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Climate Change Adaptation: Opportunities and Challenges from Two Communities in Ethiopia

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Abstract
Climate change is real and is disproportionately affecting poor communities in poorer countries. Climate change drives climate extremes which manifest in the form of extreme droughts in some areas and excessive precipitations in others. The nature of impacts from climate extremes depends not only on the intensities of the extremes themselves but also on exposure and vulnerability of communities. Communities in poor countries are the most exposed to such extremities and are forced to bear a huge burden to adapt to these extremes. As such, adaptation to disasters is not new to these communities in a sense that they have been adapting to extremes even before climate change became a concern. What is now new is the extent of exposure factors exerting an ever-increasing pressure on livelihoods of already destitute communities. As if their poverty was not enough, climate change extends the plights beyond previous adaptation capacities. These communities and countries not only have to tackle clime-driven consequences, but also other forms of disaster impacts and poverty in general. How can these communities and countries deal with such intricately related environmental management, disaster risk reduction and overall poverty alleviation challenges all at the same time?
A survey was carried out in communities with varying socio-cultural and environmental conditions in two different parts of Ethiopia to understand their perceptions on climate change and variability, and their capacity to adapt. Institutional support levels provided to such disaster-prone communities in terms of policy, technical and material from local governments and international organizations has also been reviewed. The results of various group discussions suggest that community awareness on climate change impacts is fairly good, but commensurate action lags behind for various reasons. The groups also identified opportunities, challenges and concerns. Local institutional support is growing as manifested through, among other things, ratification and implementation of relevant international conventions, integrating climate change issues in development programming, creating coordinating faculties, apportioning significant resources in important sectors such as agriculture, and creating public knowledge, though with enough challenges and concerns.
Given their current levels of human, financial, natural and socio-political capital, poor communities in Ethiopia and perhaps other poor countries in Africa, are tackling their part of the problem with the needed intentionality and vigour. However, their resources and technical capacities are not enough to deal with the current levels of disasters, let alone with the projected increase of climate and weather impacts. On the other hand, the current level of global adaptation funding and technical support for developing countries is below even conservative estimates. Noting the gravity of the problem and the level of poverty prevalent in the most climate affected areas, and existing difficulties in adaptation, global institutions need to take the implementation of the already-agreed upon international conventions for the reduction of GHG and adaptation funding more seriously. The situation is already dire for the poor communities and countries and if GHG emissions continue unabated even more resources will be needed in the future to respond to climate change impacts.
Keywords: Adaptation, drought impacts, environmental degradation, Ethiopian highlands, famine, forests, perception

1. Introduction

1.1 Current Disaster Stresses

Africa is one of the most disaster-affected continents, mainly by climate extremes. At least 60% of Sub-Saharan Africa (SSA) is vulnerable to drought and about 30% is highly vulnerable (Benson and Clay, 1998). In SSA about 359,246,626 people were affected and about 82,305 died between 1986 and 2005 due to drought (IFRC 2006). In East Africa alone, severe droughts occurred over at least a portion of the region in 1933-34, 1938-39, 1949-50, 1952, 1965, 1969, 1973-76, 1980 and in 1985 (e.g. Rasmusson, 1987:Glantz, 1994, Campbell, 1994) and most recently in 1987, 91/92, 1999/2000, 2002/2003, 2005, 2009 (e.g. Glant et al, 1997; Hastenrath et al 2007; Viste et al, 2012). In addition, severe floods occurred in East Africa in 1961, 1994, and 1996/97 (Behera et al 1999; Birrkett et al 1999). Since the major drought in Africa in the 1980s, the number of undernourished people in eastern and southern Africa has more than doubled, and while rural development stagnated, rural poverty expanded during the 1990s (Funk et al, 2007). In recent years it has become clear that climate change is an inevitable process (IPCC AR5, 2013) and Sub-Saharan Africa, will be disproportionately impacted not only

due to the result of projected warming and rainfall deficits, but also because of the structural vulnerability of the population (Thompson et al, 2010).

Ethiopia is seen as one of the African countries most vulnerable to the impacts of climate change, with limited capacity to cope with short-term climatic shocks or adapt to longer-term trends (Conway et al., 2007). The main documented drought-related disasters affecting Ethiopia occurred in 1888-92, 1958, 1965-66, 1973-74, 1984-85, 1987, 1990-91, 1999-2000, 2002-2003, and 2009 (NMSA, 1996; DPPA, 2003, Tafere, 2011; Viste et al, 2012). During the last four decades, a number of severe droughts have caused extensive human and material loss in Ethiopia, often covering the greater Horn of Africa, in 1965, 1973, 1984, 1987, and 2011 (Camberlin, 1996, Viste et al, 2012). In terms of the spatial incidence of drought occurrence, Webb and Braun (1994) indicated that most of the drought events were concentrated in two broader zones of the country. The first covers the central and north-eastern highlands, while the second area is comprised of the crescent of low-lying agro-pastoral lands. These areas cover a major part of the Ethiopian highlands, which occupy 44% of the total surface area of the country, and are affected by deforestation and degraded soils leading to recurrent food shortages. In spite of its relatively smaller size, the Ethiopian highland is home to over 90% of the people and 75% of livestock and about 85% of the crop lands are located in this area (Amede et al, 2001). With climate change impacts projected to worsen, people living in this part of the country might face an insurmountable challenge. More frequent droughts, increasing variability, and areal expansion of drought coverage continue to create an uphill struggle to these subsistence farmers.

1.2 Impacts of drought disasters

Disaster-related loss is increasing with devastating consequences on lives and livelihoods of poor communities (ISDR, 2005, IPCC AR5, 2013), and is expected to increase due to climate change and variability (Thompson, 2010). Direct link between the increasing hydro-meteorological disasters and climate change is also almost certain (IPCC AR5, 2013). Climate change impacts can erode economic, social, and human capital. Economic impacts of disasters can be categorized as direct, indirect and secondary effects (World Bank, 2005). Direct losses imply losses of assets damaged by the disasters, whereas indirect losses are the losses accrued while production assets remain unproductive due to damage or destruction. During disasters, both direct and indirect losses accrue across the social, productive and infrastructure sectors. Even though reports available on the costs of disasters are often related to direct costs associated with physical destruction (Benson and Clay, 1998), disaster affected countries suffer from secondary effects that divert resources from mainstream development to relief, recovery, rehabilitation and reconstruction of disaster damages. Ethiopian economic and human cost of the most devastating droughts has not been computed, but some data indicate drought being a serious threat to the survival of its populace. Between the 1970s and 80s, most of the northern and eastern regions of the country experienced drought, which affected about 15% of the total population; the impact of subsequent droughts increased from the 1990s onwards, affecting a wider geographical area and up to 20% of the population (IIRR and Save the Children, 2007). As climate change impacts depend on exposure to disaster risks and vulnerability, on a social vulnerability index (SVI), Adger and Vincent (2005) put Ethiopia among the top ten most vulnerable countries in Africa.

