The Impact of Climate Change

and environmental degradation on sustainable access to food, water and energy in the region of eastern and southern Africa

2013

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Executive Summary

The findings of a recent study commissioned by Plan International and Practical Action in Eastern and Southern Africa have added currency to the growing evidence that climate change is happening on a global scale and that great emphasis should be placed on the importance of understanding the impact of climate change and its consequences. Latest research shows that mismanagement of environmental resources will exacerbate the impact of climate change.

This research was undertaken against a background where the majority of Africa's population depends on rain-fed agriculture for their livelihoods, hence the need to uncover the impact of climate change and environmental degradation on access to food, water and energy cannot be underestimated. However, there is limited information about how people perceive climate change and there is also limited empirical evidence on the impact of climate change and environmental degradation on food, water and energy from a child centered and gender perspective. This affects the integration of climate and environmental issues into policy and practice. It also hampers effective environmental management and consequently influences the direction of the economy and the livelihood choices that people make.

In view of the foregoing, the study was deliberately meant to create an understanding about the impact of climate change and environmental degradation on sustainable access to food, water and energy; the implications on the community (especially women and children); identify programmatic and policy interventions currently being undertaken to address effects of climate change and environmental degradation; and to identify existing programmatic and policy gaps. Data were collected between January and June in 2013 from five case study countries in the region of eastern and southern Africa were Plan International operates. These countries are: Ethiopia, Kenya, Malawi, South Sudan and Zimbabwe. Several methods were employed to collect reliable and valid information and these included: household surveys, semi-structured interviews, focus group discussions (FGDs), oral histories and document reviews.

The results of the study showed that climate change and environmental degradation are causing pronounced negative effects on food, water and energy, with two distinctive features – gender and geographic inequality, where men, women and children are disproportionately affected and where some areas are more vulnerable and hit much harder than others. The study also revealed that the effects of climate change have a tendency of being accompanied by other human-induced impacts such as resource over-exploitation, which are already posing a major environmental challenge in Africa. These factors represent a major challenge in building response strategies.

The majority of people interviewed during the research process acknowledged that climate was changing. They attributed this to observable changes in rainfall distribution, temperature and increased occurrence and severity of extreme weather events such as droughts, dry spells, floods, and strong winds. All research participants at household, district and national level noted a high rate of environmental degradation primarily in form of deforestation, soil erosion, and pollution, which they attributed to changes in human settlement and unsustainable household and income generating activities.

The results from this research were concomitant to the Inter-governmental Panel on Climate Change (IPCC) 2007 Africa climate change projections. Participants reported both positive and negative impacts of climate change. Generally, they noted that although climate change and environmental degradation had negatively affected food production, there was an increase in crop production in some areas due to an increase in rainfall. Decline in crop yield was mostly observed in cereals such as maize, the staple food crop in most of the countries in the region. Performance of small grains had also deteriorated. Other negative effects included insufficient pasture; reduction in number of livestock, rise in food prices and increased pest infestation. The loss of livestock disempowered men and women economically and socially. The results of the research showed that food shortage mostly affected women and children and that this had implications on children's health (increase in malnutrition), increased school dropout, increased child labor and led to changes in social behavior.

Similarly, research showed that there were both positive and negative effects of climate change and environmental degradation on access and availability of water. It revealed that due to the increase in temperature, rainfall variability and siltation, there was a marked decline in water levels especially in rivers, wells and dams. In other areas, there was improved access to water due to rise of the water table e.g. in Kenya and Malawi. Additional negative impacts on water increased contamination and exposure to health risks. The effect on water mostly affected women and children as they walked longer distances to fetch water. This increased their workload, exposed them to health risks, wildlife attack and death. Water shortages in turn influenced children's participation in school, affected household nutrition status and led to economic disempowerment since farmers could not grow vegetables, a source of income especially for women.

The research showed that due to unregulated deforestation, there was shortage of fuel wood and charcoal across the region. It revealed that households were facing challenges in accessing fuel wood hence some households resorted to cow dung and crop residue as alternative sources of energy. The mode of accessing cooking energy especially in rural areas has changed from gathering firewood from forests to purchasing various types of cooking energy. Where households still use firewood, they have to trek long distances in search of it. Therefore, households incur additional expenses on energy for cooking, lighting and heating. Shortage of cooking energy also affects the type and quality of food prepared. Foods (such as beans) which require more energy are not prepared and some of the foods are undercooked as a result. The majority of households have no access to modern energy sources such as electricity, solar, wind or energy saving stoves.

Overall the results indicate that climate change and environmental degradation is posing challenges to government, NGOs, development partners and communities in their quest to protect children's right to food, water, energy, education, protection and descent livelihoods. Amongst the five countries studied, Zimbabwe and South Sudan have no consolidated policy frameworks to address climate change. In addition, energy interventions are very few across the counties. Although environmental, water and energy policies and Acts are in place, all participants interviewed emphasized poor policy enforcement and lack of compliance with environmental policies.

For programmes designed by government and development partners to address the needs of community members including children and also to build an environment where children can realize their rights, there is need to consider variation within communities in terms of socio-economic status, economic activities, resources available and their status, infrastructure, demographic characteristics and traditions/culture. This will foster proper targeting of communities with appropriate programs and policies thereby fostering attainment of food, water and energy secure communities.

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Acronyms

CCCD	Child Centered Community Development Approach
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
GCMs	Global circulation models
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute
MDGs	Millennium Development Goals
NEPAD	The New Partnership for Africa's Development
RESA	Region of Eastern and Southern Africa
UNFCCC	United Nations Framework Convention on Climate Change

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Chapter 1

Introduction

Climate change is now widely recognized as the major environmental problem facing the world today. Climate change is expected to hit developing countries the hardest, Africa being the most vulnerable continent. The Inter-governmental Panel on Climate Change (IPCC) defines climate changes as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (IPCC, 2007). These changes could be due to either natural variables or human activities (such as observed or projected increases in global temperature, extreme weather events, sea level rises or melting of glaciers).

Climate change is anticipated to have far-reaching adverse effects on Africa's sustainable development. Climate change is anticipated to have greater impact on sectors related to the achievement of the Millennium Development Goals (MDGs) such as agriculture, water supply and demand, health, energy, and political economic stability (Tadesse, 2010). Climate change may jeopardize in particular the achievement of goal 1 (eradicate extreme poverty and hunger), goal 6 (combat HIV/AIDS, malaria and other diseases) and goal 7 (ensure environmental sustainability) (UNFCCC, 2007) and ensuring gender equity. Africa is vulnerable to climate change and climate variability due its high dependency on vulnerable resources and rain-fed agriculture for economic development. This is further exacerbated by existing development challenges such as endemic poverty; complex governance and institutional dimensions; limited access to capital (including markets, infrastructure and technology); ecosystem degradation; and complex disasters and conflicts (UNFCC, 2007; Boko et al., 2007; Madzwamuse, 2010).

Climate exerts significant control on the day-to-day social and economic development of Africa, particularly in the agricultural and water-resources sectors, at regional, local and household levels (Malhi & Wright, 2004). However, climate change is not well understood by many people in Africa, their governments and the African Union (Tadesse, 2010). In addition, there is limited empirical evidence on the impact of climate change and environmental degradation on food, water and energy, analyzed from a child centered and gender perspective. A study conducted by the international research institute for climate and society (IRI) revealed that lack of climate change information affects the integration of climate into policy, practice, climate services and climate data (IRI, 2006). This hampers effective environmental management and consequently impacts the economy and the livelihood choices people make (FAO, 2008b).

Although there is general consensus that changes in climate and environment are happening, consequences of such changes tend to be localized and may vary between individuals, households, and communities due to a multiplicity of factors. Ways in which different categories of people (such as children, youth, women and men) perceive and experience consequences of climate change and environmental degradation may vary from one category to another. Despite the fact that climate change impacts are likely to affect people differently, children are disproportionately vulnerable to the impacts of climate change. Children's nature of vulnerability is multi-dimension, shaped largely by the physical, social and emotional changes that take place during the early stages of development. Therefore it is imperative to achieve a proper understanding of the impact of climate change especially in the child centered community development and gender perspective.

To gain insights and be informed on the consequences of climate change and environmental degradation, Plan International - Regional office of Eastern and Southern Africa (Plan RESA) entered into a partnership with Practical Action – Eastern Africa Regional office, to undertake a study in Ethiopia, Kenya, Malawi, South Sudan, and Zimbabwe. This study was a visionary and strategic development exercise for Plan RESA, possibly for Plan International as an organization to look into the new nexus dimension of improving access to sustainable energy, ensure water and food security, sustain the environment and address child poverty and gender inequality within Plan's Child Centered Community Development (CCCD) approach. Although the actual and potential impacts of climate change and environmental degradation in Africa are wide ranging, affecting many aspects of people's daily lives, this study is limited to the impact on sustainable access to food, water and energy. Results from this study will be used to design Plan RESA's climate change and environmental degradation strategic framework and influence policy to mitigate the adverse impacts of climate change and environmental degradation mainly on children.

1.1 Objective of the study

The overall objective of the study was to create an understanding of the impact of climate change and environmental degradation on access to food, water and energy in the region of eastern and southern Africa.

The specific objectives of the study were to:

1. Assess and report on the impact of climate change and environmental degradation on food, water and energy security, mainly analyzing in a child centeredness and gender equity perspective.
2. Assess how Plan's child centered programming strategies and responses address climate change adaptation/mitigation and promote environmental sustainability.
3. Identify programmatic and policy interventions currently addressing climate change and environmental degradation.
4. Identify policy interventions, strategies and legal frameworks addressing climate change and environmental degradation.
5. Identify existing policy and programmatic gaps and suggest responsive recommendations on environmental degradation and climate change.

