Climate Change in the Southern Lowlands of Ethiopia: Local Level Evidences, Impacts and Adaptation Responses

Alebachew Adem[1] and Aklilu Amsalu[2]

Abstract

Despite the vulnerability of Ethiopia to the impacts of global climate change and weather extremes, and the recognition of this by the Ethiopian government, research-generated knowledge on regional and local impacts of climate change, locally available adaptation and mitigation measures and other community responses are seriously inadequate. In the absence of such empirical research-generated knowledge, however, attempts to improve the quality of poor households and bring about development through attaining food self-sufficiency would be unrealistic especially in the hazard-prone areas of the country. This article tries to identify major climate change induced-hazards, impacts and local level responses in the southern lowlands of Ethiopia and provide inputs for "climate proof" development interventions and policy formulation.

Keywords: climate change, vulnerability, adaptation, impacts, lowlands, Ethiopia

[1] Environmental Researcher, Forum for Social Studies (FSS)
[2] PhD, Environmental Geographer, Addis Ababa University

Introduction

Climate change is rapidly emerging as one of the most serious threats that humanity may ever face. Hence, it has recently become a pressing issue in various development, environment and political forums at the national, regional and international levels. Many regional summits worldwide have dedicated discussion sessions on climate change based on the recognition that the global climate is changing and this has become more evident in recent years. In its fourth assessment report, the Intergovernmental Panel on Climate Change (IPCC, 2007) concluded that climate change is already happening with its multifaceted effects on human society and the environment.

Although no country is immune to the potential impacts of climate change, the impacts are highly variable over space and time. Particularly, climate change will present a significant challenge for developing countries (IPCC, 2001; 2007). Developing countries who have contributed least to greenhouse gas emissions are among the most vulnerable. These countries have limited adaptive capacity as compared to the developed countries because of their limited financial resources, skills and technologies, high levels of poverty, and their excessive reliance on climate sensitive economic sectors such as agriculture (Reid and Huq, 2007). Further, poor communities are not only located in high-risk areas, but their lack of economic and social resources mean they are ill-equipped to adjust to the long-term changes in climate (Orinda and Murray, 2005).

It is widely recognized that poor communities who live in marginal areas and whose livelihoods are highly dependent on natural resources are especially vulnerable to the impacts of climate change (Macchi, 2008). They have limited capacity to cope with existing climate variability and future changes. Recent studies undertaken in several developing countries indicated that temperature increase and changes in the rainfall pattern reduced agricultural productivity and availability of natural resources (Morton, 2007; Kurukulasurvia and Rosenthal, 2003; Jones and Thornton, 2003; Dinar *et al.*, 2008; Thomas and Twyman, 2005; Mendelsohn and

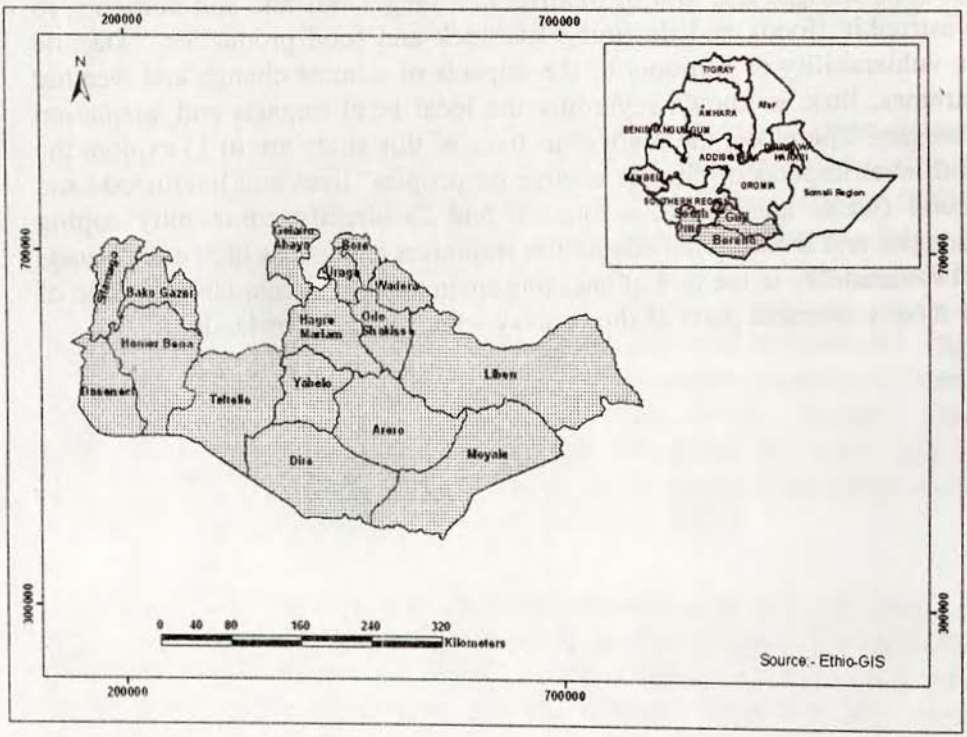
Dinar, 1999). Moreover, changes in the mean climate have brought direct negative impacts on livelihood assets, health, food, and water security. Increased pressure on local coping strategies, social protection measures, and the ability to recover from shocks in many instances have led to resource degradation and scarcity, social tension, and conflicts.

