3 4 5 6
C3. Permanent migration (to other rural areas, urban areas or abroad)					1 2 3 4 5 6
C4. Non-timber forest product commercialisation					1 2 3 4 5 6
C5. Home-garden agriculture					1 2 3 4 5 6
C6. Increase market sales					1 2 3 4 5 6
C7. Handicrafts					1 2 3 4 5 6
C8. Charcoal or timber sales					1 2 3 4 5 6
C9. Start fisheries					1 2 3 4 5 6
C10. Reduce expenses by changing consumption (type and number of meals)					1 2 3 4 5 6
C11. Draw down on livestock, surpluses or savings					1 2 3 4 5 6
D. COMMUNAL POOLING					
D1. Restore and preserve homestead or mountain forests to reduce erosion					1 2 3 4 5 6
D2. Rangeland preservation and grazing restrictions					1 2 3 4 5 6
D3. Soil erosion prevention programmes (e.g. community terracing)					1 2 3 4 5 6
D4. Communal water harvesting, tanks					1 2 3 4 5 6
D5. Communal irrigation					1 2 3 4 5 6
D6. Other:					1 2 3 4 5 6
D7. Other:					1 2 3 4 5 6

Observations:
.....
.....
.....

10. Administrative issues

Date of interview	
Name of interviewer	
Checked by	

APPENDIX 2. GUIDE FOR PRA'S: THEMES, SOCIAL GROUPS, AND METHODS

<i>Themes and Issues</i>	<i>Individuals/Groups to interview</i>	<i>Methods</i>
The socioeconomic condition of the community		
Social systems – kinship, governance, norms/regulations and enforcement, esp. in relation to natural resource management	Community leadership (Chiefs, magazias, UC members, AP)	semi-structured interviews (SSI); trend analysis
Social and economic amenities in the community – education, market, water, energy source(s), etc	Community leadership	Guided Walk (Observation); SSI
How different people in the community are affected differently by climate change impacts (e. g: landless persons, ethnic minorities, women and other vulnerable groups)?		
What evidence of climate change is already being observed by the community? – (Communities' knowledge/perceptions of trends in climate change over the past 20–30 years) <ul style="list-style-type: none"> • seasonal shifts • changes in precipitation patterns and availability of surface water • extreme weather trends – (in terms of erratic weather, seasons or other changes in weather patterns) • in terms of disasters 	Chief, magazia, Tindaana, UC, AP; FGD with men, women, youth	Seasonal diagram; SSI
What are the most important livelihoods of the (i) community members and (ii) of the most vulnerable and poor groups?	FGD with men, women, youth, and the most vulnerable groups like settlers/migrants, the poor, persons with disabilities	SSI
What are the most important livelihood resources in this community in general and for the vulnerable groups? How available are the resources? Who has access to them? Who controls them? How are they being used to achieve livelihoods outcomes?	FGD with men, women, youth, and the most vulnerable groups like settlers/migrants, the poor, persons with disabilities	Resource Map & SSI
What resources and people are most at risk of climate related hazards What parts of the community are most vulnerable to the hazards identified? Who are the members of the community who are most at risk? Why? Are the hazards different now than they were 20 years ago? How?	FGD with men, women, youth, and the most vulnerable groups like settlers/migrants, the poor, persons with disabilities	Resource map & SSI
Vulnerability and the coping/adaptation strategies employed by community members/groups		
Identification of the most vulnerable socioeconomic groups in the community	Chiefs; Tindaana; FGD with men, women, youth.	Wealth/wellbeing categorization; SSI
What coping/adaptation strategies are currently being employed by various members of the community, especially the most vulnerable? (mobility, risk pooling, storage, diversification, market exchange etc) Which are working/which are not working and why? What are the costs and benefits? Which are sustainable?	FGD with men, women, youth, and the most vulnerable groups like settlers/migrants, the poor, persons with disabilities	SSI
Which social/economic group in the community is vulnerable and most at risk of the impact of climate change? <ul style="list-style-type: none"> • in terms of food security • health/disease burden • migration • access to productive land and water 	Chief/Tindaana & elders; FGD with men, women, youth, children	Matrix Scoring
What are the key drivers/underlying causes of vulnerability to climate change? Which social beliefs, norms and practices enhance or limit adaptive capacity? Which institutions in the community promote or hinder adaptation? And for which vulnerable group? Which power structures enhance or limit access to and control over resources needed to adapt? And for which vulnerable group?	Chiefs/Tindaana & Elders FGD with men, women, youth, and vulnerable groups	Institutional Analysis using Scoring
Policies and institutional capacities and types of support needed		