1. 2 Research questions

This study sought to address the following research questions:

1. What is the effect of climate change and environmental degradation on access to food, water and energy in the region of eastern and southern Africa?
2. What is the implication of these consequences on the community (especially children, youth and women)?
3. What programmatic interventions are currently in place in response to the effect of climate change and environmental degradation?
4. What policies, strategies and legal frameworks are currently in place in response to the effect of climate change and environmental degradation?
5. What gaps exist in these programmatic and policy interventions in the RESA countries?

This regional report presents a snapshot of the key findings in all the five case study countries. In-depth discussions can be obtained from the respective country reports. The report is organized into six chapters. Chapter 2 presents literature on climate change and environmental degradation in Africa; chapter 3 presents Plan's child centered community development approach; chapter 4 presents the research design and methodology, followed by chapter 5 which reveals the results from the study and chapter 6 which presents the conclusion and recommendations.

Chapter 2

Climate change and environmental degradation

2.1 Climate change in Africa

The effects of climate change and environmental degradation on food, water and energy in Africa cannot be overstated. Africa is believed to be one of the most vulnerable continents to climate change and variability. Africa's climate is controlled by complex marine and terrestrial interactions which culminate into a variety of climates across a range of regions e.g. from humid tropics to the hyper-arid Sahara (Christensen et al., 2007). The IPCC reported a trend in temperature increase since the 1960s (IPCC, 2001). Between 1961 and 2000, there was an increase in the number of warm spells over southern and western Africa and a decrease in the number of extreme cold days (New et al., 2006). In eastern Africa, decreasing trends in temperature from weather stations located close to the coast or to major inland lakes have been observed (King'uyu et al., 2000). The Global circulation models (GCMs), which provide an understanding of climate and project climate change, also tend to agree that temperatures across the region of sub-Saharan Africa are increasing (Ringler et al., 2010).

Assessment of precipitation trends over years has been complex since rainfall exhibits spatial and temporal variability (Hulme et al., 2005). Although some regions e.g. in west Africa have exhibited long-term trend of decline in annual rainfall, in other regions e.g. southern Africa, no long-term trend has been noted. However, increased inter-annual variability has been observed, with higher rainfall anomalies and more intense and widespread droughts (Richard et al., 2001; Fauchereau et al., 2003). In different parts of southern Africa (e.g. Angola, Namibia, Mozambique, Malawi and Zambia), a significant increase in heavy rainfall event has been observed (Usman & Reason, 2004), and changes in seasonality and weather extremes (New et al., 2006). On the other hand, East Africa has been experiencing an intensifying dipole rainfall pattern on the decadal time-scale, characterized by increasing rainfall over the northern sector and declining amounts over the southern sector (UNEP, 2008). Despite the fact that models vary widely regarding predicted changes in precipitation there are some agreements that precipitation decreases from June to August in southern Africa and increases from December to February in eastern Africa (Ringler et al., 2010).

Reports produced by the IPCC (2001, 2007, 2012) conclude that Africa will experience increased water stress, decreased yields from rain-fed agriculture, increased food insecurity and malnutrition, natural resource degradation, and an increase in arid and semi-arid land. Extreme weather events, notably drought, flood, and tropical storms are also expected to increase in frequency and intensity across the continent (IPCC, 2007). The U.N. Climate Panel projects that up to 250 million people in Africa could face greater stress on water supplies by 2020 and that yields from rain-fed agriculture could fall by up to 50 percent by 2020 in some African nations[1].

1 http://www.reuters.com/article/2009/04/20/us-climate-africa-idUSTRE53J2RG20090420

2.2 Environmental degradation in Africa

Environmental degradation is one of Africa's greatest environmental challenges today, hindering the ability of humans to meet their basic needs. Ecosystems are of critical importance in Africa contributing to biodiversity and human wellbeing (Biggs et al., 2004). There is increased recognition of the changes in Africa's ecosystems particularly in southern African, occurring at a faster rate than anticipated. Human activities such as deforestation, forest fires, invasive species and land use change are increasing threating Africa's forest ecosystem and species which thrive in the ecosystems (UNEP/GRID-Arendal, 2002; Thomas et al., 2004; Muriuki et al., 2005). Literature also reports that changes in grasslands and marine ecosystem are increasingly noticeable. It is projected that by 2080, the proportion of arid and semi-arid lands in Africa will increase by 5-8% (Stige et al., 2006). About half of the semi-humid and semi-arid parts of the southern Africa region are at moderate to high risk of desertification (Reich et al., 2001; Biggs et al., 2004).

The major causes of severe land degradation are poverty (e.g. cutting trees for farm land and energy), population pressure and lack of structural transformation of the economies in rural areas (FAO, 2008b). On average, 13 million hectares of tropical forests are disappearing annually (FAO, 2010), which is equivalent to about six billion tons of carbon dioxide being released into the atmosphere. Deforestation also damages crucial ecosystem services such as soil stability, affects watershed production and destroys habitats and livelihoods (UNEP, 2011:2). Loss of arable land (due to deforestation, overgrazing and fuel-wood collection) coupled with severe and prolonged droughts, and flooding have led to soil degradation, which has in turn contributed to reduction in agricultural yields, crop failure and loss of livestock which endangers rural pastoralists (UNESCO, 2003). Effects of intensified land use, demographic shifts and climate pressures are increasing the occurrence of events of climate related disasters (Chen et al., 2010; Dussaillant et al., 2010).

Several studies have highlighted the importance of terrestrial vegetation cover and the associated dynamic feedbacks on the physical climate (Christensen et al., 2007). An increase in vegetation density, for example, has been suggested to result in a year-round cooling of 0.8oc in the tropic, including tropical areas of Africa (Bounoua et al., 2000). Complex feedback mechanisms, mainly due to deforestation/land-cover change and changes in atmospheric dust loadings, also play a role in climate variability (Wang & Eltahir, 2000; Nicholson, 2001; Semazzi & Song, 2001; Prospero & Lamb, 2003). Protections and enhancement of forests is essential to stabilize the global climate. Previous research suggests that a 50% reduction in deforestation is needed by 2020 if the forestry sector is to support, rather than undermine, global efforts aimed at holding global temperature rise below 2 degrees Celsius (UNEP, 2011:2).

2.3 Climate change and environmental degradation impacts on food, water and energy

2.3.1 Food

Climate models have predicted negative impacts of climate change on agriculture production and food security in many parts of Africa especially sub-Saharan Africa (FAO, 2008a). Climate change impacts on crop production are manifested in three dimensions i.e. (1) direct effects on rain-fed yields through changes in temperature and precipitation, (2) indirect effects on irrigated yields from changes in temperature and available irrigation water (including precipitation), and (3) autonomous adjustments to area and yield due to price effects and changes in trade flows. Production of cereal in SSA is projected to decline by 3 percent in 2050 and the largest negative yield impact is projected for wheat (grown less in the region) followed by sweet potatoes. However, millet and sorghum yields are projected to be slightly higher due to their tolerance to high temperatures and drought stress (Ringler et al., 2010). Southern Africa is likely to experience notable reductions in maize production (Stige et al., 2006).

Climate change affects all four dimensions of food security (i.e. food availability, food accessibility, food utilization and food systems stability) (FAO, 2008a; UNSCN, 2010). Climate change is likely to reduce the length of growing season and also force large regions of marginal agriculture out of production with small-scale farmers being the most affected. Many African countries are now experiencing semi-arid conditions which make agriculture challenging (Boko et al., 2007). Climate change will have short and long term effects on food production and distribution channels, and cause changes in purchasing power and market flows (FAO, 2008a; UNSCN, 2010).

Climate change effect on food production has led to increase in food prices (including price of all staples) which affect the poor and vulnerable people throughout the world mostly those in Africa (FAO, 2008b). Increases in food prices make food more inaccessible to poor people, in particular to women and girls whose health has been found to decline more than male health in times of food shortages[2]. On the other hand, it's argued that an increase in food prices may motivate local farmers to increase production of food, which subsequently raises household income and potentially increase child wellbeing (Holmes et al., 2008). Increase in food price in Africa is mainly attributed to land degradation, poor infrastructure, poor power generation and distribution networks, and lack of water storage and irrigation capacity (FAO, 2008a; UNSCN, 2010). It is anticipated that in the face of climate change, the price of maize, rice, and wheat will be 4, 7 and 15 percent higher in 2050 than under the historic climate scenario. The prices of other important crops in the region will also increase—for sweet potatoes and yams by 26 percent, cassava by 20 percent, millet by 5 percent, and sorghum by 4 percent (Ringler et al., 2010). Traditional sources of food become more unpredictable and scarce under climate change[3]. Decline in the availability of wild foods and limits on small-scale horticultural production (due to scarcity water) affect food availability and utilization (Tadesse, 2010).

It is also anticipated that climate change will lead to the emergency of new patterns of pests and diseases affecting plants and human health. Emergency of new water borne diseases in flood-prone areas, vectors for climate responsive pests and diseases and emergency of new diseases could affect both the food chain and people's physical capacity to obtain the necessary nutrients from the foods they consume (Tadesse, 2010). Climate related events such as floods and droughts disrupt families and expose young women and children in particular to malnutrition and other health related risks (Goudet et al., 2011). Climate

2 htpp://www.fao.org/FOCUS/E/Women/Sustin-e.htm

3 htpp://www.fao.org/FOCUS/E/Women/Sustin-e.htm

related shocks drive poor families to adopt negative coping strategies (e.g. reduction of the quality, safety, and quantity of meals, reduction of the expenditure on health and education, sale of productive assets, etc.) (WFP et. al., 2009) which increase the risk of under nutrition. Women and children are the first to be affected (UNSCN, 2010). Therefore, investment in technology to foster other food system processes such is processing, distribution, acquisition, preparation and consumption are of paramount importance in food security (Dinar et al., 2008).