In Ethiopia, climate change poses particular risks to poor farmers and pastoralists who have an immediate daily dependence on climate sensitive livelihoods and natural resources. The limited economic, institutional and logistical capacity to mitigate and adapt to climate change exacerbates the vulnerability of millions of people in the country. The impacts range from recurrent drought and loss of biodiversity, rangelands and soil nutrients, to catastrophic floods and declining livestock and food production. Despite the vulnerability of Ethiopia to the impacts of climate change and weather extremes, little is known regarding the local level impacts and adaptation strategies. Therefore, the main objectives of this study are to 1) explore the local level impacts of climate change on peoples' lives and livelihoods and natural (water and range) resources, and 2) identify community coping strategies and institutional adaptation responses and assess their effectiveness and sustainability in the face of changing environmental circumstances in one of the most vulnerable parts of the country – the southern lowlands.

Study Area

The study is carried out within three selected zones in the southern lowlands of Ethiopia (Figure 1). The lowlands of Ethiopia account for about two-third of the total area and 15 % of the population (Beruk, 2002; EPA, 2007; MoA, 1998). The population is pastoral and agro-pastoral mainly engaged in livestock production.

Figure 1. Location of the study area (shaded)



Source: Adapted from Ethio-GIS, 2008

The study focuses on three zones within the southern lowlands: Borena, Guji, and South Omo zones. Table 1 presents total area and population of the three zones.

Table 1. Population and total area of the study zones

	Population ('000)		Total area	Density
	Total	Female	('000km^2)	(persons/ km^2)
Borena	966	477	48.7	20
Guji	1,413	699	35.0	40
South Omo	577	289	24.3	24

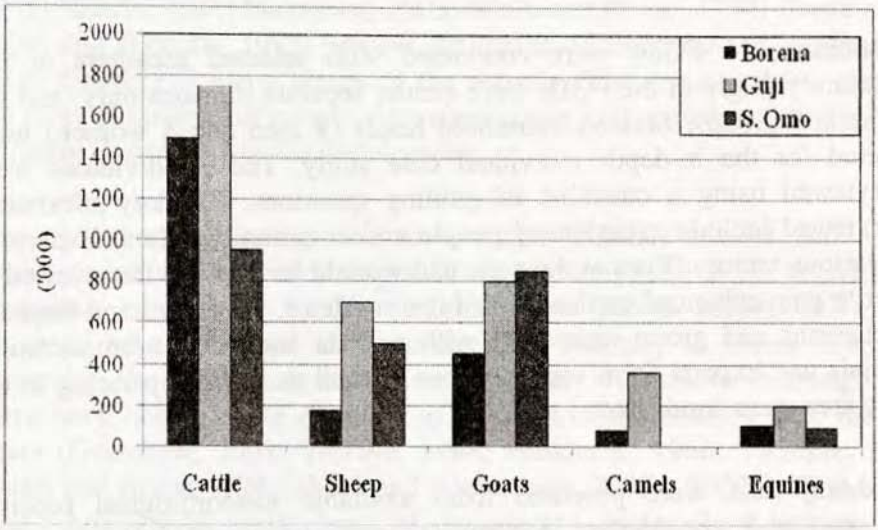
Source: CSA, 2007

The physiographic setting of the study area is characterized by an extensive plain land with scattered hills and mountains. Elevation is generally below 1500m a.s.l. and some places are as low as 800m a.s.l. The topography of Borena and South Omo zones is dominated by extensive flat land while that of Guji varies from gently undulating plains to hills and mountains. The climate of the study area is of semi-arid and arid type with average annual rainfall ranging between 350 and 800mm and average annual temperature between 19 and 29°C. The area belongs to the dry sub-humid to the semi-arid moisture regimes. In some places, annual rainfall reaches up to 1000mm in the highland parts of the study area, like in the highland of Guji Zone. The rainfall distribution is bimodal with long rains occurring during March to May and short rains from September to November. The long rains account for about 60% of the total annual rainfall in many places of the study area. Both perennial and seasonal streams drain the area. While there are few perennial streams, the seasonal streams are countless. The major perennial rivers include Dawa, Woito, Segan, Omo, and Genale. Omo is one of the largest rivers in the country and flows down south from the central highlands and joins Lake Turkana. The vegetation type is dominated by woodland savanna which is composed of shrubs and grasses.

