Ghana Country Report

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1. Introduction

The project carried out in Ghana under the Netherlands' Climate Assistance Program (NCAP) aimed at exploring the linkages between poverty alleviation, climate change, and adaptation responses. There were numerous activities and outputs of the project spread over two distinct phases during the period 2003 to 2008, and all were underlain by the overriding goal of developing a national approach to mainstreaming climate change concerns into ongoing development efforts that address poverty, adverse impacts from climate change, and new planning frameworks in a conterminous way.

The Ghanaian economy depends heavily on the agriculture, forestry, and fishery sectors, all of which are highly sensitive to projected climatic fluctuations. As many have noted and which is widely recognized in Ghana, the adverse impacts associated with climate change will most likely hit poor rural communities the hardest; the very communities engaged in agricultural production, dependent on annual yields of forests, and fishing for their livelihoods.

Rural communities in Ghana can be characterized by a relatively high incidence and extent of poverty, higher fertility rates, higher biomass usage, fewer infrastructure facilities, lower educational status, and lower health status. The overwhelming majority earn no more than about $2 per day, rendering them the least capable of adapting or coping with increasing climatic hazards.

The urban poor are another group vulnerable to climate change in Ghana. Typically living in unplanned settlements (slums and densely populated areas) located along the coastal areas, or close to surface watercourses and stagnant drainage systems, it is likely that they will face increased flooding, rising sea levels, and new public health risks as temperatures rise and disease vector distribution patterns shift.

These inescapable perceptions form the basis of the NCAP effort in Ghana. Also, since climate variability and climate change had not been seriously addressed in national policymaking dialogues at the time the study was launched, there has been growing concern that climate change could undermine national poverty reduction strategies and render development targets unmet. Subsequently, mainstreaming climate change into the Ghana Poverty Reduction Strategy (GPRS) was a critical starting point for the Ghana NCAP project.

At the broadest level, the effort to mainstream climate change into development activities was carried out in two distinct phases. The first phase focused on the development of climate change, the conceptualization of socio-economic development scenarios and the preparation of sectoral vulnerability and adaptation assessments. Taken together, activities in the first phase were essential in developing a better understanding of socioeconomic vulnerability to future changes in temperature and precipitation regimes. They were also instrumental in the identification of the range

of potential adaptation strategies that would build resilience in local communities against climate risks in the agriculture, fishery, land management, and public health sectors.

The second phase of the effort attempted to build on these results and develop a strategy to integrate the outputs of sectoral vulnerability and adaptation assessments into national development planning. A key feature of this process was extensive consultations with a wide range of stakeholders through public workshops and forums, with the aim of capturing salient input on the project's emerging understanding of vulnerability and potential adaptation strategies. The workshops also helped to develop national capacity in methodological approaches and analytical tools for the prioritization of adaptation options. Overall, the key output for the second phase was the national adaptation policy framework and its direct application in the preparation of an adaptation project portfolio for Ghana.

The rest of this report describes the process, activities, results, and lessons learned associated with the Ghana NCAP projects. The next section describes the rationale and key objectives of the project. In Section 3, key results and finding are presented. Finally, section 4 presents lessons learned. A numbers of annexes are also included that provide additional detail for some of the key activities and processes.

2. Rationale and Objectives

As background, it is important to note that Ghana participated in the earlier climate change assistance programme offered by the Dutch government. The Netherlands Climate Change Studies Assistance Programme (NCCSAP) ran from 1996 to 2003 in Ghana and provided technical support for the preparation of climate changes projections, as well as vulnerability and adaptation assessments for water resources, coastal zones and agriculture (cereal production). As such, the current NCAP project was able to benefit from and build upon the significant level of capacity enabled by the earlier NCCSAP.

The technical outputs of the NCCSAP project were instrumental in shaping a broad understanding in Ghana regarding the likely evolution of the climate system in the West Africa region. The outputs of global circulation models indicate that a temperature rise of about 1˚C, a 20% reduction in rainfall, and a 30% reduction in runoff would likely occur around the middle of this century. As the regional climate changes, many of Ghana's physical and biological systems were determined to be at risk. Indeed, Ghana's natural systems were found to be vulnerable to more frequent droughts and floods, particularly impacting ecosystem-based livelihoods like fishing and farming. Moreover, growing aridity would reduce groundwater recharge and an increasingly arid climate would lead to the depletion of biodiversity and desertification.

While the Ghana NCAP project continued NCCSAP's focus on vulnerability and adaptation studies, its motivating rationale was the need to better understand the linkages between poverty and climate change and the way in which the livelihood systems of poor communities could be affected. Given the results of the previous climatic modelling and vulnerability assessments, the driving question was how could adaptation responses be introduced that would mitigate the harm to rural communities already confronted with persistent poverty. The formulation of climate change policies that could complement and strengthen existing national policy documents addressing poverty alleviation – most notably the Ghana Poverty Reduction Strategy (GPRS) prepared in 2005 by the National Development Planning Commission – was a key strategic objective.

This was considered a crucial point of departure for the NCAP project because of the readily apparent weaknesses of the GPRS. Although Ghana's poverty reduction efforts and the GPRS itself do indeed recognize a number of environmental issues that affect quality of life, climate variability and change have not been included. When compared to other national policy documents addressing development issues, this is not particularly surprising – the impacts associated with climate variability and climate change on poverty tend to be overlooked at worst or only implicitly

acknowledged at best in key national policy documents. The Ghana NCAP project's outputs, as summarized in the next section, addressed this important gap in a proactive way.

3. Key Results and Findings for Phase 1

At the operational level, the Ghana NCAP project was divided into two, eighteen-month phases. Mainstreaming climate change into the national development agenda was the overriding driver for both phases. Broadly speaking, the first phase focused on assessment and the second phase focused on policy integration.

Phase 1 unfolded over the period 2003 to 2006 and primarily involved the development of climate scenarios and vulnerability and adaptation assessments for the agriculture, land management, human health, and fishery sectors. Two additional policy reports were also prepared to explicitly address gaps in the GPRS; one on the nexus between climate change adaptation and poverty and another on women's vulnerability to climate change.

Activities during Phase I also addressed capacity building. During the course of activities, three capacity-building workshops were organized around training in tools for sectoral vulnerability and adaptation assessments, including poverty, gender and livelihoods linkages. By any measure, these stakeholder meetings were excellent opportunities to promote public participation and social learning, to address the effects of climate change, and to identify community-driven adaptation measures.

3.1 Climate Scenario Modeling

A climate change scenario represents a plausible future regarding temperature and precipitation regimes in response to increasing levels of greenhouse gases in the atmosphere. The difference between a reference scenario, in which the historical climate records are continued and the climate change scenario, in which anticipated trends are incorporated offers insight into the additional stresses that may adversely affect crop production, rangeland productivity, public health, and other climate-sensitive sectors.