2.3.2 Water

Water resources comprise one sector that is highly dependent on and influenced by climate change. At the moment, a number of countries in Africa are experiencing considerable water stress as a result of insufficient and unreliable rainfall and governance issues (UNESCO-WWAP, 2006; Tadesse, 2010). As the population in Africa increases, water demand is expected to increase (Tadesse, 2010). Currently, it is estimated that about 25% of Africa's population (200 million people) are experiencing water stress. Many African countries are likely to experience increased pressures on water availability, water access and water demand due to climate change and variability (Arnell, 2004; IRI, 2006). It is projected that 75-250million people and 350-600million people will be at risk of increased water stress in Africa by 2020s and 2050 respectively (Arnell, 2004).

Agriculture, the main source of livelihoods for about three quarters of Africa's population is mainly rain-fed. Therefore severe and prolonged droughts, flooding, and loss of arable land due to desertification and soil erosion are reducing agricultural yields and causing crop failure and loss of livestock thereby endangering rural and pastoralists populations. For instance, recurrent droughts in the Ethiopia-Kenya-Somalia border have severely impacted pastoralists (UNESCO, 2003). In 2010, approximately 11 million people who depend on livestock for their livelihoods were plunged into crisis due to recurrent droughts. This triggered

Plan Kenya's river diversion dam to irrigate large areas

mass migration of pastoralists out of drought prone areas (IPS, 2010). Populations displaced to or resettled in locations with inadequate infrastructure and where they directly depend on natural resources for survival, there can be an over exploitation of natural resources leading to water and soil degradation, deforestation, pollution and potential epidemics (Warner et al., 2010). Furthermore, forced migration resulting from climate related hazards produces competition among communities and nations for water and basic needs resource, which may trigger political instability and conflict (Gleick, 1993; Warner et al., 2010).

Despite Africa's vulnerability to climate change, the fragility of Africa's soils, and the uneven distribution and availability of both surface and subsurface water resources, there is substantial untapped potential for the development of the continent's water and land resources for increasing agricultural production. In Africa the percentage of arable land that is irrigated is only 7 percent (barely 3.7 percent in Sub-Saharan Africa), compared to the corresponding percentages for South America, East and Southeast Asia and South Asia being 10 percent, 29 percent and 41 percent respectively (NEPAD, 2002). To increase productivity and contribute to poverty reduction, increasing water availability and reliability in agriculture e.g. through irrigation is a prerequisite (Tadesse, 2010). Building up soil fertility and the moisture holding capacity of agricultural soils, and rapidly increasing the area equipped with irrigation, especially small-scale water control, will not only provide farmers with opportunities to raise output on a sustainable basis but will also contribute to the reliability of food supplies (NEPAD, 2002)

The main long-term impacts of climate change in Africa include: changing rainfall patterns affecting agriculture and reducing food security; worsening water security; decreasing fish resources in large lakes due to rising temperatures and over-fishing; rising sea levels affecting low-lying coastal areas with large populations; and rising water stress (Besada & Sewankambo, 2009). Climate change induced water stress is likely to decrease the quantity and quality of drinking water in rural and urban areas, reduce the run-off necessary to sustain the country's hydro-electric power supply and contribute to declining agricultural productivity (Brown et al., 2012).

Wind powered multiple and economic uses water for food & household economic security - Zambia

In developing nations, women and girls bear the burden of fetching water for their families and spend significant amounts of time daily collecting water from distant sources. Women experience greater workloads as they have to trek longer distances for water for household consumption such as drinking, cooking, childcare, washing etc. (Mitchell et al., 2007). Depletion of water resources exposes women and children to problems of sanitation, health, hygiene and safety. Water from distant sources is hardly enough to meet the needs of the household and is often contaminated such that women and girls pay the heaviest price for poor sanitation (Khan et al., 2003; Mitchell et al., 2007).

2.3.3 Energy

Energy is central to the attainment of the MDGs and sustainable development. Therefore improving the quality and quantity of energy services in sub-Saharan Africa is a necessity in order to improve livelihoods, access to water, agricultural productivity, health, population levels, education and address gender related issues[4]. Energy is needed to meet the basic needs of poor men and women, especially for cooking, lighting and mechanical power[5]. However, access to energy is very constrained in majority of developing nations especially in sub-Saharan Africa. Seventy nine percent of people in developing countries lack access to electricity. In sub-Saharan Africa 74 percent lack access to electricity compared to 28 percent of those in other developing countries as a whole. In addition, 91 percent and 83 percent of people in less developed countries and sub-Saharan Africa lack access to modern fuels (electricity, liquid fuels or gas fuel) respectively (UNDP/WHO, 2009) majority of which are in rural areas. Its is estimated that only 51 percent of urban populations and only 8 percent of rural populations have access to electricity (IEA, 2002) with exception to northern Africa and other countries such as south Africa, Ghana and Mauritius which have higher access to electricity in both urban and rural areas.

Solar powered multiple and economic uses water for food & household economic security-Ethiopia

Lack of access to modern energy sources implies that about 80 percent of the African population relies primarily of biomass to meet its energy needs (Hall & Scrase, 2005). Nearly all rural households in Eastern and Southern Africa use fuel wood for cooking and 90 percent of urban households use charcoal (IEA, 2002; van Jaarsveld et al., 2005). However, the majority of rural people lack access to improved stoves to meet their basic cooking needs. Only 6 percent of rural population in developing countries and sub-Saharan Africa who use biomass for cooking (such as wood, charcoal and dung) has access to this option.

Heavy reliance on biomass for energy promotes removal of vegetation and can also result into health impacts associated with carrying fuel wood and other hazards e.g. settlement fires (IEA, 2002). Worldwide lack of improved energy resources causes about 2 million deaths a year due to indoor air pollution from use of solid fuel (e.g. biomass and coal) for cooking and heating (UNDP/WHO, 2009). Additional challenges from urbanization, rising energy demands and volatile oil prices further aggravate the energy situation in Africa (ESMAP, 2005). Ensuring energy security will require diversification of types and sources of energy, with increasing focus on consumer needs, on indigenous energy supplies, energy efficiency and regional interconnections[6]. Although there has been investment in modern energy resources, progress has been very slow especially in sub-Saharan Africa thereby preventing attainment of the MDGs (UNDP/WHO, 2009).

In many parts of the world, wood, the most widely used solid fuel is now located further away from the places where people live due to deforestation. In many communities in the developing world, women and girls are responsible for collecting fuel wood, a

4 http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/sustainable-energy.html

5 http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/sustainable-energy.html

6 http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/sustainable-energy.html

physically draining task that can take from 2 to 20 or more hours per week. As a result, women have less time to fulfill their domestic responsibilities, engage in income generating activities, engage in politics or other public activities, participate in adult literacy or acquire other skills, or simply rest. Girls are sometimes kept home to search a field for resources hence absence from school which perpetuates the cycle of disempowerment. When environmental degradation forces them to search further afield for resources, women and girls become more vulnerable to injuries from carrying heavy loads over long distances and also face increased risk of sexual harassment and assault[7].

2.4 Governance and institutional framework

Although Africa may have institutional and legal frameworks to address climate stress, they are insufficient to deal with environmental degradation and disaster risks (Sokona, & Denton, 2001; Beg et al., 2002). Lack of institutional capacity to deal with environmental degradation in Africa has contributed to resource degradation (Moyo et al., 1991). World Bank asserts that for Africa to attain sustainable development, the current impacts on economic development caused by climate change need to be recognized and integrated into climate negotiations (World Bank, 2010). The productivity and sustainability of Africa's environment is heavily dependent on how climate change is managed (United Nation, 2006).

It has been noted that women are under-represented in policy and decision making bodies. Critical bodies on climate change have an under-representation of women (MacGregor, 2010). In addition, despite women's central but disproportionate role in sustaining livelihoods and the environment, there is little evidence that specific adaption efforts, policies, funding and institutions target them (Mitchell et al., 2007). UN reports that women are not usually involved in discussion about energy plans and policies. Energy is primarily thought of in terms of electricity, gasoline and diesel and dealing with these resources is often considered as men's work. In developing nations, most energy comes from traditional biomass fuels (e.g. wood, charcoal and agricultural wastes) and collection and management of these fuels is mainly the responsibility of women. Lack of recognition of women's role in the energy sector leads to gender-blind energy policies that limit the capacity of developing countries to adapt and mitigate climate change. Therefore, Governments need to be encouraged to incorporate gender perspectives into their national policies, action plans and other measures on sustainable development and climate change. Women need to be actively involved in energy decision making so that energy supplies can be managed more effectively and productively in the face of climate change (UN women Watch 2009[8]).

2.5 Adaptation to climate change and environmental degradation

The UNFCCC defines adaptation as the 'process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes' (UNFCCC, 2007:12). The IPCC defines adaptation as 'adjustment in natural human systems and response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (IPCC, 2001). To strengthen the livelihoods of Africa's population and reduce their vulnerability to climate change and environmental degradation, adaptation is the only feasible strategy (Boko et al., 2007; Tadesse, 2010). However, climate change exposure and ability to adapt varies amongst people and depends on their degree of dependence upon weather patterns for livelihoods and food

7 UNDP. Sustainable Energy Services. The Gender Dimension. Htpp:///www.undp.org/women/mainstream/sustainableEnergyServices.pdf

8 httpp://www.un.org/womenwatch/feature/climate_change

security. Ability to adapt is influenced by gender, social status, economic poverty and power - access, control and ownership over resources in the household, community and society (Nellemann et al., 2011).

Adaptation can be achieved through improving agricultural productivity, diversifying on and off-farm activities, providing better access to markets and market information, and improving infrastructure, linkage to technology, education, access to resources (Brooks et al., 2005; Grothmann & Patt, 2005; Benhin, 2006). Improving seasonal weather forecast; early warning system; improvement in existing rain fed agriculture (e.g. water harvesting systems to supplement irrigation systems in semi-arid areas); biotechnology research and appropriate crop selection could yield tremendous benefits, (O'Brien & Vogel, 2003; Rockström 2003; Kurukulasuriya & Mendelsohn, 2006). Social networks and social capital is also important in shaping adaptive actions taken (Grothmann & Patt, 2005). Migration has also been adopted as an adaptation measure.