Borena and Guji zones are dominantly inhabited by the Oromo people. These places are also considered as the cradle of Oromo people and reservoir of their culture and tradition (Asmarom, 1973). Although the Oromos are dominant in Borena and Guji zones, there are a number of other clans/ethnic groups living interspersed with the Borena and Guji: Geri (predominantly in Moyale), Gebra, Degodi (Somali clan around Moyale), Konso, Arbore and Hamer (in Teltelle and Dire woredas of Borena Zone). However, people of diverse ethnic groups inhabit South Omo: about 16 ethnic groups with diverse of cultures and traditions. are known to live in the Zone Hamer, Arbore, Daasenech, Nyangatom, Ari, Banna, Karo, Kwegu, Mursi, Tsamai, Dime, and Bodi are some of the largest ethnic groups in the Zone.

Majority of the people in the three zones are engaged in livestock- based livelihoods. Although crop cultivation is practiced in some places, pastoralism is the main economic activity of the area. In Borena Zone, for instance, livestock production is largely the dominant activity mixed with intermittent cultivation of crops. The low-lying parts of Guji Zone focus on pastoralism while the uplands are agro-pastoralists. In South Omo, while pastoralism is the main engagement, there is also riverside cultivation along the lower courses of Woito and Omo rivers. Other activities such as bee keeping, collection of wild leaves and berries, and hunting are also common. Figure 2 portrays the type and distribution of livestock in the three zones. According to a World Bank report (2007), arid pastoral areas have limited access to social and economic services (e.g. the road density was 14.1km/1000 km^2, the gross enrollment ratio at secondary education level was 20% and only 3% of the population had access to electricity).

Figure 2. Type and distribution of livestock in the study zones



Source: Zonal Agriculture Offices in Borena, Guji and South Omo, 2008

Methodology and Data Sources

Data for the study were collected from both primary and secondary sources. Primary data were obtained through a household questionnaire survey, focus group discussions (FGDs), key informant interviews, in-depth individual case study, direct observation, and expert interviews. The study selected six woredas from the three zones (two from each zone) and focused on eight rural kebeles purposively selected from the woredas. The selection was basically based on the prevalence of the problem and the presence of pastoral and agro-pastoral households. A total of 359 households were drawn by employing a systematic random sampling procedure from the selected kebeles for the household questionnaire survey. The sampling was done by using kebele registration lists whenever these were available and in consultation with local experts; kebele officials and community elders where lists were not available. Households included in the study were interviewed using a structured survey questionnaire. The questionnaire covered topics that range from household demographic and socio-economic

profile to the occurrence and effects of climate change-induced hazards, impacts, adaptation strategies, and institutional responses.

In addition, 16 FGDs were conducted with selected members of the community. Eight of the FGDs were gender separate (females only) and the rest mixed groups. Sixteen household heads (8 men and 8 women) were selected for the in-depth individual case study. These individuals were interviewed using a checklist of guiding questions. The key-informants interviewed include experienced people and community elders. Experts at the various sector offices at the zone and woreda levels were interviewed in order to gain enhanced explanation of the problems, the causes and impacts. Discussions and group interviews with woreda and zonal administrators, officials and experts form sector offices as well as NGOs operating in the study area were conducted.

Secondary data were procured from available meteorological records, published and unpublished documents, and various activity reports of governmental and non-governmental institutions. Although not complete, long-term rainfall and temperature records for some selected stations that cover three to five decades were obtained from the National Meteorological Agency (NMA). Relevant federal and regional government policies, strategy documents, and proclamations were also reviewed and used. The information obtained was analyzed by employing appropriate quantitative and qualitative techniques and procedures.

An Overview of Climate Change Impacts and Responses in Ethiopia

Ethiopia is especially vulnerable to climate change because of its greater reliance on climate sensitive economic sectors like subsistence crop cultivation and livestock production. In addition, a large part of the country is arid and semiarid and is highly prone to desertification and drought (NMA, 2001). IPCC's regional review of the impacts of climate change identified three vulnerable areas in Ethiopia as food security, water resources and health (IPCC, 2001). Droughts, famines, epidemics and floods are also very common occurrences in Ethiopia. In most instances,

these disasters are associated with climatic variability and change. Several studies (e.g., Beruk, 2002; Coppock, 1994; Dagnew, 1995; Dessalegn, 1991; Mesfin, 1984; Mahmoud, 2003; Webb and Braun, 1994; Carter *et al.*, 2004; and Nicholls, 1993) pointed out increased frequency of incidence of these disasters in many places of the country. The disasters have claimed the lives of millions of people, destroyed crops, and contributed to the death of many livestock over the past decades.