<i>Themes and Issues</i>	<i>Individuals/Groups to interview</i>	<i>Methods</i>
What policies and institutional capacity exist to facilitate adaptation? <ul style="list-style-type: none"> • within the community • outside the community • key partners/allies (NGOs) 	Chiefs/Tindaana & Elders FGD with men, women, youth, and vulnerable groups	Institutional Analysis
What types of support are needed to facilitate adaptation by various members of the community? (e.g. Interdepartmental cooperation, treatment of supplementary benefits, perceptual changes, policy priorities): <ul style="list-style-type: none"> • at the individual or household level • at the community level • for institutional capacity development • for influencing policies (local & national) 	Chiefs/Tindaana & Elders FGD with men, women, youth, and vulnerable groups	SSI & Scoring

APPENDIX 3. VILLAGE ENTRY GUIDE

For the village level discussions:

Hello, my name is _____ and these are my colleagues _____. Our team from the Participatory Development Associates (PDA) Kumasi is here studying livelihoods in the area and the responses of

households to changes in climate. We are interested to know about this village, the work you do, and how you earn income throughout the year. We would like to ask you some questions about this and do some exercise to understand the main features of your village. The discussion should take a couple of hours.

APPENDIX 4. NO. OF HOUSEHOLDS INTERVIEWED (SITE; INCOME TIER; GENDER OF RESPONDENT)

Zone	Site	No. of household interviewed	Income tier (High, Medium, Low)	Gender of respondent	
				Male	Female
Northern Savannah	Tetauku	10	Low	7	3
	Boayini	10	Low	8	2
Total				15	5
Transitional	Buoyem	10	Low	6	4
	Dzatakpo	10	Low	6	4
Total				12	8
Forest	Kamaso	10	Low	5	5
	Gonukrom	10	Low	6	4
Total				11	9
Coastal	Ada-Anyakpor	10	Low	4	6
	Nima	10	Low	7	3
Total				11	9
Grand Total		80		49	31

APPENDIX 5. NO. OF FOCUS GROUP DISCUSSIONS HELD

<i>Site</i>	<i>Date visited</i>	<i>Groups met</i>	<i>Number of Participants</i>		<i>Total</i>
			<i>Men</i>	<i>women</i>	
Tetauku	18 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	20	15	35
Boayini	20 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	25	15	40
Buoyem	18 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	21	15	36
Dzatakpo	20 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	24	12	36
Kamaso	20 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	22	16	38
Gonukrom	18 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	24	13	37
Ada-Anyakpor	18 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	26	18	44
Nima	21 – 05 – 09	Community (men and women groups), chief and elders, vulnerable groups	25	17	42

APPENDIX 6. LIST OF KEY INFORMANT INTERVIEWS WITH DATES

<i>Site</i>	<i>Date visited</i>	<i>Key informants</i>
Tetauku	19 – 05 – 09	Community elder
Boayini	21 – 05 – 09	Chief and linguist
Buoyem	19 – 05 – 09	Chief and elder
Dzatakpo	22 – 05 – 09	Chief and linguist
Kamaso	20 – 05 – 09	Community elder
Gonukrom	23 – 05 – 09	Community elder
Ada-Anyakpor	20 – 05 – 09	Chief and linguist
Nima	22 – 05 – 09	Chief and linguist