Women represent a primary resource for adaptation because of their experience, knowledge, agency, multiple and simultaneous responsibilities, as well as their roles in production. Women play an important role in management of ecosystem services and food security. Therefore, sustainable adaption must focus on gender and the role of women if it is to become successful. Women's voices, responsibilities and knowledge on environment and the challenges they face will need to be a central part of the adaptive response to a rapidly changing climate. However, women's ability to adapt is challenged by lack of access to formal education, economic poverty, limited access to and control of resources, exclusion from policy and decision making institutions and processes and other forms of social marginalization (Nellemann et al., 2011). Such inequalities undermine the capacity of women to cope, adapt and increase their vulnerability to negative effects of climate change.

Series of fish ponds of Plan Zimbabwe which are also used for irrigating vegetable garden and drip irrigation

Adaptation measures need to increase women's access to and ownership of land, micro-credit, water, livestock, storage facilities, agricultural inputs, markets, education and green technology. These need to be culturally appropriate, socially acceptable responsive and practical for women's needs (Devendra & Chantalakhana, 2002; UNEP, 2009; 2010; Shackleton et al., 2010; Sijbesma et al., 2009). Women's concerns, demands and experiences need to be integrated into action-oriented research (Mitchell et al., 2007). Gender sensitive responses will require more than gender disaggregated data illustrating differential impacts on women and men but will require in-depth understanding and rigorous analysis of existing inequalities and gender power relations and ways in which climate change exacerbates these inequalities (Nellemann et al., 2011:55-56)

Adaptation is, however, shown to be successful and sustainable when linked to effective governance systems, civil and political rights and literacy (Brooks et al., 2005). Institutions and their functioning play a critical role in aiding successful adaptation. Therefore, it is important to understand the role of both informal and informal institutions (Reid and Vogel, 2006). To effectively respond to the effects of climate change and environmental degradation, various organizations and agencies, including NGOs and research organizations have developed approaches to boost the adaptive capacity of communities mainly the community-based adaption approach (CBA) (Brown et al., 2012). Effective response to climate change will require efforts from all stakeholders and good coordination across multiple levels of governance from household and community to national and international levels (UNICEF, 2011).

Chapter 3

Plan RESA's Child Centered Community Development Approach

Children watering trees in Iruma Primary School.

Plan International is a child-centered development organization committed to promoting the rights and wellbeing of disadvantaged children to help them spiral out of poverty. It promotes Child Centered Community Development (CCCD) Principles. Plan's interventions appear to emanate from the strong conviction that children have the right to be protected and to participate in decisions that affect their lives. Therefore, it works to ensure that children, their families and communities are involved in all aspects of their development – helping to identify major problems and implement long term solutions.

In the region of eastern and southern Africa, the organization operates in 12 countries, addressing five dimensions of children's rights including survival and

health, development and education, protection and participation, justice and democratic governance, and sustainable and dignified livelihoods. In the last 15 years Plan RESA has been promoting livelihood and household economic security programs in all the RESA countries to ensure food security and economic growth. Plan's organizational principles and strategies are founded on Child Centered Community Development (CCCD), which is a Rights based approach that promotes participatory and sustainable development models where sustainable environment management has to be the core. Although environmental management and the negative impact of climate change is not explicit or well articulated as standalone policy or strategic document of Plan, there are policy statements and programmatic guidance to address environmental management. Disaster Risk Reduction (DRR) initiatives at community level are important, particularly in the light of environmental and climatic concerns, in order to enhance resilience.

Plan's Child Centered Strategic Programs

To achieve organizational goals, Plan RESA is engaged in different strategic intervention/program areas. The design of programs is country specific but overall, they all address the five key components:

i) Child survival and development

This program area encompasses the following core components:

- Improvement of the health of communities by implementing programs to tackle childhood illnesses and improve safe motherhood services;
- Promotion of water, sanitation and hygiene which involves construction of water supply schemes, train communities in sanitation and hygiene education, as well as support the construction of basic sanitary facilities of latrines and solid waste disposal;
- Strengthening of community based organizations, government and local non-government organizations to help them participate effectively in health development issues.

ii) Education

This program aims to enable children receive quality education so that they can realize their full potential. The work ranges from supporting early childhood care and development to teachers training and adult literacy initiatives.

iii) Food security and nutrition

This program intends to improve the economic security of households so that they can become more resilient to shocks – such as the loss of a job, death of family members or natural disaster – and plan for the future. It involves:

- Diversification of agricultural production for household food consumption;
- Improvement of employment opportunities by providing training in marketable skills and help families to save for the future through our partners' saving and credit schemes;
- Promotion of nutrition in communities and provision of supplementary feeding to children and food aid to the general population affected by drought and famine.

iv) Child Participation and Protection

Awareness raising and lobbying on child rights to tackling harmful traditional practices and child trafficking is a central intervention. To this effect, the program activities include training relevant government offices and law enforcement implementers, and strengthening child rights institutions such as legal protection centers and children's clubs.

v) HIV and AIDS

It is also learned that Plan helps communities living with and affected by HIV/AIDS by increasing access to prevention, care and support services for orphans, vulnerable children and people living with HIV /AIDS. It also works to improve access to services dedicated to the prevention of parent-to-child transmission, as well as voluntary counseling and testing services.

Chapter 4

Research design and methodology

4.1 Study sites

The study targeted 12 countries where Plan RESA operates. However, to generate an in-depth understanding of the impact of climate change and environment degradation on food, water and energy crisis in the region, five case study countries were selected (i.e. Ethiopia, Kenya, Malawi, South Sudan, and Zimbabwe). The criteria for selection were: presence of Practical Action, commitment to participate, vulnerability context, security and logistical convenience. In each country, two to three communities (i.e. districts, counties payams or woredas) with a variety of cultural and socio-economic situations were selected. Data were collected between Jan.-June 2013.

4.2 Research design

A cross-sectional, descriptive research design was adopted to generate an in-depth understanding of the current status and trend of climate change and environment degradation over the past 5-10 years, their impact on food, water and energy, and the policy and program interventions in place to address the effects of climate change and environmental degradation.

4.3 Sampling

Sampling was done using the multi-stage sampling technique complemented with purposive and random sampling techniques at each stage. The first stage entailed purposive selection of districts, counties, payams or woredas with on-going key Plan interventions. A vulnerability scoring matrix was developed in the selection of communities. Each community was scored against the following factors as perceived by the planning team (including Plan staff, Practical Action staff, government officials and enumerators):

1. Exposure to climate risk- drought, floods, storms, soil salinity, sand harvesting, charcoal burning.
2. Food security and poverty levels - crop failure, pest, disease incidence, land/soil conditions (e.g. productivity, acreage per household)
3. Access to infrastructure (roads, schools, water supply facilities -wells, dams, energy, social amenities)
4. Access to community resources (e.g. accessibility and availability of forests, woodlots, rivers, water levels, NGO services, extension, input supply etc.)
5. Population factors (e.g. densities)

4.4 Data collection

Data was obtained from primary and secondary data sources. To collect primary data, both quantitative and qualitative data collection methods (survey, semi-structured interviews, focus group discussions and oral histories) were employed. Multiple methods of inquiry were used to triangulate the information to improve its validity and reliability. Primary data sources were: farmers, community leaders, government staff, NGO staff and private sector. Data collection tools included a semi-structured questionnaire and checklists.

4.5 Data Analysis

Quantitative data was analyzed using SPSS version 20 to generate descriptive statistics (e.g. frequencies and cross tabulations). Line by line coding was used to analyze qualitative data to identify the key themes which emerged.

Chapter 5

Findings and discussion

5.1 Local perceptions and experience of climate change and environmental degradation in the region

There was variation in participants' perception about climate change. Although the majority of respondents believed that climate had changed over the past 30 years, some of the individuals did not believe in climate change due to lack of scientific and historical evidence that climate was changing. Generally, climate change was mostly understood in terms of weather–related events manifested in terms of shift in rainfall seasons, unpredictability of weather, delays in planting dates, frequency and intensity and spatial distribution of extreme weather events (such as floods, droughts, and strong winds) which had impacted people's livelihoods. The change in climate resulted from human action such as deforestation. Individuals who defied strongly urged scientists to get concrete evidence of the past events before concluding that climate was changing.

Shift in weather partners was significant across the five case-study countries with farmers experiencing delays in the onset of rainfall and shortened duration of the rainfall season. Drought/dry spells and floods were the most recurrent climate related hazards across the region. The intensity and frequency of droughts and dry spells had increased over the past 10-30 years with households experiencing rain shortage at critical stages of the crop.

Environmental degradation was mainly understood as the destruction of natural resources or lose of value of environmental resources (such as forests, plants, soil, water and animals) caused by human interference. Environmental degradation was mostly caused by unsustainable economic activities (such as selling of wood/timber, mining, charcoal burning and sand harvesting) but also veld fires and human settlement which contributed to the enormous cutting down of trees both for home use and income generation. The other indicator of environmental degradation was severe soil erosion which caused poor soil fertility. This negatively affected the livelihoods of people and animals which depend on the natural resources.

5.2 Impact of climate change and environmental degradation on food and the implication on children, women and men

a. Crop loss and decline in crop yield

The shift in rainfall partners, intermittent dry spells, drought and floods contributed to a decline in crop yield thence subjecting households to food hunger and food insecurity. Change in onset and off-set of rains delayed planting, weeding and harvesting of food crops. In some areas, crops withered at critical stages of development due to insufficient rainfall, sporadic dry spells or floods resulting into poor yields and financial loss. The most affect crops were maize, bean, cowpeas, and vegetables. Drought tolerant crops such as pigeon peas, millet, and sorghum were

not doing well in some of the study areas. Crop failure due to climate related events was further aggravated by poor soil fertility due to poor soil and water conservation practices and pest and diseases. Some of the respondents stated:

"Long back we used to harvest plenty of maize, pearl millet, rapoko/finger millet, groundnuts, round nuts and sorghum. However yields have declined since 1999 when we started to experience sporadic droughts" (Participants, Men FGD, Gombakomba Ward, Mutare, Feb. 6 2013).