Currently, Ethiopia is still an agrarian economy with about 85% of the employment dependent on agriculture, and about 41.6% of its GDP derived from it (IMF, 2011). Agriculture is dependent mainly on traditional systems and is largely rain-fed, which itself is highly variable and unpredictable due to climate change. Despite Ethiopia's insignificant per capita GHG emission rates, researchers assert that the country loses from 2 – 6% of its total production due to climate change every year (IMF, 2011). This is higher than the projected economic cost of 1.5 – 3 % of Africa's GDP of climate change by 2030, (Clements, 2009). In addition, studies depict positive correlation between major drought years and GDP decline in the period between the beginning of 1980s and 2005 (for example Conway and Schipper, 2011). This picture being a national level status, it does not necessarily represent the true picture of the rural communities that are almost totally dependent on agriculture, and/or are disaster prone. When comparing the GDP growth trend and the demographic dynamics, a mismatch between the two is evident (fig. 2). Demographic data indicates that Ethiopia started the 20th century with about 11 million people. Sixty years later, in 1960, the figure had doubled. After another doubling by 1987, the country's population was estimated at 44 million (MoWR, 2004). The latest estimate (2012) puts the total population at 86,613,986 out of which 83% live in rural areas (CSA, 2012). While the population grows sharply, agricultural and total GDP increases steadily and variably, showing at times significant decline corresponding to drought years.

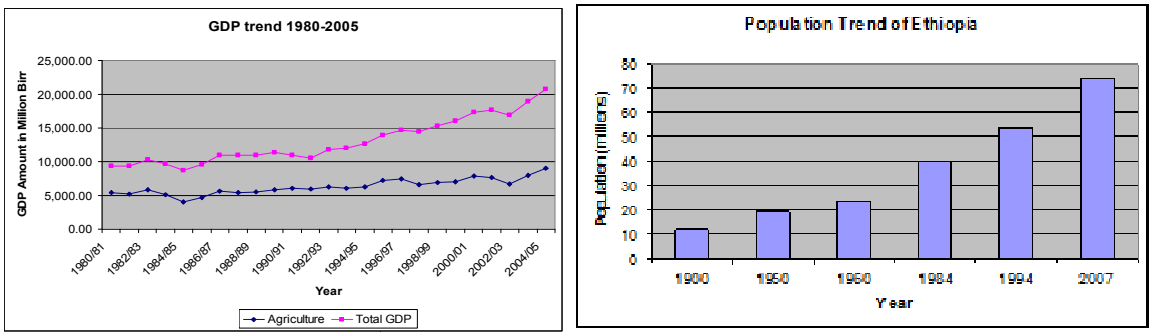

Fig. 2 (a): Trends of agricultural and total GDP in Ethiopia from 1980 to 2005 (Source: Digital data taken from the ministry of Finance and Economic Development); (b) Population trend of Ethiopia: Data source: CSA 1964; and projections from the Population Census Commission, 2004.

1.3 Climate Change Adaptation

Climate policy has occupied centre stage since the Rio summit in 1992, followed by the Kyoto protocol which introduced mandatory emission reduction targets in 2005. Since then political commitment to greenhouse gas (GHG) reduction is growing, though emissions also continue to grow (Sperling & Cannon, 2007). Mitigation rather than adaptation dominated the international political agendas during the 1990s and early 2000s (Adger et al 2009). While mitigation aims at reducing GHG emissions primarily by the rich countries in the west, adaptation is in reality the responsibility of those facing the impacts of climate change (mainly communities in poor countries). Adaptation, simply defined, refers to "the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate" (IPCC, 2012). As such, societies are not new to climatic changes and have been adapting throughout history, implying the existence of latent adaptation capacity which is triggered when needed (Burton et al 2006). Communities are reasonably adaptive to environmental changes occurring gradually, and do so with their own means and initiatives. However, the magnitudes and intensities of current and future climatic changes are likely to push poor communities beyond past levels of adaptive capacities.

The effects of climate change manifest in the form of more frequent and intense ENSO events leading to widespread drought in some areas, devastating floods in other areas (Ware et al, 2005), and increased temperature (IPCC AR5, 2013). Not only is global warming real (IPPC AR5, 2013) but Africa and other developing countries are the prime victims of the projected changes (Smith et al; 2003, Ahmed et al, 2009) because widespread poverty in these countries limits adaptation (IPCC, 2012). For these countries, efforts to adapt to the changing climate are inseparable parts of the broader challenges of natural resources management, poverty reduction, and sustainable development (Bapna & McGray, 2009). Various forms of weaknesses such as structural, technological and institutional coupled with low asset base due to extreme poverty aggravate the vulnerability of SSA to climate change impacts (Hassan, 2010). In sub-Saharan Africa, socio-economic vulnerability often coincides with bio-physical vulnerability and a large proportion of the population (the rural poor) depends on climate-sensitive rain-fed agriculture for subsistence income and has limited livelihood options (Eriksen and Næss, 2003). This is further confirmed by the World Risk Report (2011), which puts 26 countries in Africa as very highly vulnerable while 14 others were ranked as highly vulnerable.

Farmer-level adaptation to drought and other climatic changes can be seen as comprising two important elements. First, adaptation depends on farmer's perception of the risk factors (Adger et al, 2005) and the level of conviction that business as usual is not an option. Secondly, adaptation depends on the options available, which in turn may be a function of several factors including economic status, education level, and other environmental endowments (Hassan, 2006; Deressa et al, 2009). Effective adaptation and disaster risk management strategies and practices also depend on a rigorous understanding of the dimensions of exposure and vulnerability. In addition, proactive adaptation calls for a stable political system and governance (Magadza, 2000), and proper financing of additional resources. That is why the UNFCCC has established clear resolution at Bali 2007 (UNFCCC, COP 13) to "improve adequate, predictable and sustainable financing … and provision of new and additional resources for developing countries." Climate change perception (on risks, and opportunities), institutional support, and financial capacity are key areas to effectively strengthen adaptation capacities in poor countries. Unfortunately, funding for adaptation and disaster risk reduction (DRR) makes a small fraction of aid budget, is highly unstable, and highly concentrated in small middle income countries (CFU, 2013; Caravani, 2013).