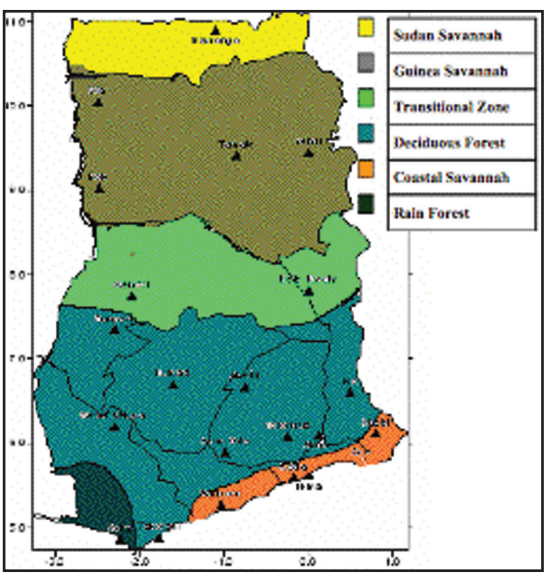

Figure 3.1: Map showing areas for which climate scenarios have been developed.

Climate change scenarios were developed for use in the assessment of the impacts of climate change in several regions as shown in figure 3.1. Climate scenarios were used in the assessment of impacts on human health, fisheries, agriculture (emphasis on root and tuber and cocoa production), and land management (including biodiversity conservation, soil erosion and desertification). Trends in the observed time series of temperature and rainfall, during the period 1961 to 2000, were analyzed and used as calibration points for the selection of particular global circulation models (GCMs) that best correlated with Ghana's historical climate patterns. After this initial screening phase, the outputs for the years 2020, 2050, and 2080 were downloaded from the MAGICC/SCENGEN1 tool for the selected models.

As shown in figure 3.2, projections of temperature and precipitation were developed for 30-year mean climates for the years 2020, 2050 and 2080. The chart on the left shows the variation in monthly mean air temperatures for Ghana as a whole. As can be seen, incremental temperatures in 2080 are expected to be the highest during the January to May period (about 4.1°C) and smallest during the summer months (about 3.5°C).

The chart on the right in figure 3.2 shows average annual rainfall for each of the six ecological zones. As can be seen, rainfall levels decrease over time for each zone. By 2080, rainfall is expected to decrease between 10% and 16%, with the steepest reductions expected in the rainforest (southwest corner) and deciduous forest (southern third) areas of the country. A number of other climate scenarios, not shown here, were developed relative to mean levels in 1990, including changes in daily rainfall levels and sea surface air temperature for coastal areas.

3.2 Vulnerability to Climate Change – Key Linkages

In order to better understand the underlying linkages between climate change and the vulnerability of key groups in Ghana, two studies were undertaken. The first focused on a review of climate and poverty links, particularly focused on rural communities; the second focused on a review of climate change issues affecting women. Both are briefly summarized in the following subsections.

3.2.1 Climate-Poverty Linkages

There is a strong relationship between climate and poverty levels. The key findings of the study showed that districts that fall within ecological zones with high temperature and low rainfall such as Sudan Savannah, Guinea Savannah and the transitional zone tend to have higher poverty incidences than those with low temperatures and higher rainfall. The ultimate effects of climate change on socio-economic or ecological systems depend on the interplay of three factors, namely, the characteristics of the climate change, the sensitivity of the system to a given change, and the capacity of the system to adapt to climate change.

Poor households tend to depend heavily on environmental goods and services. Their livelihoods are punctuated by dependence on agriculture, fisheries and forestry both of which rely on the use of land and water resources. Livelihoods depend on the capacity of ecosystems to provide the services vital for environmental balance without which food production and other productive activities cannot be carried out sustainably. The paper demonstrates that whereas poverty and climate change may appear at the extreme ends of the tunnel, the attainment of poverty reduction goals, both nationally and globally, will hardly be realized without due consideration for mainstreaming climate change into national development and poverty reduction programs.

Some of the fundamental reasons for Ghana's persistent poverty can be traced to environmental causes (see figure 3.3). For example, indoor and outdoor air pollution is a major contributor to

1 MAGICC: Model for the Assessment of Greenhouse-gas Induced Climate Change, is a suite of coupled gas-cycle, climate and ice-melt models integrated into a single software package and SCENGEN: A Regional Climate SCENario GENerator, is used to construct a range of geographically explicit climate change projections using the MAGICC results.

poor human health. Inadequate sanitation, poor hygiene practices and lack of access to safe drinking water are major causes of diseases. Additionally, nearly a third of Ghana's population of about six million is unable to meet their basic nutritional needs, even if they were to devote their entire consumption budget to food. Climate variability will reduce food security even more because agriculture depends heavily on rainfall with few farmers using irrigation schemes.

The key finding from a detailed review of the Millennium Development Goals (MDGs), New Partnership for Africa's Development (NEPAD), and the Ghana Poverty Reduction Strategy (GPRS) is that they provide very little focus for climate change even though all documents recognize the importance of environmental health in reducing poverty. These documents poorly articulate the strong climate-poverty linkages and the recognition of a vulnerable population's need for adaptive measures. The process of integrating climate change into the GPRS is constrained by the complex cause-effect relationship between climate change and poverty and the absence of appropriate and effective data and information.

There is evidence of consistency across the GPRS and the MDGs, and in fact, the targets and indicators set up for both appear to show that meeting the GPRS goals and targets will work in correspondence with the attainment of the MDGs. The challenge here is how to overcome the assumption that meeting the GPRS targets will automatically realise the MDGs. It is one which simply goes beyond the point of integrating MDGs at the national level or into the GPRS. Insufficient attention to the practical realities on the ground, at the local level, could result in neglecting the concerns of the vulnerable and the adaptive measures that could be instituted to address their concerns.

To address these important shortcomings, a number of recommendations have been developed as briefly outlined below:

- *Deeply Involve Policy Makers:* The effectiveness of policy interventions depends on the policy makers' ability to understand and appreciate the complexities through which climate change affects the poor. It is important to deeply involve policy-makers in integrating climate change issues into national development planning, emphasizing long-term planning and the implications for poverty reduction.
- *Encourage Climate Change Research and Education:* Information and data are vital in the process of integrating climate change into national development planning. Given variations in the economic, social, and cultural contexts of affected social groups, care must be taken to avoid a "one size fits all" approach.
- *Develop Insurance Schemes:* New insurance schemes should be developed for climate-sensitive sectors such as agriculture, health, housing and infrastructure, since some impacts of climate change may be unavoidable. It will be important to adopt a "learning-by-doing" approach that starts on a pilot level at local levels, and seeks to integrate lessons learned into nationwide programs.
- *Fund Adaptation Initiatives:* A critical factor in adaptation is the availability of funds. For Ghana, it will be important that effective bilateral and multilateral strategies are put in place to mobilize funds for priority adaptation initiatives. National incentives such as tax rebates, encouraging private/public partnerships, and realignment of the national budgeting process should also be explored.
- *Strengthen Institutional & Organizational Capacity:* To promote the mainstreaming of climate change into national development, the Inter-Ministerial Committee on Poverty Reduction (IMCPR) and the Technical Committee on Poverty (TCOP) should be re-activated. It would be strategic to start with development issues that are already prominent and explore how such issues can be address in a climate-sensitive way.
- *Build and Disseminate Early Warning Systems:* Build early warning system for natural disasters and effectively disseminate these warning to stakeholders especially at the local level. Also provide efficient mechanisms for disaster management.