In the past people used to harvest a lot e.g. 15 ox-carts (from 2-3 acres) but now, the highest yield is about 7 ox-carts (Participants, children FGD, Muzumazi Community Day Secondary school, Apr. 10, 2013)

Decline in crop yield had affected food access and availability hence more households were experiencing food shortages more often as compared to 10-30 years ago. Households within communities which had been classified as less vulnerable were equally experiencing food shortages. Vegetable production had also been affected due to water shortages or floods due to heavy rainfall. Drought-induced famines are further exacerbated by limited coping mechanisms and inadequate contingency planning for drought mitigation and the threat of climate change.

However food insecurity was a contentious issue especially in Kenya and Malawi. There were mixed perceptions about food insecurity with some of the key informants expressing that households were food secure since they had received enough rain at the time of the study.

b. Increased crop yield

Despite the fact that climate change and environmental degradation had contributed to the decline in crop yield there was reported increase in crop yield in some of the study areas in Malawi and Kenya due to increase in rainfall, use of improved agricultural inputs and expansion of land under crop production. Similar trends where also noticed in Ethiopia in recent years. Crop output in the country has been increasing which is largely attributable to yield improvement and the expansion of cultivated land.

The southern part is very dry e.g. districts like Balaka Nsanje and Chikwawa, almost every year, they have drought but this year it's been different. They have harvested enough. Last year they received rain in Jan but this year, it's been normal (Unicef staff, Lilongwe, Apr. 5, 2013).

Previously, farmers were not using certified seed, it was not common but now farmers are seriously using them. We were not using inorganic fertilizer but are now using. Farmers are now harvesting 20bags/acre. Potential is higher. Potential for this area is 30 bags. There are varieties, with adequate moisture, fertilizer, can give 35 bags per acre. But farmers are harvesting 20-25 bags. DHO 4 maize hybrid variety is preferred. Selling food then was now common. You needed a permit from commissioner. With liberalization, people opened more land for commercial purposes. Even my stepmothers are now harvesting not less than 40bags (Agricultural officer, Matungulu District, May 2, 2013).

In Malawi the Farm Subsidy program had to a certain extent boosted crop yield but deeper analysis needs to be undertaken to understand who exactly benefits from this program and how they are benefiting.

c. Shift in diet and variety of crops grown

Severe deforestation over the years had also compromised the nutritious diet of many households due to lack of access to wild foods. Participants of oral history lamented that they could no longer hunt wild animals and caterpillars in the forests (source of protein) or gather vegetables (source of vitamins). Deforestation and subsequent soil degradation had caused reduction in the type and variety of crops grown, type of foods and the nutrition.

In the past there was a lot of firewood and would collect logs that had fallen 1-2 years back. The advantage is that those logs would keep caterpillars and those caterpillars were food to us. So we would collect the firewood and food at the same time but now there no trees at all (Male participant, oral history, Chikuthe, Apr. 9, 2013).

d. Livestock loss, shrinkage of grazing land, deterioration of pasture quality

Over the past 5-10 years, participants had noticed a decline in number of livestock. Communities were experiencing more drought-related livestock deaths than due to lack of pastures, water and diseases. Livestock spend a lot of time searching for pastures and water in perennial rivers. In addition, pasture hardly regenerates due to severe and frequent droughts causing feed shortages. Grass had lost vigor and some of the grass species had been lost. This affected livestock productivity, health and fertility (low growth rates, low calving rates, weak calves and still births). Loss of livestock also economically disempowered households thereby limiting their capacity to purchase food.

Further more due to poor soil fertility, erratic rains and deforestation, there has been change in land use pattern whereby land originally reserved for grazing is now used to cultivate crops. Shortage of land was also attributed to human settlement. Encroachment on grazing land had led to shortage of grazing area which translated into poor quality animals and conflicts. With the reduction in grazing area farmers were increasingly spending more on pastures. This is reflected in the quotes below:

"We experienced drought in 2002 and 2008. Livestock in this community died, we did not get enough food to eat, people lacked milk and nutritious food to eat" (Participants children FGD, Gombakomba Secondary School, Mutare, Feb. 6, 2013).

"The number of animals has deteriorated. The forests are no longer there, grass is burned trying to look for wild animals, and veld fires etc. grasses do not grow well because of limited rainfall. This has affected mostly the cattle. Some goats survive in certain areas but the cattle...because of shortages of water, animals are not drinking and there are animals disease" (District Development officer, Ministry of gender and women affairs, Kwekwe, Feb. 7 2013).

There is shortage of grass and low water table so most of the time they go wondering looking for food but they are very thin because grass dries up fast. Over 30 years ago there was no problem because there was enough land for grazing and water (Female Participant, oral history, Chikuthe, Apr. 11, 2013).

e. Increased food prices

Food scarcity had led to an increase in food prices which affected household's capacity to access food. An exorbitant food price especially of the staple crops had increasingly limited people's access to food. Lack of sufficient income further incapacitated households to purchase food. However, the effect of high food prices varied across urban and rural households with the impact being more felt by rural households due to limited livelihood options. Poor access to food has direct effect of dietary status, nutrition and consumption and consequently, children's right of access to food.

"Food security has been affected. The price of maize has gone up from 6 to 8 dollars. Rural communities cannot afford money and can't purchase food. But in urban areas, they may not be affected that much because they have money circulating" (Irrigation office, Kwekwe, Feb 4, 2013).

"This year, a small bucket [5L bucket] we've been buying it at 800-1000MK. If you have many children, how many days will it last? One cannot afford 2 meals a day" (Staff, TSAPA primary school Tambala, Apr. 8, 2013).

f. Emerging, recurring crop pests and diseases and increased disease incidence

There were mixed results on pest and disease emergency in crops. While some participants had not noticed any change in crop pests and diseases others reported emergency and reoccurrence of pests and diseases e.g. grey leaf spot in maize and armyworms respectively. A considerable number of households reported increase in disease incidences as one of the noticeable changes resulting from climate change and environmental degradation. Wilting of crops was cited many times. Increased temperature provided a favorable breeding environment for pests. However, this could also be explained by poor farming practices such as continuous cropping.

"There is an increase in pest occurrence and damage to crops. This is due to continuous mono cropping because when pests infest a field, it attacks the crops over seasons. Other contributing factors are soil degradation and unreliable rainfall. We have not observed any new pests and diseases" (Participants, children FGD, Muzumazi Community Day Secondary School, Chikuthe, Apr. 10, 2013).

"There are changes in diseases and pests e.g. army worms which damaged more than 2000ha of grazing land and crops. They came in 1996 and are back" (livestock officer, Kwekwe, Feb. 6. 2013).

"If you plant crops late, worms attack them. The worms are under the roots. The rains may start in Nov. but we might think it's not the normal rains so we wait for Dec and the rains may continue through Dec. so when you plant in Dec you find that they have some worms under the roots. CC is confusing us a lot. If we had planted early, the crops would not be affected" (Teacher, Muzumazi Community Day Secondary School, Chikuthe, Apr. 11, 2013).

What were the implications of these effects on children, women and men?

Children and women's welfare

Across the five countries studied, children and women were considered to be the most affected category by food shortages. The implication of food shortage on children included malnutrition, dehydration and deteriorating health. This violated children's right to food and a descent livelihood. The effect varied across households or communities based on availability of alternatives livelihood options. In communities with diverse income generating activities e.g. stone quarrying, sand mining, the level of malnutrition among children was low. In addition, households with livestock where not heavily impacted by food shortages resulting from weather calamities as they sold livestock to purchase food.

Women were more vulnerable to the impact of climate change due to lack of productive resources and limited power and control of resources. In most of the communities visited, men controlled the produce and larger livestock e.g. cattle and donkeys while women mostly controlled poultry. With the increase in food shortages women were increasing getting engaged in casual labor in order to provide food for their families, which increased their workload, affected productivity, child care and nutrition, and presented health risks to women themselves. One of the participants emphasized that:

Children are the most affected because they are still growing. They need nutritious food and when there is shortage families start scaling down and give them less nutritious food and less food quantities. People start skipping meals. Women would also get affected because in our culture, they are the ones in the forefront to make sure that the whole family has food so they deny themselves food so that other people in the family get food and going an extra mile to get food for their families (Unicef staff, Lilongwe, Apr. 5, 2013).

Literature shows that women are more vulnerable to the impacts of climate change than men due to skewed power relations and inequitable cultural and social norms (IPCC 2007; Brody et al., 2008). Women have unequal access, control and ownership of resources such as land, property, livestock, labor, and development resources such as credit, agricultural inputs, technologies, trainings and information (Verma 2007b; FAO 2011).

Child education

Lack of sufficient food also affected children's education. In all the countries studied, respondents recounted that children did not go to school due to lack of food and the dropout rate increased because of hunger and poor health, lack of school fees and other school supplies due to lack of income resulting from loss of crops and livestock. Loss of crops and livestock disempowered households economically hence could not afford school fees, uniform or even purchase food and energy to cook. Furthermore, children did not concentrate in class which affected their performance and further demoralized their quest for education. Lack of food programs such

as school feeding programs exacerbated the rate of school dropout among younger children which contributed to the rise in number of street children. One of the key informants elaborated that:

Sometimes children absent themselves from school to assist their parents to do piece work. Some have to help their parents in sourcing school fees and some stay with guardians who are elderly so they have to assist them to find money for food and school fees. These children a dull in class...they doze during classes, when they work in the afternoon they wake up in the morning so tired and can not concentrate in class (Children FGD, Muzumazi community day secondary school, Chikuthe, Apr. 11, 2013).

"Climate change affected our families and the community by contributing to shortages of water, lack of income for family needs and education costs, diseases such as diarrhea" (Participants, children FGDS, Gombakomba Secondary School, Mutare, Feb. 6, 2013).