2. Research objectives

Despite the fact that climate change adaptation has been high on the global agenda since the early 1990s, and that Ethiopia has been experiencing its impacts, adaptation research has been not been widely carried out. A majority of those so far conducted focused on a component of adaptation or covered a smaller portion of the country (Kinfe. 1999; Tadesse and Belay, 2004; Meze-Hausken, 2004; Kidane et al, 2006; Deressa et al, 2008; Deressa et al, 2009; Conway and Schipper, 2011; Mesfin, 2011; Oates et al, 2011, Tesso et al, 2012, Woldeamlak & Dawit, 2011). These studies highlight some adaptation options and barriers inter alia lack of information, financial limitations, inadequate size of land, shortage of labor and limited potential for irrigation. However, only a few assess institutional efforts to support community's adaptation efforts. This research intends to enrich the climate change adaptation discourses by filling some of the gaps.

The findings discussed in this paper are taken from a body of a much wider study carried out to understand rainfall and environmental degradation patterns, perceptions of disaster risks and adaptive capacity of communities and institutions in Ethiopia (Tafere, 2011). It focuses on a part of a much bigger body of disaster impacts propelled by climate change. Adaptation to disasters in general and to climate change in particular is discussed under this topic. It is based on a response of two communities in Ethiopia to questions related to peoples' perception on disasters and their ability to adapt to these livelihood disruptions.

Adaptation is one of the preoccupations in the field of climate change and disaster risk reduction. As such humanity has been adapting for generations to changing circumstance forced by natural or human beings, though such forced human adjustments were not necessarily called adaptation. What may be new these days is that the frequency and intensity of the risks has increased and that vulnerable communities are faced with increasing pressure to do more. But, what can poor farming communities with no other skills, limited alternatives and connections do? It is essential to know about the opportunities and challenges around adaptation in such poor rural communities.

The objectives of this specific paper can therefore be summarised as:

- to find out community's level of perception on climate change impacts, risks, and opportunities;
- to study community's capacity to adapt to the ever increasing disaster threats driven by climate change; and what constraints, and challenges retard adaptation in these communities
- to determine the roles of various local and international institutions, resource support mechanisms and technological transfer mechanisms received by poor communities.

3. Research Methodology

3.1 Location of the research area

The research was conducted in Tigray (Eastern zone) and Southern Nations, Nationalities and Peoples' region (SNNP), *Wolaita* zone of Ethiopia. Eastern Tigray zone is located in the northern most part of the country. The centre of the zone is about 890 Km north of Addis Ababa, the Capital of Ethiopia, and 120 Km from *Mekelle*, the capital of Tigray regional state (Fig. 1). This part of the country is characterized by sparse and irregular rainfall, and is highly drought-prone. Average annual rainfall and temperature of the area is 500-600 mm and 18ºC respectively. The pattern of rainfall in any given year is inconsistent. Eastern Tigray is found between 13º48' – 14º02' N and 39º 34' – 39º48' E with a topography characterized by steep and rugged terrain and altitudes ranging between 1800 to 3100 m.a.s.l. The eastern margin of this area borders the western margin of the Great East African Rift system.

The second study area (*Wolaita* zone) is in the SNNP regional state, its centre (*Sodo*) being at about 420 km south of Addis Ababa. The study area covers a portion of the zone located between 6º 42' – 6º 58' North and 37º 40' – 37º 54' East. Annual average rainfall in the highland and mid-highland areas of *Wolaita* zone is about 1300 mm while the lowland areas is up to 600 mm or even less. Rainfall is bimodal with the main rains falling in the June-September and the short rains in February – March. The short rains (*Belg*) are more variable and unreliable. Failure of one or both rains often leads to food insecurity in the area. Average daily temperature is between 15ºC and 30ºC. Like the eastern part of Tigray, *Wolaita* zone is also highly affected by drought.

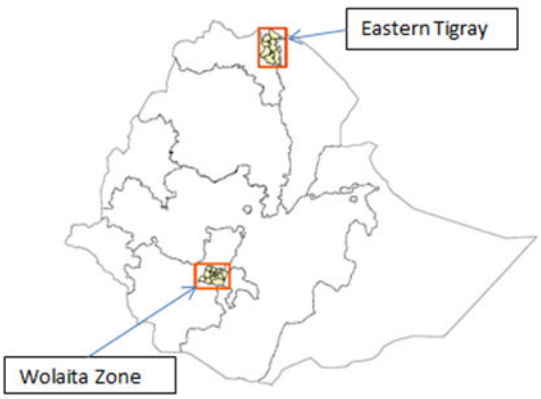

Fig. 1: location map of research areas

In both research areas, agriculture is the main stay of the

people, though cereals predominate in Eastern Tigray while root crops (*enset* – false banana, sweet potatoes, etc.) make up the main staple food in *Wolaita*. The size of the small-holding farms in these communities has continued to diminish and at present is on average about 0.5 ha. The two zones were selected for the research due to their relevance. The people of the two study areas experienced years of declining environmental quality (forestry, soil, water resources). Besides, these zones are drought prone (Hurni, 1994) and as a result have been targets of the Disaster Prevention and Preparedness Agency of Ethiopia (DPPA) for food assistance programs (DPPA, 2003).

A total of 264 persons (136 in Easter Tigray and 128 in *Wolaita* Zone) participated in 14 group discussions, of which 30% and 22% were women from Eastern Tigray and Woliata zones, respectively. In Eastern Tigray, three districts that border a natural forest (*Dess'a* forest), namely *Atsbi-Womberta*, S. *Tsaeda-Emba*, and *Enderta* districts, were included in the study. In *Wolaita* zone, the groups came from two districts, *Humbo* and *Sodo-Zuria*. Before the actual discussion started, the groups were guided to have a common understanding on what constitutes a forest and on the definitions of forest protection, environmental law, and civil conflict. In addition to the group discussions, follow-up conversations were held with prominent resource experts and elders in these areas for verification purposes.