- *Strengthen Regional Collaborations:* Climate change issues cut across countries. Therefore, the learning of best practices and sharing of ideas and information on adaptation among countries in the sub-region should be explored using existing agencies/entities. The Ministry of Regional Cooperation and NEPAD could lead this process since they have existing collaborations with countries in the sub-region.

3.2.2 Women-Vulnerability Linkages

Vulnerability, in its entirety, reaches beyond social and economic impacts into the very foundation of sustainable livelihoods. Women, in particular, depend on local ecosystems to provide food, energy, water and medicine, and to renew fertility in soil and purity in water. In Ghana, women constitute about 51% of the total population and about 30% are heads of households according to the 2000 census. Women also control key productive sectors. They produce 70% of the country's subsistence crops, constitute 52% of the agricultural labor force, and contribute 46% of the total GDP. They play major roles in distribution and production, undertaking 85% of food distribution.

Women's roles in the society are reinforced by traditions, customs, attitudes, practices and institutional structures. In the Ghanaian system, women are the primary caregivers for childcare. In the rural areas and in female-headed households, they are also the primary managers of household resources like water, fuel and sometimes food for domestic animals. In addition to these household responsibilities, women participate in land preparation, planting, weeding, fertilizer application, harvesting and transportation of produce. They usually undertake vegetable cultivation in the dry or minor rainy season. Some women process both food and cash crops for home consumption and for sale. Given the variety of women's daily interactions with the environment, they are the social group most implicated by environmental degradation, which includes impacts from climate change.

Box 3.1: Major Socioeconomic pressures facing women

- One third of women are already living below the poverty line
- Livelihoods depend on all the sectors that are vulnerable to the impacts of climate change
- Lack of formal education
- Limited land rights
- Constrained access to formal saving and lending schemes
- Inadequate capital for expansion of economic activities

Even though women's livelihoods and their contributions towards the national economy dominate the agriculture sector, several socio-economic factors diminish women's productivity including: inaccessibility of realistic financial resources; lack of information; lack of improved appropriate technology; and unfavorable land tenure systems (see Box 3.1). Women face major challenges in the legal system too, especially with respect to land rights. Even though constitutional provisions protect women's land rights, in most parts of the country they experience discrimination under customary law.

Women in the fisheries sector are mostly on a low-income and manage large households. Post-harvest fisheries activities provide a wide range of full-time and seasonal employment to many women. The loss or decline of these opportunities through the impacts of climate change would significantly increase the risks to many women already on the margins of poverty as their income declines significantly.

The study found that women's livelihoods are also inextricably linked to adequate quality and quantity of water resources. Water scarcity has always been a potential source of social upheaval and contributes to other problems associated with climate variability such as migration from drought-affected areas. The arduous burden of retrieving and carrying water over long distances

falls mostly on women and children. Particularly in the rural areas, it is the women's responsibility to make sure that there is enough water for the family to wash, cook and to support farming activities. During recurring droughts and chronic water shortages, the poor majority usually pay a high price for water, especially women and children. They pay more in cash to buy small amounts of water and they expend more in calories carrying water long distances. In the event that climate change results in flooding and other extreme weather events, the limited involvement of women and children in planning for disaster renders them extremely vulnerable.

Women and children are the most vulnerable to hunger related deaths and illness, which would be exacerbated indirectly by climate change through increased food insecurity and water shortages. Cases of cholera, diarrhea, malaria, malnutrition, and heat related deaths might increase depending on the climate scenario.

In conclusion, the two key issues that emerged from the study are women's lack of knowledge of the causes and impacts of climate change and inadequate capital for women for their economic activities. Discussions with women revealed that despite experience with climate variability and ongoing adaptation, the vast majority of women are unaware of the causes. As key stakeholders, women could enhance their roles in national development by being better informed and improving the scientific and technological basis of their livelihood activities with respect to climate change.

3.3 Vulnerability and Adaptation Assessments – Key Socioeconomic Sectors

The following subsections summarize key findings from vulnerability assessments in key socioeconomic sectors in Ghana. These sectors are public health, fisheries, agriculture and land management. A targeted list of recommended adaptation strategies is also summarized for each sector.

3.3.1 Public Health

The human health sector was selected for assessment because of its importance to the national economy and the implications for addressing poverty. Climate change, in the form of thermal stress, can directly affect cardiovascular and respiratory morbidity and mortality. Indirectly, climate variability can influence food production, malnutrition, and disease agents for vector-, water-, food-, and air-borne categories. Moreover, changes in climate can impair the efficient functioning of many ecosystems in Ghana, which in turn can have adverse effects on human health.

The key goals of the assessment were to better understand the association between climate change and human health vulnerability, investigate the consequences of climate change on the livelihood systems of poor communities, as well as provide a technical indication of the impact of climate change on human health for the following diseases: Malaria; Measles; Meningitis; Guinea worm; and Diarrhea. Adaptation options for the health sector are typically those that should happen anyway, where disease incidence is high, regardless of future predictions.

The key finding of the study is that the impact of the disease burden from projected changes in the Ghanaian climate on individuals, communities and the nation as a whole is likely to be considerable. The number of months with climatic conditions suitable for high incidence of meningitis cases will increase, bringing with it a higher risk of meningitis nationally. Diarrheal diseases are also likely to increase due to reduced rainfall and increased mean air temperatures. Less rain and hotter temperatures also increase the risk of Guinea worm infestation nationally. Table 3.1 summarizes the major public health concerns in Ghana, and how they are likely to be affected by climate change.

Regarding the relationship between health, food security and climate change, the study found that malnutrition is likely to increase due to the increased frequency of extreme weather events. Such

events will reduce farmland productivity in rural areas of Ghana and by extension diminish the supply and availability of foodstuffs. Indeed, food scarcity and the corresponding increase in the cost of local foods will also be likely to lead to increased infections, absent adaptation strategies through an increase in biological susceptibility.