Children go to school in the morning and come back in evening and are supposed to carry food for lunch. Without food, children have nothing to carry to school. When a child is hungry, no concentration in school. Some children refuse to go to school and when there is famine or drought, people have little money to buy school uniform and a child cannot go to school without uniform (Public Health Officer, Nguluni Area medical center, Matungulu district, May 6, 2013).

When we look at early child development centers...we have the community-based child care development centers. They are designed in terms of children having a meal a day like porridge or fortified maize mill. So you can see that when they don't have food available in these centers, the enrollment of children in these centers decreases. The communities normally organize themselves to provide food in these centers but when they don't have enough they cannot even contribute food to their centers and that affects the attendance (Participant, department of social welfare, Lilongwe, Apr. 10, 2013).

In Plan's CCCD approach, the right to education is a fundamental right of every child. Plan International used to support the school feeding program which increased the number of children enrolled in child development centers. Termination of the program led to severe reduction in child enrollment. Results from the study showed that climate change and environmental degradation have taken a toll on children's education. Therefore for Plan and other development organizations to protect children's right to food and education, there is need to adopt a more holistic approach which integrates climate change, environmental degradation and poverty in the child centered community development approach.

Increased child labor

Increase in child labor was mentioned several times by key informants and household members. Children were also involved in doing piece jobs to raise income or provide food for their families. This affected children's school attendance and health. For instance, some of the participants stated:

"Some children do not go to school and will be forced to go and work somewhere to get food. We are seeing that in coffee farms. Children do not go to school. They go and harvest coffee to get money to buy food. Regulations are there but not strictly followed. This affects their health too" (Health Officer Nguluni Area medical center, May 6, 2013).

School going children are affected most as they are forced out of school during famine to take up manual jobs such as sand harvesting and quarrying to support their families (Education Officer, Matungulu, May 7, 2013).

Thus engagement of children undermines their right to education, good health and protection.

Shift to unsustainable income generating activities

Increased decline in agricultural productivity had driven more households into other income generating activities, using practices which were environmentally unfriendly. For instance in Zimbabwe, mineral mining was on the rise, mostly carried out by men and youths although women and children (including those below 5 years) were increasingly getting involved in these male dominated and risky activities. In Kenya and

Malawi, Sand harvesting and charcoal burning were on the rise causing massive deforestation and water loss.

"We have seasonal rivers and when they dry up, people scoop sand and extract water from the sand but when the dry season is prolonged, even that areas were they scoop sand to get water, they water dries up and are forced to move long distances to fetch water. There are areas were they have scooped sand and sold and in these areas, when the dry season comes, they dry up completely and never get any water. So we advise them to reserve soil so that they have water held in sand. So if they do not preserve, they will have to walk 20 kms to and from" (Masinga District Agricultural Engineer, Kolping Vocational Training Center, May 3, 2013)

"In Kwekwe we had 30ha of tobacco but now, we have 106ha. Tobacco was fetching a lot of money and now people are going into tobacco production and we see a lot of deforestation. We need programs to provide alternatives. We anticipate conflicts because people may want to fight for resources. Gold panning has increased and people cut trees to support their shafts so that they do not collapse" (Agricultural officer, Agritex, Kwekwe, Feb. 5, 2013).

"We are encouraging farmers to do tobacco curing but it is causing serious deforestation. People are not planning trees as required. So there are programs we do with other partners in terms of re-afforestation and tree planting campaign" (Agritex acting director, Ministry of Agriculture, Harare, Feb 8, 2013).

Mining had driven youths and children out of school to supplement household income thereby increasing the incidence of child labor. Further more, as men where increasingly getting involved in mining, tobacco curing, sand mining and charcoal burning, more women were moving into prostitution (including married women) which increased the level of divorce and family disputes. Increased stress exposed men and women to diseases. There were also marked increases early marriages and teenage pregnancies.

Increased domestic violence, child abuse and family disputes

Change is social behavior was also cited many times by the research participants. Stress from food insecurity sparked off antisocial behavior among household members e.g. frequent fights and quarrels, and theft. Women and children were more exposed to socially unacceptable behavior such as prostitution in order to raise money. Young girls engaged in premarital sex in order to fend for their families leading to unwanted pregnancies. Families also broke up due to pressure to provide food or money. Men fled their homes to search for food or to avoid watching their families suffer. In extreme circumstance, the bread winners committed suicide due to lack of food. Additionally, youthful men had relationships with widows so as to be fed. Some of the participants cited:

Sometimes the woman goes further to look for food and when she returns late they pick up fights with their men. Fights in homes contribute to early marriages amongst children because their friends at school make fun of them. Some children are abused especially those who live with stepparents so that they leave the home and go elsewhere (participant, children FGDS, Muzumazi community Day Secondary School, Chikuthe, Apr. 10, 2013).

"There are cases of divorce which culminates from conflicts in family. This is contributed by disagreement when both couples spend the whole day searching for food but in vain…increase in death rates mainly due to diseases outbreak and much suffering for instance some community members have committed suicide due to lack of food…he/she assumes the problem is too much to tolerate" (Participants, women FGD, Mamba village, Yatta District).

This implies that the effect of climate change and environmental degradation on basic needs like food was increasingly exposing children and youths to unacceptable social behavior, unwanted pregnancies, early marriages and sexual relationships which

affected their development. Engagement in undesired relationships exposes children and adults to HIV and other sexually transmitted diseases. This denies children their right to education, food, protection and a descent livelihood. Among adults inability to meet family needs undermines their self-esteem hence some resort to ending their lives. Hence food programs need to build in a component that aims at rebuilding self-esteem of affected members including children, youth, men and women.

5.3 Impact of climate change and environmental degradation on water and the implication on children, women and men

A number of countries in Africa already experience considerable water stress as a result of insufficient and unreliable rainfall. Changes rainfall patterns and occasional flooding also affect water quantity and quality in a number of countries in Africa. In the five case study countries - Zimbabwe, Malawi, Kenya, Ethiopia and South Sudan, it was established that a local communities were already experiencing water stress. Literature review on the impacts of climate change and environmental degradation on sustainable access to water in seven non-case study countries including Tanzania, Uganda, Rwanda, Zambia, Mozambique, Sudan and Egypt indicate that climate variability is already imposing additional pressures on water availability, water accessibility and water demand in Eastern and Southern Africa region.

An analysis of six climate models and the SRES scenarios (Arnell, 2004) shows a likely increase in the number of people who could experience water stress by 2055 in northern and southern Africa. In Eastern Africa, however, more people are likely to experience a reduction rather than an increase in water stress (Arnell, 2006a; IPCC, 2007). High temperatures and less rainfall during already dry months in the Tanzanian river catchments could affect the annual flow to the River Pangani by reductions of 6-9% and to the River Ruvu by 10% (VPO-URT, 2003). The Pangani Basin is also fed by the glaciers of Kilimanjaro, which have been melting alarmingly fast.

The current and future challenges affecting water availability and access may however not be attributed to climatic variations and climate change only. Other impacts such as over-harvesting of forest resource, industrial pollution and sedimentation are also degrading local water sources such as Lake Victoria (Odada et al., 2004). Uncontrolled sand harvesting in river valleys led to severe environment degradation and resulted in loss of water retention capacities of some of the seasonal and perennial rivers.

This had severe implications on women as they had to trek longer distances to look for water. Reduced water levels in rivers stimulated economic activities such as sand mining which further drained all the water from the core water sources. A number of studies indicate that present population trends and patterns of water use more African countries will exceed the limits of their “economically usable, land-based water resources before 2050.

Local communities in case study countries reported extremely low water levels in rivers and dams due to increasing temperatures which accelerated evaporation. Drying of dams and rivers was also attributed to rainfall variability, and siltation of dams due to soil erosion. The water table was also receding to the extent that boreholes only yielded water at greater depths and many of them dried up during drought seasons. Siltation of dams and rivers was exacerbated by deforestation and poor agricultural practices which compromise vegetation cover.

A high proportion of households in case study communities in the five countries of Eastern and Southern Africa region are dependent on boreholes. Over 80% of the respondents in areas such as Jobur, Rokon and Kuda of South Sudan accessed their water for domestic and livestock purposes from boreholes. In Zimbabwe, over 70% in Kwekwe, Tsholotsho and Mutare depend on borehole water in dry months and occasionally on rivers and dams/pans in wet seasons.

Malawi had about 70% of respondents in case study communities of Lilongwe, Mulanje and Mzimba dependent on borehole. Those households which access water from boreholes in case study communities of Ethiopia and Kenya ranged between 18% and 30% respectively. Most of the respondents in Ethiopia depended on surface water sources – rivers, shallow wells or water pans.

Study results show that a majority of households in Eastern and Southern Africa depend on groundwater for their water supply. Most of the respondents also reported that the borehole water is receding deeper beyond current extraction levels, especially during extended drought periods. It was also established that maintenance costs of diesel propelled water pumping generators tended to increase during drought periods due to increased demand as more people relied on such sources of water. Drying up of boreholes and breakages in water pumping generators contributed to severe water scarcities.

Climate change and environmental degradation impacts on water availability and access, especially water scarcities have particular implications for women and children in Africa. This is because women and children are responsible for gathering water. Women and children in case study communities reported that they either walked long distances or spend long hours to get water. Results from the case study communities across the five countries showed that women (63%) and children <5 years (25%) were more affected by water shortages. Most of the household (75) took 30 minutes to get to water source and 18% took 2-3 hours.

Children suffered from waterborne related diseases because their families could not access clean water. The distance increased during water scarcity. Children, especially girls are affected by water shortages as they participate in accessing water for their families. Most of the girls reported that scarcity of water interfered with their homework studies or caused them to miss school or get to school late.

Poor access to safe and clean water exposed communities to water borne diseases (such as diarrhea and typhoid) especially in communities with poor access to quality public services and NGO intervention. However, even in communities with such services, disease incidences were report because the safe water resources were not sufficient. Poor sanitation, washing away of toilets by floods and chemicals carried by water increased health risks. Floods and stagnant water also increase Malaria incidences in the communities. Progressive drought interspersed with floods will increase incidences of environmental diseases.