3.2 Data collection and analysis

A focus group discussion method was employed in eastern Tigray and *Wolita* zones between July and October 2010. The groups were made up of farmers, traders, local administrators, and experts in natural resources management. A questionnaire (comprising of 36 questions) was employed to gain insight into the community's perception on drought frequency and environmental degradation patterns. This paper does not cover all the questions, but focuses only on five relevant to the subject under discussion. The questions included:

1. Coping mechanisms:
    - (a) In your opinion, do you think drought has increased, decreased or remained the same in the past forty years?
    - (b) What did you do to cope with the drought impacts?
    - (c) What else can you do if the drought frequency and their effects increase?
2. Behavioral changes (farming practices, and social characteristics if any):
    - (a) Was there a change in your farming practices to cope up with the changes in climate/ rainfall patterns?
    - (b) What types of new methods of farming techniques have you adopted (land preparation; farm inputs; improved seeds; livestock, others)?
    - (c) Is there any change in:
        - i. Ceremonies that require food/water?
        - ii. Consumption patterns?
        - iii. Culture of conservation of food and other resources?
        - iv. Has there been a shift in the form of livelihoods practiced? in the past (from farming to trade, livestock raring, other)?
3. Institutional support (policy, technical and material support):
    - (a) In your opinion has government policy matched, during these periods, the changing contexts (to be supported by policy analysis)? Why do you think so?
    - (b) What type of information/technical support do you get from outside the village (from government line ministries, universities, NGOs, other international organizations) during drought times?
    - (c) How helpful are these supports?
    - (d) How did your community respond to the support (reception, participation and adoption)?
    - (e) What else do you need to tackle changing climate, but do not get?
4. Adaptation speed vis-à-vis drought recurrence
    - (a) How fast does your community adopt new methods?
    - (b) Is it easy to shift to new techniques? Why do you think so?
5. What are the major challenges affecting adaptation?

The questionnaires were administered during interviews to farmer groups of various capacities (very poor and moderately poor), and a modified version of the questionnaire was used with experts from the local Ministry of Agriculture, and local administrators. Additional information from experts was captured during a two-day workshop organized in *Mekelle* to deliberate on farmer managed natural resource rehabilitation. This workshop gathered experts from the Ministry of Agriculture, and Natural Resources, Agriculture research institutes, Universities, Non-Governmental Organizations (NGOs) working in the research area, and local leaders of three districts in Eastern Tigray. It was necessary to obtain separate feedback from the farmers and technical groups so that cross-checking could be possible. In order to link local level adaptation efforts with institutional support, a

government policy analysis was conducted through literature review, and discussions with government officials, and relevant technical experts. However, this research does not intend to be exhaustive in its policy analysis both at country and global level, but to set the floor for more discussion on the progress made to support community level adaptation efforts by national governments and international institutions. The findings discussed below are those agreed up on by the majority of the groups. Contested opinions by members of respondent groups were cross-checked against existing literature, or using further discussions with experts in the relevant disciplines and with ample work experience in the study areas. Some of those that were not supported by the majority of the groups have been discussed under challenges.

4. Findings

4.1 Community awareness of disasters, behaviours and coping mechanisms

The responses from the discussion groups on community awareness levels, corresponding attitudinal and behavioural expressions as manifested in the form of coping mechanisms and adaptation responses are described as follows:

- According to respondent groups, 80-95% of the farmers residing in the research areas had adequate understandings of drought risks, their exposure and vulnerability as well as their roles. After 1984/85, the frequency of droughts increased with droughts occurring in consecutive seasons and/or years, rainfall variability is greater, and a shift to late start and early cessations in rainfall are common. The respondent groups noted that un-timeliness and variability of rainfall are more difficult to deal with. Another important finding from the group discussion, is what was described as partial rainfall coverage of farmlands i.e. today's rain covers only a portion of a village at one go, leaving some parts without the much needed showers. This implies that a denser distribution of rain gauges is required to identify differences in the spatial extent of rain events. Before the 1984/5 drought, attested respondents, a major rain event would cover a large area at once. However, the group's response to the drought trend was not based on scientific data analysis but on observations on the length of the rainy season, crop performance (which is not solely dependent on rainfall) and hydrological patters (rivers & springs drying fast, and groundwater performance). Notwithstanding the debate on the drought patterns, other factors such as caseloads due to population growth, and thinning of soil thickness due to erosion may be exacerbating the drought effects.
- Respondent groups also highlighted the relationships between drought (or inadequate rainfall) and pest infestation. Years of less rainfall are also characterised by pest infestation which affects the little left in the field.
- As climate challenge adaptation efforts, farmers accept new farming techniques and soil and water conservation measures, practice water harvesting for small-scale irrigation, use of drought resistant crops, expansion of agro-forestry, vegetable gardening, off-farm activities, and small businesses. All households are not affected in the same way at the same time: those with no land or small and/or marginal lands, the elderly, those with big family size, and women headed households exhaust their stock during the first 3-6 months after harvest. Groups asserted that the majority of households struggle to cope beyond six months during seasons of drought. The community's overall coping capacity has decreased over the past many years. The main coping mechanisms include sales of animal assets, sales of trees, labour work in towns and seasonal migration to areas of employment (Western Tigray, and Wonji), resorting to use of *enset* as sole food (Wolaita) and *Beles* in eastern Tigray (a form of cactus fruit). When every other effort fails to provide the means, people resort to food aid and/or wild trees.
- Livestock play an important role in coping with climate change impacts. However, they are also affected by the major droughts. Families with large herds of animals and inadequate pasture (during the dry season hay is the principal sources of pasture, which in turn is dependent on crop performance) send their herds to the lowland areas. Diseases prevalent in the low-land areas affect both livestock and the accompanying humans, which at times prove to be fatal.
- Many years of exposure to drought effects compelled communities in these areas to change some of their social behaviours. Overall wasteful social functions such as holiday celebrations and feasts to remember the dead have reduced in number. Before 1984/85, such festivities were many and lengthy, which consumed a significant portion of their food resources. The number of people invited for such festivities has also been reduced, limiting guests to only close family members, the clergy and neighbours. Respondent groups also indicated the changes introduced in eating habits: the type of cereals used to produce *enjera* (a big flat bread normally produced from indigenous cereal called Teff (*Eragrostis teff*)), and its thickness has decreased over the years. Nowadays, *Enjera* is prepared from a mixture of cereals such as maize, sorghum, and wheat because Teff is more expensive, less productive and labour intensive compared to other cereals. However, farmers indicated that in times of good

harvest, some of the old traditions still tend to recur.

- Prior to 1984/85, with the exception of short-term season labour movements during harvest, few people moved away from their place of birth on a permanent basis. Those forced to go to resettlement areas during the 1984/85 campaign by the communist government, were the first to move *en mass*. The program was ill-planned, forced and staged by the government, and thus was neither popular nor successful. In recent years, however, youngsters with no adequate land or other skills have started to leave their areas in search of employment and better life. Respondents affirmed that they know at least one family whose children have resettled elsewhere in the country, as well as in neighbouring countries including the Middle East and South Africa.
- Respondent groups in *Wolaita* indicated that the young generation farmers quickly switch to off-farm activities rather than trying new farming methods as they find farming very laborious. This may rather suggest that the youth desires to discontinue the laborious farming practices as a profession if other options were available. This could be an opportunity to reduce pressure on land. But the youth who stay in the farming are quick to try new technology which affirms earlier findings by Tadesse and Belay (2004).
- With regards to the future, farmers in the respondent groups were hopeful for the future due to the implementation of conservation activities, the regeneration of lost forests when closed and properly managed, increased productivity due to intensive farming using fertilizer complemented by increased food prices, and the government's focus on poverty eradication. However, the natural resource base of their villages and the support level from national and international governments are so minimal that climate change continues to pose real threats to the most poor in those risk-prone communities.