On the positive side, there are a few indicators that suggest that with hotter and drier conditions, there could be a decrease in the incidence of malaria and measles infection rates. This is mostly due, however, to effective case management and preventative measures that are already in place. The adaptation portion of the assessment concluded that several adaptation options will be instrumental in helping Ghanaian communities to adapt to the public health impacts associated with climatic change. Principal among them are the following:

- *Form community health groups:* This is a crucial part of the strategy as such groups would improve education that would lead to behavioral change as well as build awareness among communities of actions they could take to ameliorate risk factors in their daily living conditions. In addition, such groups could be used to promote and enforce exclusive breastfeeding for children for their first six months, and disseminate information on improved weaning practices.
- *Conduct vaccination campaigns:* The key focus of these campaigns would be on measles and meningitis as an epidemic management strategy whose objectives dovetail nicely with the role of community health groups. Health workers and health groups would also play a vital role in monitoring and communicating disease risk and strengthening nutrition and food security, both of which would build resilience and facilitate adaptation to climate change. Indeed, community groups are also well-positioned to mobilize around immunization campaigns.
- *Implement vector control:* Improved vector control was also identified as a means to breaking the transmission cycle as infection becomes more prevalent and probable. Intervention initiatives include early detection, rapid treatment, and using multiple means for disease prevention.

3.3.2 Fisheries

A quarter of the Ghanaian population lives in coastal zones and roughly 10% depend on coastal fisheries for their livelihoods. On average, 65% of the animal protein intake of Ghanaians comes from fish, giving the sector an important role in poverty reduction and food security. Fisheries also create employment opportunities and so any adverse changes in sea surface, inland water, and ambient air temperatures along the coast could dramatically affect fisheries production. For the last four decades, climatic variability has been positively correlated with fluctuations in the landings of the pelagic species upon which Ghana's fishing industry depends. Moreover, as the fishing industry in Ghana is predominantly in the hands of women, rural fisherwomen's vulnerability was a focal point for the assessment.

The vulnerability assessment was carried out using the 3-step methodology illustrated in figure 3.3. Step 1 focused on a representation of climate scenarios focusing on changing sea surface and coastal temperatures. These scenarios fed into Step 2 which applied an impact model to predict the effect of these changes in fish stock populations. Finally, Step 3 focused on understanding the perspectives of local stakeholders on the root causes of vulnerability, current coping mechanisms, and suggestions for building long-term adaptive capacity.

The key overall finding was that traditional livelihoods dependent on fisheries will be highly vulnerable to climate change. This finding is exacerbated by the fact that current fish stocks off the Ghanaian coast are already considered to be at their maximum level of exploitation.

Stakeholders identified several factors for changing trends in fish stocks. These included warmer air and sea surface temperatures (SST), over-fishing, and population growth (i.e., greater demand for fish products). Moreover, stakeholders noted that reductions in available fish stocks have led to increasing unemployment among fishermen and created serious risks to livelihoods and food security.

Disease Baseline		Increased mean air temperature	Decreased Humidity	Decreased Precipitation	At risk populations
		Expected changes in incidence and occurrence due to climate factors:			
Malaria	Perennial in mean air temperature ranges (25.6°C to 31.1°C), thrives during high relative humidity and precipitation.	-	Down	Down	Children under 14, boys are more vulnerable than girls based on responsibilities (indoor vs. outdoor tasks)
Measles	Incidence increases from the cold dry months (Jan. & Feb.) to the hot dry months (Mar. & Apr.).	Up	Up	Up	Men and boys seem to be the most at risk. The increase is anticipated based on climatic conditions, but independent of current control mechanisms that have sent the disease into decline.
Meningitis	High numbers of meningitis cases occur in the hot dry months, the range of suitable months is increasing.	Up	Up	Up	Hot dry conditions coupled with poor ventilation favors the occurrence of meningitis cases.
Diarrhea	Diarrhea is perennial with very small monthly variation and can occur at any time of the year. Climate factors affecting the incidence and occurrence are water scarcity, poor water supply and rainfall.	-	-	Up	The most at risk group is children under 14 (boy and girls about the same); women 15-60 are much more impacted than men. The incidence of disease is more dependent on behavioral changes, poor sanitation poor disposal of feces, overcrowding, and hygienic conditions.
Guinea Worm	Low numbers of Guinea worm cases occur in high rainfall months.	Up	-	Up	The nation is at a risk of Guinea worm infestation under conditions of increased temperature and reduced rainfall amounts, but the annual distribution of Guinea worm cases showing a decreasing trend (1999-2004).

The adaptation portion of the assessment concluded that several adaptation options would be instrumental in helping Ghanaian fishing communities to adapt to the climate change impacts on fisheries. Principal among them are the following:

- *Reuse wastewater for aquaculture:* As rainfall decreases and the accessibility of freshwater declines, recycled wastewater should be used as a resource for the promotion of an aquacultural industry.
- *Restore freshwater fishery systems:* Agro-forestry and ecosystem rehabilitation at Lake Bosumtwi and in the Lake Volta Basin would build ecosystem resilience and improve the adaptive capacity of these fishery systems as the climate changes.
- *Enhance data collection and monitoring networks:* There is an overarching need for improved data quality in the fishery sector to facilitate and inform future climate change system-based fishery impact analyses.

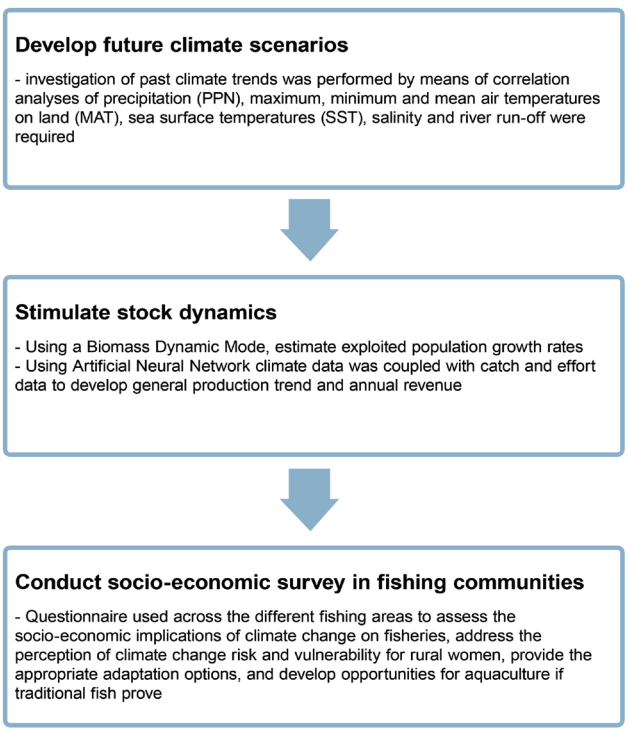

Figure 3.3: Fisheries study methodology

3.3.3 Agriculture

Agricultural land in Ghana is used mainly for production of cereal, cocoa, oil palm, root vegetables, tubers, livestock raising, and irrigated farming in conjunction with shallot farming. The vulnerability and adaptation assessment focused on a subset of these systems: root/tuber production, cocoa farming, and cereal production. The key findings for each assessment are briefly summarized in the paragraphs below.