Conflicts over shared environmental resources such as water are attributed to climate change factors such as drought (Vorosmarty et al., 2005). In pastoral areas severe drought are accompanied by increased violence and insecurity as people struggle to access scarce grazing resources in countries such as Kenya, South Sudan and some areas of Ethiopia. Case study communities in South Sudan attributed most of their inter-community conflicts to drought and inadequate water and pasture resources.

5.4 Impact of climate change and environmental degradation on energy and the implication on children, women and men

Biomass, especially fuel wood and charcoal is a major domestic energy resource used in food preparation, warming and even lighting for a majority of households in case study communities of Zimbabwe, Kenya, Malawi, South Sudan and Ethiopia. Over 80% of the households in case study communities use either wood or charcoal in their homes. About 90% of the households in South Sudan used firewood and charcoal.

The local population in the study areas was quite aware of the environmental risks associated with dependence on biomass as a resource of energy fuel and finance. They were also aware of drought impacts on regeneration of biomass, and the future risks of scarcity of such energy resources. FGDs in all the case study communities revealed that trees were hardly

regenerating due to frequent droughts and poor soils which had been exhausted through erosion. Overharvesting of Biomass also interferes with the water cycle and thus contributing to local climate variations.

Availability and access to electric Energy: Most of the case study countries, except South Sudan depended on hydropower to generate electricity. Climate change related constraints of the hydro system are caused by the variability of rainfall. In years of low rainfall and drought the amount of water available during the rainy season does not allow for the reservoirs be filled up to the maximum. These extreme changes in water availability indicate the problems of electricity supply in Kenya, Ethiopia and Zimbabwe. In the past extended drought has been the reason for extensive load shedding, cutting regions or businesses off the grid to reduce consumption.

Vulnerability of women and children: Although every community member is affected by energy shortages, women were considered to be most affected because they walked longer distances to collect firewood to be able to execute their role and responsibility of cooking food. Children were also affected especially the girl child. This exposed women and girls to danger. Although the effect was felt more by women, it trickled down to other family members.

Women and children have been affected more especially the girl child. Collection of firewood and charcoal is done by women and girl child; people are walking longer distances to collect firewood. Charcoal has become expensive. Travelling long distances and even subjecting them to danger.

The children expressed incidences of domestic violence when women returned home late. Women go further to fetch firewood and sometimes, it generates fights with men when they return late (Participant, children FGD Muzumazi Community Day Secondary, Apr. 10, 2013).

Child education

Limited access to modern energy such as electricity affected children's learning as they could not extend time to study e.g. at night. This contributed to their poor performance. Teachers were also not motivated to teach in rural areas without electricity which had affected education in rural areas. Besides this, children did not go to school without food and those who made it to school without food did not concentrate. Children bathed cold water in cold seasons which exposed them to respiratory diseases such as phenomena and consequently, irregular school attendance. Participants stated:

In schools children do not have light to study at night so they need electricity; also some teachers are not willing to work in rural areas because of lack of electricity so this has affected education in rural areas. In schools where we have installed solar in rural areas teachers are happy, willing to stay.

Lack of energy affects children because cooking food becomes difficult and a child cannot go to school without food. When hungry they cannot go to school to listen to the teacher. They will be dozing most of the time. They use cold water to bath which can cause Pneumonia. If we had electricity, children would be studying at night. As a result, we are getting poor performance. They spend time looking for firewood to warm water and cook breakfast. And children come late at school instead of arriving at 7.30a they arrive at 8a so they find their friends have gone far.

In most cases, households buy firewood and this is used sparingly. So children come to school without breakfast because firewood is reserved for lunch. Children have difficulty getting fire to boil water for bathing and cooking porridge. Children waste time colleting maize stocks to cook water so they come to school late. They are punished. Those who do not have food stay hungry. Governments say that they should have break for 30 minutes and you see children standing out there in the trees for 30 minutes with no food. They are used to staying without food. They doze in class but we try to keep them awake (Teacher, Muzumazi Community Day Secondary, Apr. 11, 2013).

This implies that lack of technical capacity in responsible government institution (department of alternative energy) to develop and promote alternative energy sources will further aggravate the situation. Hence there is need for governments to invest more in alternative energy sources.

5.5 Climate change and environmental degradation policy status in the region

Countries in eastern and southern Africa have made strides to design policies and programs to address the effects posed by climate change and environmental degradation. Polices were formulated at both national and local levels. At local level, communities formulated rules and by-laws to protect the environment and effectively utilize the natural resources available. A cross the case study countries Ethiopia, Kenya and Malawi, exhibited higher levels of commitment to address climate change and environmental degradation through institutionalization of climate change and environmental degradation. Interaction with Plan Zambia also indicated tremendous progress in the State's endeavor to mainstream climate change and environmental degradation. The least degree of institutionalization of climate change and environmental degradation was noted in Zimbabwe and South Sudan. However, the government of Zimbabwe had initiated activities to design a policy framework to mainstream climate change and environmental degradation. South Sudan was in the process of institutionalizing climate change and environmental degradation but because it's still a new State, it will take time to fully integrate climate change and environmental degradation in policies and development programs. This implies that social, economic and political instability has implications on countries' priorities and capacity to address climate change and environmental degradation.

Despite the fact that most of the countries visited had policies and strategies to address climate change and environmental degradation, the major gap was in harmonization of policies across sectors. Some sector policies conflicted with each other, which calls for multi-sector integration and harmonization of policies to effectively address climate change and environmental degradation. Implementation of policies was also a major constraining factor and non-clarity of policies and guidelines. Poor enforcement and compliance to environmental policies, by-laws was strongly emphasized in all the countries. Implementation and compliance to policies was hindered in part by the fact that community members' needs where not fully address by government for instance lack of alternative energy sources. Community members lack alternative livelihood strategies in the face of climate change and resorted to activities which negatively impacted the environment. Therefore there is need to enhance the capacity of national States to design policies that address the needs of community members and capacities of policy implementers and community members to implement the policies.

Countries had also developed a set of policies, strategies and frameworks to address food security, water and energy crises. These where formulated at both national and local levels. However, while the specific policies address how to boost food production, energy or water outputs/supplies, they fail to directly address direct risks and linkages between the sectors and climate change. This is due to lack of a trans-institutional or cross-sector approach to holistically integration of climatic change and environmental degradation.

Group discussion of Community Health Workers from Katoro Ward during monitoring meetings.

5.6 Programs in place to address food, water and energy crisis in the face of climate change and environmental degradation in the region

Programs were in place (both by government and NGOs) to address food security, water and energy crises. However, amongst the three sectors, energy was least addressed. Government and NGOs in the region had not ventured a lot in developing alternative energy sources. Although countries such as Malawi were implementing rural electrification the process was too slow that the impact was very marginal. Lack of alternative energy sources drives community members to cut down trees for energy use and income as well. This is aggravated by lack of alternative livelihood strategies. Community members engage in activities such as charcoal burning, selling of fuel wood, mining, and sand harvesting among others for income. This had in part contributed to loss of trees especially indigenous tress species and soil erosion. Hence there is need for government, NGOs and private sector to invest in alternative energy sources and energy saving technologies. Technologies such as solar driven pumps would be used to support small-scale irrigation. Organizations such as Plan International in Ethiopia had invested in solar energy to support children education and health facilities thereby protecting children's rights to education and survival.

Programs on food mainly enhanced community members' capacity to increase production through use of improved agricultural practices. Some of the programs supplied food handouts mostly to disadvantaged households including child headed households, HIV infested/affected families and other resource poor households. Sustainable land management programs were implemented to enhance adoption of sustainable land and water management practices and reverse natural resource degradation in agricultural landscapes and watersheds to increase agricultural productivity and protect ecosystems integrity/services.

However, most of the programmes that addressed food, water and energy did not explicitly address the impacts of climate change on the respective sectors and did not consider seriously the issues of women and children. Participation of women and children in decision-making was minimal. It was observed that programs targeting children were limited or non-existent in many of the communities visited. Children's rights were not mainstreamed holistically in most of the development programs implemented by government and most of the NGOs.

In addition, promotion of market-oriented programs was still marginal. Programs to improve access to water mainly supported installation and rehabilitation of boreholes, wells and dams. Although some of the communities where plan operates seemed to be water secure, in many of the communities visited, the boreholes were non-functional thus needed rehabilitation. Therefore there is need to invest more in water supply system to increase access to safe water. Such programs need to be scaled out to benefit a larger number of community members. On the other hand, most of the programs implemented by government and NGOs were sectorial, addressing specific interests of the departments. More holistic programs integrating food, water and energy will better caution community members especially children and women against the impacts of climate change and environmental degradation.

Chapter 6

Conclusion and Recommendations

Climate change and environmental degradation are now widely recognized as the major environmental problems facing the world today. Climate change in the African Continent is anticipated to have far-reaching adverse effects due the continent's dependency on rain fed agriculture and vulnerable resources for economic development. Poor management of natural resources further exposes Africa to the negative impact of climate change. Climate change is anticipated to have greater impact on sectors related to the achievement of the MDGs such as agriculture, water supply and demand, and energy. However, there is limited empirical evidence on the impact of climate change and environmental degradation on food, water and energy from the child centered and gender perspective. Lack of this information affects integration of climate and environmental issues into policy, practice and climate related services.

This study was conducted to create an understanding of the impact of climate change and environmental degradation on sustainable access to food, water and energy in the region of eastern and southern Africa. The research established the implications of climate change and environmental degradation on children, women and men; identified programmatic and policy interventions currently addressing climate change and environmental degradation; and explored existing programmatic and policy gaps. Although the actual and potential impacts of climate change and environmental degradation in Africa are wide ranging, affecting many aspects of people's daily lives, this study was limited to the impact on sustainable access to food, water and energy due to the complex linkage between the issues. The study focused on countries where Plan was operating.