4.2 Institutional support to drought-prone communities (national & International)

The international legal framework for climate change agenda emanates from the UN Framework for Climate Change (UNFCC), the Kyoto Protocol and subsequent Conference of Parties (COPs). Institutional support to climate change-affected communities can vary from enacting relevant policy instruments to facilitate disaster risk reduction, creating access to technology, material, financial and technical supports. In Ethiopia, a predominantly agrarian subsistence economy, policies related to poverty alleviation, natural resources management and environmental protection, and promotion of alternative forms of livelihoods are relevant to climate change adaptation. Ethiopia's lead government agency for climate change is the Environmental Protection Authority (EPA), which is responsible for the coordination of national adaptation and mitigation activities. These findings cover institutional bases for climate change related mandates, the role of EPA and current levels of support systems from other governments, the international community and the limitations thereof.

- Overall, the Ethiopian policy environment has been in support of global climate-related policy instruments expressed through ratification of major UN conventions and declarations. Ethiopia, a signatory to UNFCCC and its various instruments, attempted over the past years to implement the provisions of the COPs. In order to comply with the conventions, Ethiopia carried out a vulnerability assessment based on which priorities were outlined. This was followed by promulgations of various legislatives, global declarations and conventions. The climate change adaptation program of action (NAPA), Biodiversity Conservation Act (FDRE, proclamation #120/198), water resources management (FDRE, proclamation #197/2000), environmental pollution control (FDRE, proclamation #300/2002) the establishment of the Wildlife Conservation and Development Authority (FDRE, proclamation #575/2008), the Conservation Strategy (EPA, 1997), the forest development, conservation and utilization proclamation (proclamation #542/2007), and the recent Climate Resilient Green Economy (CRGE) are among some of these instruments. The EPA, conducts reviews of compliance and delivers reports on progress. This then calls for integration and synergy for effectiveness. However, with the web of institutions supposed to be involved in the implementation, monitoring and regulation processes, and the presence of various legal and strategic plans which in one way or another concerns the same treaties, coordination cannot be an easy adventure. The lack of a separate unit empowered to follow up the coordination of the efforts and the rather ad-hoc nature of the arrangement is bound to test the systems.
- Ethiopia's investments in agriculture and food security endeavours were inadequate prior to 1991. Since 1991, however, some progress has been made in refocusing on the livelihoods of the majority of the people. One such effort is the Poverty Reduction Plan, and the compliance to the 2003 Maputo declaration of the African Union which resolved, among other things, to allocate at least 10% of national budget for agriculture. Ethiopia is among the few countries that apportioned more than 10% of its budget to agriculture - about 17% in 2005, and 19% in 2011 (AU/UA Maputo declaration on agriculture and food security, 2003; Capital, Tuesday 2 April 2013). As part of redressing poverty

issues and reducing exposure to disasters, Ethiopia implemented two phases of poverty reduction program and the third ones is on progress (IMF, 2011). The first Poverty Reduction Strategy Paper (PRSP) of the country was termed as Sustainable Development and Poverty Reduction Program (SDPRP) which was implemented from 2002 to2005. The second PRSP, implemented from 2006 until 2010 -was known as the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) and had more or less the same mandate. The third poverty reduction program, was called the Growth and Transformation Plan (GTP) covers the period 2010 – 2015. Under these programs, agriculture remained the major focus and interventions have been recommended for drought-prone and food insecure regions. The fact that Ethiopia is one of the fastest growing economies in the world (The Economist, 2013) may be indicative that its agriculture is reviving, though sustaining such growth may prove challenging.

- Land tenure policies have been arguably the most contested in public debates over the past two decades. The current government, almost immediately after taking power in 1991, issued a land policy which maintained land as public property, but liberalized the use of it by allowing transfer to kin and renting of both land and labour. The right to rent & to transfer to kin, and the on-going rural land certification process supported by state level legislations markedly differentiates the current policy from the old though its effectiveness to create incentives is yet to be studied. Due to presumed disincentives to invest in land - and the insecurity that it can created - significant redistributions have not taken place since the 1997 proclamation was issued. The few exceptions include the redistribution in the Amhara Regional state which was carried out in 1996/97. Such redistributions have since been discouraged. However, there are small forms of land redistributions still practiced such as in the case of death of a land owner without eligible heirs, and where the land owner has been absent for more than two years (Haile et al, 2005). The debate on land holding system notwithstanding, a country-wide land use master plan needs to be put in place based on which future decision making will be made.
- Like land, water resources are public goods and proclamation number 197/2000 covers “all water resources that exist in Ethiopia.” This raises some concerns in that individuals and entities do not have incentives to use water efficiently. With projected water scarcity due to climate change, some significant gaps in the policy such as lack of provisions for water utilization modalities in times of stress needs to addressed. The conventional way of dealing with scarcity is through understanding and discussions between water users, but such mechanisms need to be supported by acceptable procedures as traditional use can stir conflict due to scarcity.
- Another key policy issue concerns the management of communal lands and forest resources. Natural resources management in post-modern Ethiopia relied on traditional management systems and community level arrangements. It is, therefore, safe to say that lack of uniform natural resource management codes might have contributed to localized discretionary use, which depended on locally perceived needs. The current and subsequent governments live in a time where climate change and variability have become a prime preoccupation of humanity. No doubt, the government has the most daunting responsibilities of assuring better livelihoods to their rural communities while at the same time safeguarding the environment. In this regard, three environmental policy instruments have been enacted within a short period of time namely the 1994 Forestry Law, the 1997 Environmental Protection Policy, and the 2007 Forest Development, Protection and Utilization policy. However, clear implementation structures and systems lack at grassroots level.
- The national Early Warning System (EWS) was put in place in order to provide timely and accurate early warning information to decision makers, the international community and the public. The National Early Warning System draws information from government and NGOs in their respective operational areas. Nonetheless, its efficacy is largely measured by its contribution to deter disaster impacts. To this end, respondents and experts in the field have identified several challenges. Perhaps the single most important shortcoming in the EWS is the lack of information management systems (each agency keeps respective data, but there is no centralized information desk that gathers, analyses and disseminates information). Other challenges include lack of institutional capacity to analyse the realities at district level, poor infrastructure and communications systems for real-time information sharing and lack of coordination of the various bodies. The federal agencies complain about receiving inflated impact figures from districts (expressed in the form of beneficiary numbers) while the districts criticize the regional and federal agencies on withholding important disaster information until it is too late. Due to political reasons or anticipated negative implications on the general public (such as food price hikes, and political opposition), the magnitude of a potential disaster is not immediately revealed to the media and the public. The inherent uncertainties of the science of forecasting in the field of meteorology also contribute to lack of confidence – erroneous forecasts of one season or year may lead to negligence by

farmers to take warnings seriously in subsequent seasons.