Root crops are critical to local livelihoods and the Ghanaian economy. At present, they account for roughly 58% of per capita food consumption and about 40% of GDP. Typically, distribution and annual yields vary significantly depending on climatic conditions and the particular type of root crop. The primary impacts on the productivity of crops that do not have stable genotypes arise

from water shortages, as well as harmful interactions among crops, weeds, insects, and diseases/pathogens.

The role of cocoa in the Ghanaian economy is also substantial, particularly as a commodity export. Production increased from 395,000 MT in 2000 to about 740,000 MT in 2005 during a stretch when cocoa producer prices increased. The share of cocoa in GDP rose from about 5% in the 2000 to 2004 period to about 8% in the 2005 to 2006 period. Cocoa is highly sensitive to changes in climate. The crop is highly susceptible to drought making rainfall patterns, a primary determinant of productivity. High quality cocoa production also requires motivation, skill to employ best practices, and adaptive decision-making. Many farmers have not yet adopted the recommended best practices to mitigate the effects of climate change. This could be due in part to low incomes, low motivation, and lack of formal credit. Ill-adapted farming practices, more than any other factor, result in current high levels of vulnerability to climate change effects.

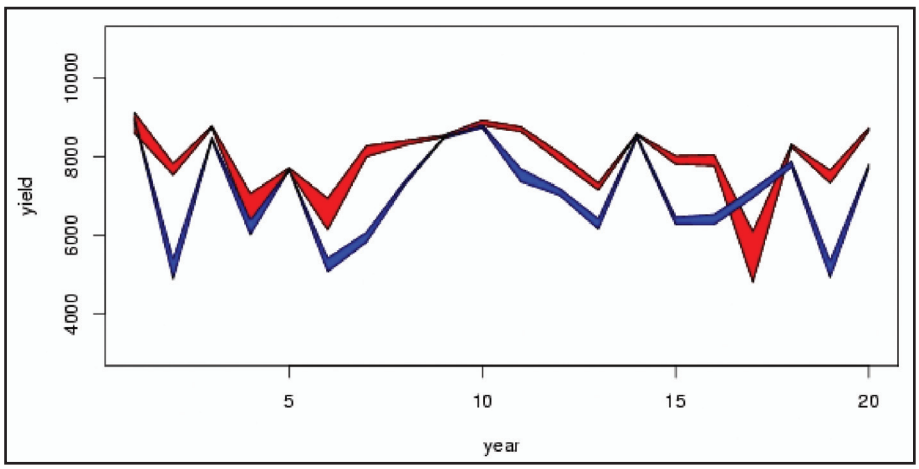

Figure 3.4: This figure illustrates a range of yields (tons/year) from a CERES maize crop model (Source: http://www.cgd.ucar.edu/asr/asr03/gsp/Image32.gif)

The NCAP project developed earlier work to assess the vulnerability of cereal production (millet, guinea corn). In 1998, the Environmental Protection Agency (EPA) commissioned an analysis of climate change on cereal production and an assessment of potential adaptation strategies. Using the climate change scenarios developed at the time and certain impact models (i.e., the CERES maize model of the CERES family of models; see figure 3.4), it was projected that maize yields would decline by about 7% by the year 2020 whilst millet, being more drought sensitive, would be largely unaffected.

The adaptation portion of the assessment concluded that several adaptation options would be instrumental in facilitating Ghanaian communities in adapting their agricultural activities to climatic change. The overriding discovery from the assessment is that effective policies could minimize adverse impacts on food security notably by reinforcing many of the existing policies and strategies as identified in the Ghana Poverty Reduction Strategy. Within this broad recommendation, specific incremental findings include the following:

- *Rehabilitate inactive cocoa farms*. Restoring degraded lands to sustainable production would build resilience in the face of climate change. Many degraded cocoa farms and forestlands that were once cultivated played important roles in reducing deforestation and migration rates, both of which actually exacerbate local vulnerability. Also, irrigation is traditionally not part of the cocoa farming systems in Ghana; however, policies to promote irrigation systems in rehabilitated farms by providing infrastructure, education and training would help farmers cope with climate change.

- *Reform financial and institutional framework for agricultural production*. The agricultural sector needs to be reformed and/or revitalized in such a way as to provide incentives for the adoption of new, more efficient farming practices. The primary means to accomplish this broad aim include enhancing farmer access to credit, stabilization of farmers' incomes through effective national pricing policies, and the development of more effective land tenure systems.
- *Promote shaded cocoa farming*. Policies should be established to encourage tree planting and maintenance of shade on cocoa farms. Shaded cocoa cropping systems are considered a sustainable agricultural practice that can provide substantial environmental benefits including habitat conservation, climate change mitigation, hydrological cycling and watershed protection. Farmers often grow cocoyam and yams alongside cocoa and new technologies in the pipeline suggest the use of cassava as shade trees in cocoa production.
- *Develop drought contingency plans*. A drought management policy should be established that makes use of information systems about changing climate conditions and patterns, advance preparatory practices, and post-drought options to deal with impacts. This would include new farm insurance programs that would help build farmers' financial resilience.

3.3.4 Land Management

Land use patterns are currently dictated by an area's environmental endowments—land is either cultivated or, if unsuitable for cultivation, it is used for pastoral purposes. Optimal land management is difficult in Ghana, hampered as it is by a lack of data for regional and local planning. Table 3.2 provides an overview of land management patterns in the region for the most recent year available, 1990.

At the broadest level, the lack of adequate land management practices has contributed towards a number of critical problems including a decline in soil quality, a reduction in biomass production, a disruption of carbon cycles, and a reduction in soil organic carbon pools. Indeed, land-degradation is considered an ongoing national threat in Ghana. Key findings showed that the situation was particularly severe in the Upper East Region (UER) where land degradation usually leads to desertification and where local vulnerability is particularly high. In the UER, more and more land is cultivated, indigenous crop varieties are nearing extinction, land is perpetually overgrazed especially under conditions of reduced rainfall, and there is a growing scarcity of firewood. Combined, these factors have led to a land degradation crisis in the region.