The results showed that the majority of participants interviewed had a clear understanding of climate change and environmental degradation. Climate change was mainly perceived as the change in weather related variables (such as shift in on-set and offset of rains and increased frequency and severity of extreme weather events (such as droughts, floods and strong winds). Environmental degradation was primarily understood in terms of uncontrolled deforestation, soil erosion; lose of species diversity resulting from unsustainable income generating activities (such as mining, sand harvesting and charcoal burning) and human settlement. The findings revealed that climate change and environmental degradation are already impacting food, water and energy security in Africa. The potential for natural environmental hazards and climate change to undermine African country's economic development and social progress is great and growing.

The impacts of climate change were concomitant to the IPCC 2007 Africa climate projections. The results indicated that there were both positive and negative effects of climate change on food, water and energy. Although the majority of participants across the five countries had registered a decline in crop yield, some of them especially in Malawi, Kenya and Ethiopia reported an increase in crop yield due to increase in rainfall, expansion of land and use of inputs. Additionally, although climate change and environmental degradation had negatively impacted access and availability of water in other communities respondents expressed increased access to water due to the rise of the water table attribute to increased rainfall. Women and children were affected most by the negative impacts as they experienced food, water and energy shortages thus trekked longer distances to access food, water and energy. Families adopted undesirable coping strategies to food shortages such as reducing number of meals given to children or children staying a whole day without food. These effects contribute to the violation of children's rights

to food, education, protection, good health and survival. Community members respond to the impact by venturing into other practices, some of which further degrade the environment.

This implies that climate change and environmental degradation will likely have pronounced negative effects on all three sectors, with two distinctive features – gender and geographic inequality, whereby some areas will be more vulnerable and hit much harder than others; and a tendency for climate change to accompany other human-induced impacts like resource overexploitation, which are already the major environmental challenge of Africa. Both factors represent a major challenge in building response strategies.

The responses so far taken by are fundamentally addressing the economic and social issues of the society/country are not entrenched to fight climate change impacts. There were gaps in implementation and compliance with environmental policies. The policies were not harmonized and revised to address realities related to community members' livelihood strategies and the future impacts of climate change. The policies do not address the need for preparedness for eminent dangers due to climate change and neither do they promote strategies that would help grasp opportunities that could come with climate change adaptation and mitigation measures such as carbon funds and carbon credits.

Preparing for and responding to climate change environmental degradation impacts on food, water and energy security will require reviewing the existing policies and strategies to incorporate natural and managed ecosystems, for example through the lens of ecosystem services, by which greater emphasis is placed on the preservation of healthy ecosystems; and through climate smart agricultural and agroforestry practices that can lend to rather than working against climate resilience and climate mitigation.

For programs designed by government and development partners to address the needs of community members including children and to also build an environment where children can realized their rights, there is need to consider variation within communities in terms of socio-economic status, economic activities, resources available and their status, infrastructure, demographic characteristics and traditions/culture. This will foster proper targeting of communities with appropriate programs and policies thereby fostering attainment of food, water and energy secure communities.

Youths planting trees along the river banks for environmental conservation.

Recommendations

Overall the results indicated that climate change is posing challenges to government, NGOs, development partners and communities to protect children's right to food, water, energy, education, protection, participation and descent livelihoods. To minimize the impacts and further protect children's rights, but also the rights of community members, the following were recommended by research participants and complemented by the researchers' views:

Recommendations to government

1. Coordination among policy makers and implementers in all sectors is very crucial especially coordination with the climate change and environment management coordinating bodies to facilitate institutionalization and integration of climate change and environmental degradation in all development programs and policies.
2. Children rights need to be integrated into national climate change responses and integrate climate change into national child rights agenda. The voices of the voiceless need to be heard and responsible parties should be present to listen to these voices. Strengthening national and local policies against child labor might minimize children's exposer to coerced labor force.
3. To address the challenge of access and availability of energy, government needs to invest and promote alternative energy sources that utilize locally available resources (e.g. investing in energy efficient cook stoves, solar or wind power irrigation systems, solar powered water pumps, wind turbines and micro hydro-power systems). Rural electrification needs to be scaled out. This will reduce dependence on fuel wood and charcoal.
4. Government needs to invest in construction of deeper boreholes to tap into rich underground water sources and train community members in maintenance of water resources. Provision of water treatments kits by government to improve the quality of water will minimize disease outbreaks from use of contaminated drinking water. Government environmental bodies need to put in place stringent measures to regulate disposal of waste and pesticides into water sources such as rivers which exposes community members to health risks.
5. Water harvesting should be strongly promoted by government e.g. through roof catchment or construction of dams so that community members make proper use of rainwater. The water in storage tanks could be treated and reserved for future use especially in public facilities such as schools and hospitals. Communities with dams were said to be water secure since dams held water for long periods of time. Water in dams and wells was used for irrigation thereby increasing access to food.
6. Deliberate policy decisions to facilitate financial institutions in rural communities to provide soft loans to farmers to enable them diversify enterprises and minimize use of non-renewable resources. Investing in income generating projects which do not depend on rainfall will reduce community vulnerability to climate change.
7. Revamp government laws on environmental degradation. Give policy enforcement mandate to institutions with elaborate structures that link up with communities. Traditional chiefs could be instrumental in supporting communities to implement measures that protect the environment and mitigate climate change impacts (such as planting trees). Local authority needs to be trained in natural resource management and there should be incentives to motivate chiefs to carry out their duties. There is need to develop a strategy to engage local authority and community members including children and women in policy formulation to increase ownership and compliance.
8. Increase involvement community members in technology design and rigorous public awareness campaign to sensitize people about alternative energy sources. More stakeholders need to be

involved in design and dissemination of alternative energy technologies especially stakeholders who operate at grass root level such as NGOs, teachers and health workers. Strengthening private sector to promote solar and wind energy in both rural and urban areas will aid dissemination of technologies. Government needs to reduce or eliminate taxes on these forms of technology for them to be widely adopted.

9. More government intervention on livestock production (e.g. breeding programs), scale-up vaccination to reduce the impact of infectious diseases especially during rainy season, linkage of pastoralist to market, and reservation of grazing land would minimize impact of climate change and environmental degradation on pastoralists. Pastoralists and farmers need to be trained in breading to improve the quality of livestock. Additionally pastoralists need to be encouraged to stock the number of livestock that can be sustained by the available resources.
10. Deforestation, mineral mining, sand harvesting and charcoal burning were the major economic activities which contributed to soil erosion, soil exhaustion, and water stress. Innovations to make these activities sustainable businesses would minimize their impact on environment. Partners involved in these activities need to be sensitized about the environment and trained to engage in such practices in a manner that reduces negative impacts on the environment. Policies and community bylaws governing these practices need to be formulated and enforced.
11. Increase public awareness, knowledge and understanding on environment and climate change. Use information and communication technologies to increase the frequency of communication and sharing of experiences and knowledge, and to improve the quality of and access to information on sustainable natural resource use and climate change. This could be achieved by conducting public awareness campaigns, school campaigns, use of traditional media (e.g. music and drama, rites, ceremonies and folklore), or conduct advocacy and social mobilization campaigns among others.

Recommendations to development organizations

- Support school feeding programs during periods of food shortage to increase child enrollment in school and protect their right to education. This can be complemented with training programs to increase the capacity of mothers to feed their children. Diversification of income sources for mothers, which are less dependent on climate, will boost their level of resilience to climate change and enhance their capacity to enroll children in schools during food shortages.
- Linking farmers to markets will motivate them to produce and invest in technologies which conserve the natural resource base. Promoting corporative gardening and collective marketing can scale this up. However, for farmers to earn higher income there is need to build their capacity to bargain for better prices and engage in farming as a business.
- There is need to strengthen collaboration among stakeholders along the value chain including farmers, extension, private business sector, research and policy makers. This can be achieved through formation of innovation platforms to facilitate exchange of knowledge and information among diverse stakeholders, collectively design technologies and jointly implementation solutions. The will facilitate design of an integrated/ holistic approach to address climate change and environmental degradation.
- Promoting diversification of income generating activities will also increase farmers' income levels and minimize engagement in activities which threaten the health of the environment. Promoting off-farm income generating activities would reduce the risks resulting from climate change and environmental degradation and boost farmers' resilience.
- Promote adoption of drought tolerant crops (such as small grains, pigeon peas, green grams, cow peas, roots and tubers) and develop technologies that reduce drudgery in small grain production. Production will be enhanced by increased access

to improved seed and adoption of soil and water conservation technologies. This could also allure youth into agriculture and address food security crises. Gender should be mainstreamed in technology design to ensure that technologies generated are appropriate for women, men and children, and reduce drudgery along the value chain.

- Farmers, extension workers, forest officers and livestock officers need to be trained on climate change and environmental management to be able to advise community members. The number of environmental officers in districts needs to be increased to be able to monitor environmental management.
- Increase the availability of equitable and sustainable water supply systems and invest in water supply infrastructure (such as drilling more boreholes and wells in water stressed areas; rehabilitating damaged boreholes, silted dams and rivers; upgrading available infrastructure and expanding irrigation schemes). Community members need to be trained in management of water resources. This will reduce the distance moved to find water for domestic and agricultural purposes, and minimize children's exposure to danger.
- Encourage people to plant more trees and design a system to monitor tree planting and management. Enforcement of policies directing farmers to reserve a portion of their land for tree planting and restrict cutting of trees would aid conservation of trees and increase the area covered by trees. Investment in energy saving technologies would also foster attainment of this goal. This would be complemented by civic education, to sensitize people about the importance of conserving trees. Exotic and multi-purpose trees need to be promoted to reduce pressure on indigenous species, which are disappearing at a faster rate. However, favorable policies are required to drive and deliver this agenda and measures put in place to enforce the policies.
- Invest in energy efficient and energy saving technologies to increase access to renewable energy sources. Investment in solar energy and energy saving stoves will reduce over-reliance on biomass for energy, distance moved to find energy and health exposure to risks by women and children.

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