- From the field visits made to the research areas, the economic and environmental disparities between various districts were evident. Some communities have transformed themselves and their environments better than others, even those located adjacent to each other. It was observed that strong and committed local leaders, who are themselves converts and actively practice what they preach, made a difference to the whole community. The best example is the strength and determination of the chairman of *Abreha Atsbeha* locality in Eastern Tigray G/Michael Gidey or locally known as "*Aba Hawi*" – literally translated as "father of fire – very active." In less than five years, *Aba Hawi* has converted almost the whole village to implementing environmental management practices. They have about 4000 ha of closure areas protected and used by the community, and groundwater use for irrigation has increased due to water harvesting techniques developed by the community. Fruits once unknown to the area are now available for consumption and for the market. In his own words, *Aba Hawi* described the situation as "I was able to imagine the options available for the community – to change the environment or leave the area, and I did not want to leave the area where I had built my life around."
- As part of the international support, carbon trading is being promoted as a tool to promote climate change mitigation (carbon sequestration) through Reduction of Emissions from Deforestation and Degradation (REDD). World Vision Ethiopia, a non-governmental organization, in partnership with UNDP are implementing a REDD project in *Humo* area of *Wolaita*. As one of the first project of its kind in the country, it faced its own share of challenges. Some experts close to this project expressed their concern on the whole approach of the carbon trading due to complications in the accounting process (computation of the amount of carbon sequestrated), the amount paid per ton of carbon sequestrated, and the process of getting funding for such projects.

4.3 Adaptation speed vis-à-vis drought recurrence

With regards to the timing of adaptation, Paavola and Adger (2002) identified three adaptation responses: proactive, reactive and inaction (postponing responses). The types of adaptive responses currently being exercised at community levels are primarily reactive and/or unsolicited inaction (because of not knowing what to do or lack of options). These kinds of responses are likely to prove neither timely nor efficient. How quickly farmers change their attitudes and behaviours in response to changing situations is another important aspect of adaptation which deserves further exploration. Changes related to climate and the environment have occurred rapidly and it is necessary to investigate the farmer's ability to catch-up (adaptation speed). Questions related to this matter were therefore posed to the respondent groups, the responses of which are hereafter given.

- Traditional communities define themselves by their culture, language, religion, and their overall worldview and actions are built around their traditions. It is therefore excessively difficult to expect fast changes in attitudes. Even if the realities had changed a long time ago, people still stick to old habits. Respondents, while recognizing an overall extreme difficulty to shift to new ideas and habits, recognized that business as usual is not anymore an option. Cheaper methods and technologies, especially those the farmers can associate with past experiences, or where adequate demonstration has been made, are accepted with relative ease. Of all the problems, the high cost of new technologies was mentioned as a major obstacle for adaptation. In the research areas, communities are normally encouraged, at times coerced, to adopt new technologies but the price of introduction may be prohibitively expensive. In one locality (*Tseada Emba* district), informants cited an expensive beehive imported from central Ethiopia was offered for sale to farmers on credit. They did not understand why such "a piece of wood" could not have been produced locally, which might have lowered the price significantly. It is evident that with proper training and orientation, the unemployed youngsters could have manufactured the desired beehives which could have lowered the price for the beneficiaries and at the same time create jobs for the local youth.
- When asked what motivates farmers to adopt new technologies, approaches or ideas, respondent groups unequivocally affirmed that the success of fellow farmers in their localities, was the most important. They trust life changes of peers compared to discourses of experts, or even stories of success in far-off communities.
- Perhaps the most important factor that hampered the speed of adaptation is fear of failure (as poor farmers do not want to take too much of risk). The amount of financial return that farmers anticipate determines the level of acceptance of any new technology. More often than not, a few farmers dared to volunteer for a pilot project, after which - depending on whether or not success was shown - the majority will follow. For example, the members of the cooperatives for the natural regeneration projects in *Wolaita*, or the groundwater users at *Abreha Atsbeha* district in Eastern Tigray were few in number at conception. After a few years of implementation and being cognizant of the benefits thereof, many more joined these groups. That is why proper research, demonstration and piloting, based on local

contexts are required before full scale implementation of initiatives. Even though overall countrywide strategies may be necessary for guidance, no single approach will be appropriate in a country as culturally diverse and agro-economically variable as Ethiopia.

4.4 Major challenges facing adaptation

Respondents in almost all groups agreed that the major challenges for adaptation are: lack of alternative livelihoods that emanate from overall poverty, socio-cultural barriers, lack of proper and timely information, lack of adequate sensitization and demonstration, and fear of failure and the risk that accompanies it. The poorest are more reluctant to try new technologies, and/or approaches due to fear of failure. From the policy analysis standpoint, federal-level policy formulation and promulgation is probably not the major bottleneck as, by and large, relevant international policy instruments have been enacted. However, climate change can be a difficult issue for national governments to tackle as it involves multiple actors both within a country and internationally because it calls for the involvement of all sectors and ministries, while considering private, public and/or international stakeholder interests (Schipper, 2007a). Some of the challenges include:

- Analysis of government policies indicates that lack of organizational stability within the responsible government faculties is one issue of concern. While the body responsible for climate change, the Environmental Protection Authority (EPA), remained an independent authority at federal level, the regional bureaus of environmental protection have been placed under numerous authorities: originally it fell under the Bureau of Agriculture; then it became a regional EPA bureau; it was then put under the Ministry of Agriculture; but recently merged with Land Administration. Since July 2013, the EPA's mandate has extended and grown to become the Ministry of Forest and Environment Protection (MoFEP). Whether or not the grassroots level arrangement will change to reflect the federal-level change is not yet clear. This has discouraged professionals in the regional states, making them feel unneeded and second-rate compared to their colleagues in other disciplines. The task is huge, touching almost every major discipline and requiring exceptional coordination mechanisms. The lack of continuity and the continuous repositioning to different implementing offices may be perceived as a disregard by the government of a globally important issue.
- The governing body of disaster management has also undergone a series of changes. The first body of this type, the Relief and Rehabilitation Commission (RRC), was established in 1975 following the 1973/74 famine. In 1995, it was replaced by the Disaster Prevention and Preparedness Commission (DPPC) with a shift in its mandate to include prevention and preparedness, as its name implies, but was largely preoccupied with disaster response measures, especially during major drought seasons. The DPPC emerged as a result of the new government's National Policy on Disaster Prevention and Management (NPDPM) issued in 1993. DPPC was renamed as DPPA (Authority instead of Commission), and now falls under the Ministry of Agriculture. Since its establishment, the DPPC acted as a coordinating body for disaster management especially emergency relief and rehabilitation activities in the country. As a country exposed to potential manmade and natural disasters, Ethiopia needs to have a sound and stable institution that can coordinate not only response to disasters, but also to organize disaster prevention and mitigation programs. With the potential threats of climate change and variability, such a strong institution equipped with technical capacity based on lessons learned from the country's past history, is indispensable.
- While the efforts made by the government in terms of policy support are appreciable, in some areas, communities witnessed top-down, and quota-based approaches that resulted in lack of ownership and even resentment towards such new initiatives. This has created a deep-rooted lack of trust in introducing new technologies and systems. That is why, while farmer's perception of the climate risks are adequate, commensurate action by farmers to embrace new initiatives designed to strengthen coping mechanisms seems to be below expectations. Even worse, failed initiatives are not well documented and reasons for failure not debated, which in turn leads to lack of faith in new ones. Both failures and successes need to be properly documented for future access. Respondents in many villages showed hesitation because of failed initiatives that were introduced without proper study, demonstration and piloting. Success will continue to suffer if the implementing entities are not involved and if lessons learned do not inform future initiatives and projects.
- One of the challenges that the respondent groups raised time and again was the gap between awareness creation and action. The expert groups as well as the farmer groups agreed that a considerable amount of time lapses between awareness creation programs and their implementations. Often, it takes a number of demonstrations on willing farmer's lands before new technologies, inputs, or services are accepted by farmers.
- Information from focus groups as well as observation in most of the drought-prone highlands revealed geography as one of the challenges. While a reasonable number of water sources are available from

surface and groundwater sources, the rugged topography makes irrigation almost impossible, or excessively costly, thereby rendering them beyond the reach of the poor communities.

- As part of environmental rehabilitation and reforestation, countless trees have been planted in the research areas. The approaches widely practiced in the country have been through tree plantation, mainly involving exotic trees, but also indigenous species. Over the past forty years, millions, and probably billions of trees must have been planted in communal and private lands. However, there is little evidence to justify the costs expended in cash and in labour, and the continuation of such enterprise. Economically important trees such as eucalyptus planted around homesteads and private woodlots remain to be the most successful. On the other hand, enclosures protected from animal and human interferences have regenerated fast, cost less, and are sustainable as the tree species have, over many years, adapted to each unique environment. In degraded areas with limited annual precipitation, investment should favour those practices that have proved effective such as natural regeneration than tree planting that has proved less successful.
- Respondents also raised the issue of timeliness as an important element that can facilitate or hinder adaptation processes. Agricultural inputs for example miss the critical planting time as they sometimes arrive too late. In drought-prone areas, missing an important planting date can be detrimental to crop productivity. Apparently, farmers wait for the right time (before or after an important rainy day) for planting. One of the authors was able to witness what differences such timings can make on crop standing differences in lands laying side by side. One day late can be too late. In such a circumstance, desired inputs should be available on time so that farmers use them when they are required.
- Even though lack of financial capital is one of the bottlenecks for alternative sources of income, for which micro-credit is the solution, the authors found most of the communities in Eastern Tigray were wary of micro-credit. Respondents thought that microcredit had made so many farmers indebted due to drought. They take loans from the micro-credit institutions, but farmers in Tigray expressed their reservations in widely using these services. A government hand is seen as intimidating due to affiliation of the micro-finance institutions with the regional states. If unable to repay, mainly due to drought or other external factors, government agents force users to either sell their available assets and repay or go to prison. High interest rates were another reason respondents indicated as to why they cannot repay on time (FIC, 2010). This seems to scare away others from getting the loan services. This can be a serious impediment if a solution is not sought, as little can be done without access to capital.
- The issue of "dependency syndrome" came up on several occasions during the field visit, especially by the expert groups. As a result, it was necessary to explore what was meant by dependency and what the respondents noticed among the farming community to justify the use of the word. Even though there was no consensus by all respondent groups on many aspects of the concept, they suggested that farmers often desire to opt for the easiest way of survival when drought hits their areas (demanding the local administration for food aid or for other forms of free assistance). In good seasons, however, respondents did not witness reluctance from the farmer's side to prepare land, to cultivate or harvest, neither has the community been observed to rely completely on relief aid. However minimal the impact may seem, this makes adaptation options less attractive to communities.
- In mixed farming contexts, the choice of which crop to be farmed is not only based on food preferences and grain productivity rates, but also on the suitability of the crop residues for animal feed, energy source, and soil fertility contributions (Amede and Delve, 2006). This complicates the process of crop selection since the most productive crops may not necessarily be the ones with the most potential use for animal feed and energy sources. Farm households are often caught up in this dilemma.
- Farmers in some villages (for example *Tsaeda Emba* district) indicated that some varieties of barley and wheat are no longer being planted in the area (due to defaulting to short maturing varieties), thus affecting genetic diversity. Of course adapting to changing climate calls for embracing new drought resistant varieties, this in turn may lead to changes of food habits and other cultural modifications. However, implications of loss of biodiversity need to be studied with long-term and broader applications in mind.
- Systematic studies and documentations lack in almost all ministries including the agricultural research institutions. When asked if they have systematic data about important inventories or indicative trends towards achieving goals, almost all line ministries asserted lack of them. Such institutions are packed with operational activities leaving little or no room for long-term investment in research and documentation of lessons learned.
- Meaningful adaptation costs money and calls for the latest technologies. It is estimated that developing countries will require billions of dollars to implement adaptation measures to reduce vulnerability to climate change. Though the projected annual requirements for adaptation by 2030 is $30 to $100 billion

(WDR, 2010), current levels of financing fall far short of estimated needs with total climate finance for developing countries estimated at $10 billion per year. At country level, adaptation funding is so minimal except for a handful REDD projects implemented through UNDP. Preparation of REDD readiness proposal has started in 2010 and the budget assigned until 2014 is less than US$15 million (FDRE, 2011). Besides, even though REDD aims to use the Climate Resilient Green Economy strategy to channel future funding, how such funds will be directed to those in need, whether or not this will be additional funding, and the funding process itself is not yet known. On the other hand the climate impacts cannot wait for the bureaucracy to take its natural course.