Table 3.2: General Land Use. Source: Ministry of Food and Agriculture

Land Use	Area ('000 Sq. km)	% of Total
Savannah Woodland	71	30
Bush fallow and other uses	60	25
Unimproved Pasture	36	15
Forest Reserves	26	11
Tree Crops	17	7
Annual Crops	12	5
Wildlife Reserves	12	5
Unreserved Forest	5	2
Total	239	100

Equally importantly, the study found that land degradation trends in Ghana are accelerating. This is true at all spatial levels—national, regional, district and farm – and is due to an overall lack of co-

ordinated land policy and planning. Additionally, even though women contribute 80% of food production labor, insecure access to land and restricted access to credit limits the crops they can grow, discourages interest in land conservation, and encourages low productivity and food insecurity.

The adaptation portion of the assessment concluded that several adaptation options will be instrumental in helping Ghanaian communities to adapt to the impacts of climate change on land resources, as outlined below:

- *Review existing legal and institutional framework:* The Land Planning and Soil Conservation (Amendment) Act of 1957 should be reviewed regarding how well it comports with project climate change conditions. This should take the form of a comprehensive review of the structure and functions of existing land management agencies and planning of land use in Ghana.
- *Enhance options for women:* Special consideration needs to be made to improve access of women to opportunities, especially in northern Ghana. This should also include mechanisms by which women can gain access to land and credit.
- *Develop land information systems:* Zoning, mapping and production of land resource management plans should be promoted and coordinated at the national, regional and district levels in order to build adaptive capacity. Degraded lands should also be targets for inventory characterization, reclamation and monitoring to better equip land management agencies to identify where and how to implement adaptation strategies.

3.3.5 Water Resource Management

With regards to the water resource assessment, the assessment focused on the relationship between water availability, climate change, biodiversity erosion and desertification. The key findings summarized below are based upon a literature survey and broad projections of probable water future demands under climate change scenarios for the nation.

Despite the fact that Ghana has considerable surface and groundwater resources, water resources will be hit hard under climate change. Surface water resources depend on the magnitudes of river discharges or runoffs, and groundwater resources depend on recharge and capacities of aquifers. Under a changed climate, lower precipitation, enhanced evaporation, and more frequent droughts will diminish water availability in the Lake Volta reservoir. Additionally, the Akosombo dam, which typically provides about 70% of the country's energy needs, produces only 30% during periods of low water levels in the dam, posing serious implications for industrialization and private sector development.

Also, due to increasingly erratic rainfall patterns, available groundwater levels have been reduced over recent years. Water for domestic use and plant use has become scarcer due to the combined effect of declining rainfall, lowering of the groundwater table, drying streams and wells, and poor water retention capacity of the soils. Most people also have to walk for miles before they find water, especially during the dry season due to reduced rainfall. Since most farmers rely on the rain-fed agriculture (irrigation is not common in most areas), these factors also contribute to large inter-year variations in agricultural productivity.

With regards to future climatic conditions, the key finding of the assessment is the exacerbation of water supply and demand trends. On the supply side, the study found that groundwater recharge is likely to be reduced between 5% and 22% by the year 2020 and between 30% and 40% by the year 2050. This is a particularly noteworthy finding for the UER given that this region has the highest number of dams and dugouts in the country, and economic activities are increasingly related to effective utilization of this infrastructure. On the water demand side, pressures from population and a growing economy will lead to significant increases in the consumption of water. For the dry interior savanna region of Ghana, water demand in 2050 is projected to be about 12 times the current levels.

Juxtaposing the future water demand and supply findings suggests a looming water crisis for Ghana. Scarcity of water will increase the competitive pressures for basic uses of water, diminish agricultural productivity, increase the risk of water-borne diseases, and will have a negative impact on labor availability, productivity and migration.

The adaptation portion of the assessment concluded that several adaptation options will be instrumental in helping Ghanaian communities to adapt to this water crisis, as briefly outlined below:

- *Enhance rural systems for potable water and sanitation:* It will be important to develop systems to provide safe water and good sanitation in the rural areas. While this is already high among the rural development priorities of the government, the most pressing current demands in the northern drier half of the country are for safe and reliable supplies of water.
- *Implement more efficient water management practices:* The scarcity of water, particularly in the low rainfall areas, is a major factor constraining crop and animal production. The rainfall in the drier parts of the country could be more effectively utilized for intensifying the production of crops and livestock. This would involve appropriate water conservation practices, such as storage in accessible aquifers and in simple surface storage facilities such as ponds, tanks, dugouts, and small reservoirs for use in the dry months.
- *Explore implications for energy management:* Given the reliance of Ghana on hydropower for meeting electricity needs, a key recommendation is that an assessment of climate change on hydropower resources be undertaken (as discussed more fully in the section below).

3.3.6 Energy Management

Ghana's energy sector has already showed signs of susceptibility to climate change, particularly the effect of highly variable precipitation patterns on hydropower production. At present 67% of electricity generation in the country is from hydropower and 33% is from petroleum-fired thermal generation, with a small contribution of less than 1% from small-scale solar systems.

The drought of the early eighties (1980 to 1983), not only affected export earnings through crop losses but also caused large-scale human suffering and called into question the nation's continued dependence on hydroelectric power. As a result, the development of petroleum-fired thermal plants is now viewed as an energy security necessity in Ghana. By 2020, national planning calls for a more diversified energy supply system, with a larger contribution from natural gas and renewables, and possibly even nuclear power. The current rate of electrification presents the challenge of providing energy in a suitable form to a large population, primarily rural but increasingly urban, while at the same time minimizing greenhouse gas emissions.

A key finding of the review of energy supply issues is that existing renewable energy programs should be strengthened. Currently, the Ghana Renewable Energy Program promotes the development of renewable energy technologies, particularly biomass and solar energy. There has also been a Liquefied Petroleum Gas (LPG) Program since 1990 to promote the wider use of LPG instead of wood fuels to alleviate deforestation pressures.

The biomass program focuses on the development of a National Wood Fuel Policy to ensure that the production and consumption of wood fuel takes place in an environmentally friendly and sustainable manner. Such a goal overlaps nicely with adaptation priorities. Other overlapping strategies call for improved methods for charcoal and firewood production to conserve forest resources, decreased consumption of firewood and charcoal by using more efficient cooking devices, and implementing forest regeneration and afforestation programs.

Ghana receives daily solar irradiation levels ranging from 4 to 6 kWh per square meter, with cor responding peak annual sunshine duration of 1,460 to 2,190 hours. At present, direct solar radiation does not represent a major form of exploited energy in Ghana, and is currently used in niche

operations mainly for crop and fish drying using traditional methods. A strengthened program for the assessment, demonstration, and evaluation of the technical, economic and social viability of solar energy technologies in Ghana, especially with regard to the development of rural communities, would be a strategic adaptation strategy. In addition, specific adaptation initiatives should focus primarily on small-scale, off-grid generation and efficiency improvements as such initiatives would lead to an improved economic situation for potential beneficiaries.