APPENDIX 7. SAMPLE PSD WORKSHOP AGENDA

Participatory Scenario Development
Workshop Agenda**Accra, Ghana***Day 1*

8:30–9:00	Registration	
9:00–9:30	Welcome and Introductions	
9:30–10:00	Introduction to the EACC Study	
10:00–10:30	Socioeconomic Trends and Projections	
10.30–10.45	Break	
10:45–11.15	Overview of Climate Change and Impacts Presentation and Plenary discussion	
11:15–12:15	Vulnerability and Climate Change Impacts	Plenary
12.15–13.15	Lunch	
13:15–14:45	Identification of Current & Future Adaptation Options	Plenary discussion Group Activity
14.45–15.15	Developing Adaptation Pathways	Group Activity
15.45–16.00	Break	
16.00–17:00	Group Presentations on Adaptation Pathways	

Day 2

9:00–9:15	Welcome Back & Opening Remarks	
9.15–10:15	Adaptation: An Integrated Pathway for Ghana	Plenary discussion Group Activity
10:15–10:30	Break	
10.30–11:15	Linking Development & Adaptation	Plenary discussion
11:00–11:30	Summary & Next Steps for the EACC Study	Presentation
11:30–12.00	Closing Remarks & Workshop Evaluation	
12.00–12.30	Break	

APPENDIX 8. RAINFALL TOTALS FOR SELECTED STATIONS

<i>Year</i>	<i>Wenchi: Transition</i>	<i>Bolgatanga: Savannah</i>	<i>Axim: Forest</i>	<i>Ada: Coastal</i>
	<i>Total rainfall</i>	<i>Total rainfall</i>	<i>Total rainfall</i>	<i>Total rainfall</i>
1960	1639.2		2436.1	979.3
1961	965.8		2179.3	1044.2
1962	1532		2515.1	1491.4
1963	1622.1		3332.1	992.9
1964	1087.6		1704.5	597.9
1965	1241.8		2930.7	838.1
1966	1209.4		1626.5	819
1967	1123.7		1747.5	1057.5
1968	1757.7		3035	1696.4
1969	1387.2		2336.3	619.9
1970	1016.3		1870.9	965.2
1971	1427.1		1802.8	887.2
1972	1345		1943.3	877.8
1973	1186.7		1860.4	1118.2
1974	1017.4		2759.4	1330.4
1975	1179.6	728.4	1967.8	947.1
1976	1285.4	3035.3	2174.5	534.7
1977	1158.9	764.4	1200.6	373.1
1978	1140.9	961.4	2495.5	601.7
1979	1148.4	967.5	2949.3	574.4
1980	1259.8	776.3	2125.7	673.1
1981	1311.8	742.2	1811.6	805.7
1982	591.1	930.5	2253.6	1247.5
1983	841.4	927.5	1071	539.7
1984	1025.9	776	1985	726.9
1985	1340	880.4	1832.8	665.6
1986	1169.5	887.8	2050.1	495.8
1987	1250.7	900.1	2748.1	931
1988	1209.6	979.2	1788.9	798.3
1989	1726.3	1230.7	1533.8	949.9
1990	1014.4	755.9	1385.1	655.9
1991	1408.3	1158.1	1768.3	1298.1
1992	1285.7	946	1847.6	359.2
1993	1212.4	1001	2355.2	759.3
1994	918.6	1041.3	2318.8	700.9
1995	1372.6	869.6	1663.2	859.2
1996	1155.7	1306.8	2161.3	992.3
1997	1019.8	953.4	2031.3	1191.2
1998	1052.7	951.8	1169.2	484.4
1999	1288.8	1165.7	1886	716
2000	1187	1000.9	1425	394.3
2001	987	985.8	1862.5	634.6
2002	1413	879.1	2310.5	842.6
2003	1396.4	960.5	1999.4	1061.9
2004	1349.7	827.3	1819.6	587.2
2005	1330.2	877.3	1980.9	779.3
2006	1210	461.4	1407.8	
2007	1217.3		2331.2	



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