5 Conclusions and Recommendations

The study highlighted many facts: community awareness on climate change effects, the progress made by the government to mainstream climate change issues in the overall development planning and the gaps thereof; the importance of leadership at all levels (especially at community level); community capacity to cope with the rapidly changing climatic situations (adaptive capacity); and the overall opportunities and challenges of adaptation. Some recommendations have been identified under some important themes:

Awareness: communities in disaster-prone areas have adequate knowledge about the risks involved, what they are expected to do to survive the recurrent threats, and the nature of expected support from government institutions. However, there is a gap between cognition and action commensurate to climate change impacts. Two questions may be raised here: were the awareness creation activities adequate, systematic, and progressive which involved all social institutions; and were the awareness creation schemes effective to the extent that they aimed at change of attitudes and actions? Whatever the answer to these questions may be, it is evident that more needs to be done. Awareness creation can be a long process, especially when people have witnessed failures from ill-studied former projects, or if some have become indebted due to resorting to new technology that failed to deliver promised benefits. One cannot overemphasize the need for careful selection, study and demonstration of new technologies before they can be introduced as adaptation instruments. A series of failures can in the end lead to lack of trust by farmers and resistance to change.

Diversity of livelihood choices: recommended alternative livelihood activities such as off-farm activities which are themselves dependent on rainfall could not serve their purposes. Activities such as beekeeping, livestock fattening, and vegetable growing fail to support communities during drought years as they themselves are significantly affected by the lack or shortage of rainfall (Abebe & Puskar, 2011). For example, honey production decreased by about 40% in drought years in the eastern part of Tigray (communication with the Tigray Bureau of Agriculture). Focusing on boosting agriculture productivity and intensification alone does not necessarily guarantee farmers a better life if such endeavours still depend on rainfall. Hence, adaptation options need to be real alternatives which are less affected by the same disaster risks. In addition, increased investment in research and technology to identify new productive means, and financing irrigation schemes can have lasting adaptive impacts. Though initially expensive, such schemes have the capacity to curb the cyclical drought patterns.

Ethiopia's history has been defined mainly by socio-economic and political activities that take place in the highland areas (for example densely populated, majority of farmlands, political power). Given the current challenges faced in the highlands, exploring ways to tap into the resources of the vast uncultivated lowlands is inevitable. Incentivising voluntary resettlement may be a good option to ease the pressure on the highland areas. Farmers in respondent groups did not seem to favour resettlement, mainly due to the stereotype developed subsequent to the forced resettlement program of the 1984/85, but also on cultural grounds. Nonetheless, more needs to be done to encourage young families in the highland areas to resettle in the sparsely populated lowlands.

Carbon sequestration programs: REDD, when implemented need to be undertaken in line with an overall country-wide master plan based on which small-scale reforestation projects can be implemented. Random REDD projects may give way to "leakages (transferring of deforestation to other non-REDD areas)." As such, the prime objective of REDD being carbon sequestration and the funding source external, it may also fail to prioritize principal dividends to local communities. Other challenges include (according to personal communication with the carbon project staff) difficulties in baseline establishment, monitoring and verifications, and the complicated systems employed by the carbon buyer (in this case the World Bank) to account for the carbon capital 'harvested' from such projects. If the compensation of REDD project is not commensurate to the efforts put together to manage such projects, communities can easily be discouraged from pursuing these objectives.

Local leadership: visionary and inspiring local leadership that is committed to bring changes in their communities are vital. Communities with such types of leaders have performed much better than those who lack them.

New technology/approach: the types of new technologies introduced need to be appropriate, and timely. Cost implications, whether or not such introduction followed demonstrations using fast adapters has significant bearing on the adaptation rate and speed.

Coordination of government efforts: poor communities and countries fighting climate change impacts require integrated approaches where various institutions of the government work in a well-coordinated and synergized fashion to make best use of the meagre resources at their disposal; as well as manage support from international institutions. Adaptation needs proper interplay of structural, financial, systemic and technical capacities at all levels. The various policies related to climate change are implemented by various government faculties and a coordinating body, instead of ad-hoc arrangements can reduce confusion, save resources, and encourages donors.
Disaster risk management: a significant part of the two communities have depended on aid since the 1984/85 famine, which according to some had eroded self-confidence. Ethiopia relied on external relief aid for far too long. It is time the country designs a sustainable disaster management fund. The government may need to adopt a different approach to disaster management, such as the following:

- The government raises emergency funds from the public and private sector, not only in times of crisis, but as a continuous process so that the country can have adequate internal capacity to respond without external assistance. Such funds may be used for DRR and/or reinvested in financial institutions in good times so that the fund does not sit idle, thereby losing its value over the years. This may require some policy support to introduce an additional tax structure (say 1-2%) designated solely for this purpose.
- In times of drought disasters, the government, instead of food aid, facilitates provision of cash loans to those affected so that they can purchase what they need. The government uses emergency funds for loan guarantees so that farmers can take the required loans from local microfinance institutions and/or local formal banks. This presumes easy access to markets and availability of adequate infrastructure and systems in the affected areas in order to prevent local price hikes. It also requires a cultural change from the farmers' side to take responsibilities into their own hands instead of holding the government hostage in times of crisis.
- While the safety net program can serve temporarily, the country needs a social security fund (pension) system that covers all citizens. This may seem easier said than done, because it entails several action items that need to be taken to include all capable citizens in the tax payer list. However, other options will perpetuate dependency on external assistance, which the country needs to avoid if it desires to attain self-sufficiency and to regain political independence.

International support: climate change interacts with climate variability and non-climatic stresses. Thus, adaptation methods, and technologies need to address the combined impacts of risks. Climate change is global and it requires global action. Unfortunately, international support to combat climate change is minimal. Without such support, poor communities do not have variety of menus to switch to in case one fails to deliver the desired result. Their lives are very much attached to natural resources and the types of activities they are accustomed to are very limited. For local governments, due to limited budget, the pressure on meeting current demands outweighs long-term environmental and development gains. This in turn hinders long-term investment, thus entangling such countries in a vicious circle. For these reasons, poor countries need to obtain support from relevant international organs to address climate change issues that are beyond their capacity. This does not only refer to the launching of swift global mitigative measures to restore 'normalcy' of the climate dynamics, but also the financial, technical and technological transfers so that poor countries can deal with the immediate and future challenges. However, the current level of global adaptation funding for developing countries is below even conservative estimates (Bapna & McGray, 2008). If federal government's adaptation capacities are weak due to poverty, lack of capital, technology, and expertise, the community level adaptation suffers likewise. Needless to say, climate change impacts are of global concern, and global challenges call for global action.

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