4. Key Results and Findings for Phase 2

The second phase of the NCAP effort unfolded over the period 2006 to 2008 and sought to build upon and extend the results of the first phase through a closer examination of specific adaptation options and how these could be integrated into policy and planning dialogues. Specifically, this phase focused on the identification and prioritization of adaptation options and mainstreaming these inputs into national policymaking processes. Methodologically, this was achieved through reliance on broad-based stakeholder inputs and the use of a variety of process-based tools.

Climate change related impacts do not recognize sectoral boundaries, and Ghana's traditional, sector-specific planning will be inadequate to meet future climate change challenges. The "business-as-usual" model will potentially miss both salutary and negative interactions between activities undertaken in different sectors. However, since expertise is typically localized within sectoral government offices, university departments, and institutions, a key challenge for effective adaptation planning is to make good use of this expertise while promoting cross-sector interactions. Consequently, planning for climate change adaptation in Ghana will require coordination and integration across sectors and issues. This is a key conclusion of this phase of the project.

4.1 The Akropong Approach

The goal for Phase 2 of the project was to take the conceptual outputs from Phase 1 and solidify them into a set of prioritized adaptation options that are integrated into ongoing national policymaking processes. As the project team soon discovered, this was a particularly ambitious goal given the complexity of the adaptation options themselves (i.e., technology, feasibility, management aspects) and the non-trivial institutional and ministry-specific barriers associated with their integration into ongoing policy dialogues.

The initial task in Phase 2 was to review existing development plans that had been developed by each of the affected ministries (agriculture, health, land/water). It quickly became apparent that development plans contained both maladaptive and enabling goals regarding climate change adaptation. With this starting point in mind, the research team sought to anticipate and promote positive interactions between proposed adaptation activities across different sectors, whilst seeking to minimize negative or maladaptive interactions.

To do this, the NCAP Ghana research team introduced a new approach to cross-sector project planning. Dubbed the Akropong Approach[2], it offered a conceptual framework to integrate technical inputs, financial data, and stakeholder perspectives into a unifying, consensus-building, policymaking process. At the methodological level, the Akropong Approach sought to combine several methods that have proven useful in planning activities into an integrated evaluation framework, as outlined below and illustrated in figure 4.1.

- *Logical framework analysis:* The Logical Framework Analysis (LFA) facilitates problem identification and policy planning, with an emphasis on tangible objectives with concrete indicators to measure the effectiveness of the policy. The main new element in the approach proposed in this

2 Two papers produced during the development of this methodology were 1) Prioritization of Climate Change Adaptation Options using the Cross-Sectoral Impact Analysis which describes the methodology to cross-sectoral adaptation prioritization efforts and 2) a guide for replicating the methodology entitled Planning for Cross-Sector Climate Adaptation.

paper is the modified cross-impact analysis. This approach starts with the following assumptions: a) each sector has already taken into account the interactions between its own activities when devising the sector plan; and b) many cross-sector activities do not have important interactions, and only a few should be discussed in detail.

- *Multi-Criteria Analysis:* Multi-Criteria Analysis (MCA) is then used to determine overall preferences among alternative options, where the options are intended to accomplish several objectives. Another step in the approach is scenario analysis, which includes both quantitative and analytical, and qualitative components (i.e. creative and forward-thinking description of possible future events that might affect the outcomes of the policies).

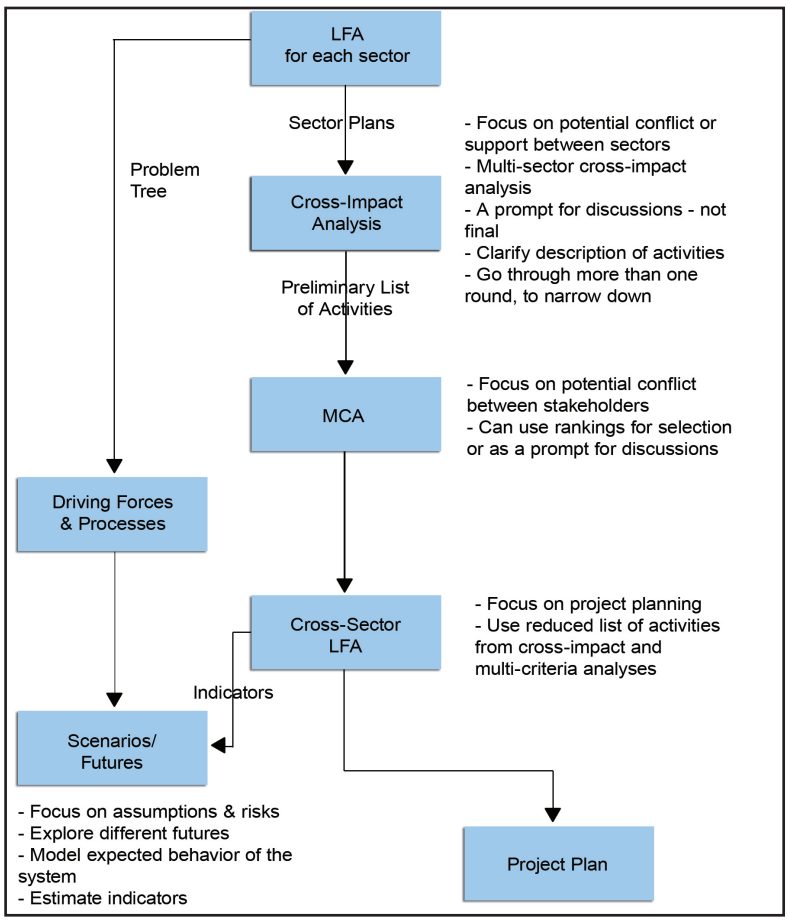

Figure 4.1: Flow of activities in the Akropong Approach

4.2 Network Building

There were a number of workshops hosted in Ghana that sought to build climate change networks both within Ghana at the Ministerial level, as well as throughout the region at the policy analysis level. The former included five Parliamentary Select Committees on Energy and Mines, Environment and Science, Finance, Legal and Constitutional Affairs, and Land and Forestry. The latter included members of NCAP country teams from Africa, the Middle East and Latin America and initiated discussion regarding linking participatory processes, vulnerability assessments, and multi-

criteria analysis.
The workshops were designed around the Akropong Approach and its combined methods outlined above. These workshops included:

- Capacity building workshop on the use of analytical tools for the formulation of a national climate change strategy. (May 2007)
- Workshop on cross-sectoral impact analysis focusing on the approach to the prioritization of adaptation options. (July 2007)
- National parliamentary stakeholder forum on climate change which focused on a range of adaptation options across various vulnerable sectors in Ghana. The program received praise from parliamentarians and observer groups. (August 2007)
- National adaptation evaluation criteria development and prioritization workshop focusing on methods and tools for prioritization of adaptation options. (October 2007)

4.3 Adaptation Prioritization

The key output of using the Akropong Approach within the series of workshops described above was a nationally prioritized list of adaptation activities as shown in table 4.1. At the end of the prioritization process, there was a clear perception across the participating stakeholder groups, whatever their level (e.g. minister or farmer) or affiliation (e.g. agriculture, health) that the potential impact of climate change on Ghana's economy is a clear threat to achieving the nation's desirable development objectives.

One key conclusion of the process was that the benefit of a full cross-impact analysis is that it enabled policy-makers to identify some decisions that could deliver significant cross-sector benefits and other decisions which could limit implementation inefficiencies across sectors. Another key conclusion was that the consensus-building Akropong Approach developed by the process focus would lead to long-term benefits insofar as it laid a widely acknowledged effective marker for future discussions on the topic of climate change adaptation.

5. Lessons Learned and Strategic Recommendations

Ample evidence is now available that climate variability and climate change are having profound effects on socioeconomic development and the livelihoods of communities throughout the world. This situation has been confirmed in Ghana through the various vulnerability assessments conducted as part of the NCAP project. Indeed, Phase 1 of the project demonstrated that the overall impacts are unacceptably high for key socio-economic sectors in the country. Urgently needed are the kinds of sectoral and cross-sectoral adaptation initiatives identified through the various consensus-building activities of Akropong Approach carried out in Phase 2.

Climate change will systematically disrupt Ghanaian communities that are reliant on subsistence farming and fishing livelihoods. For farming, impacts brought on by climate change will degrade soil conditions and reduce food production. For fisheries, increased sea water temperatures will adversely impact fish stocks in coastal areas. Income from these and other economic activities will diminish, making an already severe poverty situation worse. These developments will be particularly onerous for women who lack secure land rights, access to credit, and access to other agricultural inputs and services. Strategically focusing certain adaptation innovations on women builds their individual adaptive capacity whilst facilitating their contributions towards national development and promoting national welfare.

Vulnerability to climate change reaches beyond social and economic impacts into the very nature of sustainable livelihoods in Ghana. Indeed, the study's conclusion strongly supports the existence of a strong relationship between current climate and persistent poverty levels. Under conditions of future climate change, the exacerbation of poverty conditions in Ghana could be regulated by the

Table 4.1: Prioritized climate change adaptation options in Ghana

Priority	Adaptation option	Description
1	Research & Development	• Programmatic initiatives in the evaluation of new technologies and practices to enhance productivity across each of the vulnerable sectors in the face of climate change
2	Environmental Sanitation	• Make services available and engage households in sustainable sanitation activities against a backdrop of reduced water availability
3	Awareness creation	• Education and capacity building to combat communities' ignorance of over-fishing, land degradation and climate change
4	Improved land use practices	• Use appropriate agroforestry technologies and encourage aforestation to reclaim degraded lands • Change land use activities by planting other crops such as citrus fruits, soybeans, onions, sweet potatoes and maize • Efficient land management policies that respond to increasing population and demand on land
5	Early Warning Systems (EWS)	• Build an EWS for natural disasters and effectively disseminate these warning to stakeholders especially at the local level. • Provide efficient mechanisms for disaster management.
6	Alternative Livelihood	• Supplement income with either non-farm based livelihoods or changing land-use strategies • Develop off-farm income generating activities (e.g. artisan work, petty trading , livestock and aquaculture)
7	Water resources management	• Protect watershed and conserve biodiversity • Promote central role of traditional rulers, landlords and earth priests in mobilizing communities for Integrated Water Management activities
8	Extension Services	• Make services available and engage farmers in sustained activities
9	Improved Farming Technologies	• Promote agronomic soil and water conservation measures (e.g. agro-forestry, crop rotation, tied ridging, mulching, contour vegetative barriers and improved fallow) • Promote the use of drought resistant/ tolerant and high yielding planting materials • Promote zero tillage, non-burning of vegetation, and mulching for soil moisture conservation
10	Fisheries Resources Management	• Innovate through ecosystem research to stabilize seafood, adaptive fresh water fish species and employment for sustainable livelihood • Encourage exploitation of lesser-known species to ease the pressure on the main stocks.

reform of national policymaking that focus on a range of overarching activities spanning aware ness raising, new insurance schemes, capacity strengthening, and network building.

Foremost among future activities will be the need to raise awareness among policymakers and the public regarding the impacts of climate change. While a number of strategic adaptation options have been identified and recommended for urgent action, there will be an ongoing need to fine tune the understanding of hazard locations, evolving risk factors, and acutely vulnerable communities and groups. As this information is integrated into planning and policy dialogues and the public at large – a framework for which has been successfully developed using the Akropong Approach – it will help in reducing future vulnerability by integrating actions that protect people against disease, food insecurity, diminishing water availability, and energy insecurity into strategic discussions. There will also be the continuing need to increase technical capacity through education, and training in key skills for community groups, health and other sector workers.

Finally, the manner in which adaptation in Ghana is carried out will determine the success with which the strategic recommendations are implemented. As has been discussed in the previous sections, the findings of the project strongly suggest that a more holistic approach to adaptation is needed in Ghana. There is a need for close cooperation across the affected sectors – forestry, water, agricultural, coastal zones, public health, land use planning – to ensure that every opportunity is taken to secure the overlapping and strategic benefits of adaptation initiatives and to avoid any maladaptive or zero-sum results. Considering the uncertainties that still surround many of the key findings offered in this report, such policies should be flexible enough to adapt to any future changes in resource, market and climatological conditions.

Annex: List of Technical Reports Prepared

Phase 1:	Phase 2:
• Phase 1 Workplan • Output 1: Human health vulnerability assessment • Output 2: Fisheries vulnerability report • Output 3: Land management report • Output 4: Agriculture report on cocoa • Output 5: Agriculture report on tubers • Output 8: GPRS and climate change linkage paper • Output 9: Women and climate vulnerability paper • Final Progress Report • Progress Report 1 • Progress Report 2	• Phase 2 Workplan • Output 1: Composite Report - William Kojo Agyemang-Bonsu, et. al.: Ghana's Climate Change Impacts, Vulnerability and Adaptation Assessment, May 2008 • Output 2: Workshop report on discussion of Policy goals and criteria (LCA, MCA, scenario analysis) • Output 3: Workshop report on quantitative scenario development and results • Output 4: Report on the methodology detailing approach to stakeholder engagement and the development of evaluation criteria • Output 5: Report on the methodology detailing approach to adaptation policy prioritization • Output 6: Report on the national adaptation policy strategy in Ghana • Output 7: Synthesis report of Phase II • Progress Report 1 • Progress Report 2