Drought is widely recognized as a major climatic hazard and a key development challenge in Ethiopia. While opinions vary on the severity and frequency of drought in the historical past, recent reports show that droughts have increased in frequency and intensity in recent tirnes. In particular, the southern lowlands are extremely vulnerable to drought and there have been notable droughts in this part of the country over the past years (Getachew, 2001; Tesfaye, 1988; Pankhurst, 1966; Taffesse, 2001; Webb and Braun 1994; Aklilu and Alebachew, 2009a, 2009b). Flooding is also a problem in many places of the country. Major flood hazards have occurred in 1988, 1993, 1994, 1995, 1996 and 2006 leading to considerable loss of life and property (NMA, 2006). For example, the 2006 catastrophic flood led to the death of more than 650 people and the displacement of more than 35,000 people in Dire Dawa, South Omo and West Shewa and caused huge destruction of infrastructure (NMA, 2006).Similar situations were experienced in Afar, Western Tigray, Gambella and the low-lying areas of Lake Tana. Associated with the floods, Acute Water Borne Diarrhea (AWD) and malaria outbreaks have caused many more deaths. Changes in temperature and rainfall have also had many negative impacts on human and animal health. For example, serious disease outbreaks including cholera, AWD, meningitis, and malaria have been reported due to altered temperature patterns and rainfall regimes (NMA, 2006; Tulu, 1996; McMichael *et al.*, 2004). Changes in disease vector habitats will expose new populations to diseases such as malaria and livestock to schistosomiosis, trypanosomiasis, yellow fever and tick-borne hemorrhagic fevers. NMA (2001) noted that the growth of the country's economy is highly influenced by climate change, particularly drought, and indicated the need to take these changes into account in development policies and programs.

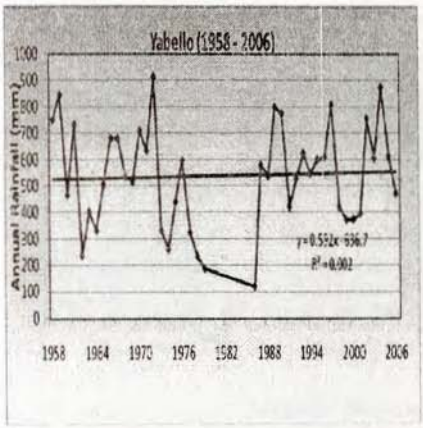
IPCC (2007) noted that climate change is causing major social and economic development setbacks in Ethiopia and urged the need to pay attention to the problem. In this regard, the Ethiopian government recognized climate change as a threat to its national development aspirations and thus ratified the UNFCCC (in May 1994), and the Kyoto Protocol (in February 2005). Within these frameworks, Ethiopia prepared National Adaptation Programs of Action and identified priority areas for development interventions and adaptations. The country has also a number of environmentally oriented policies, strategies and action plans that can directly or indirectly contribute to the objectives enshrined in the UNFCCC. Despite such developments, most development policy and strategy documents hardly captured the threat of climate change.

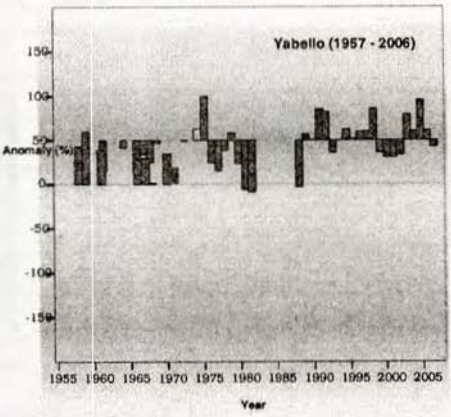
Major Findings and Discussions

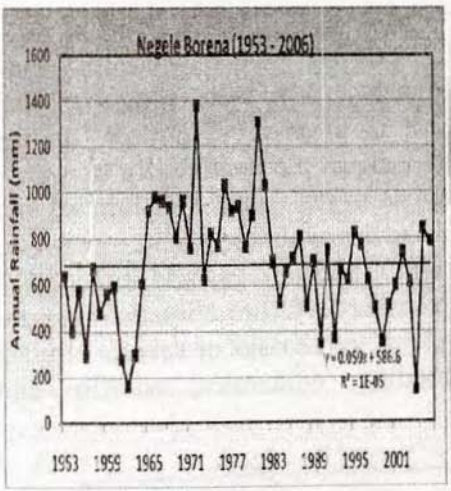
Patterns of the local climate

Analysis of the patterns of the local climate (rainfall and temperature patterns) in the study area over the last five decades reveals that there has been increased rainfall variability and temperature rise (Figures 3 and 4). Rainfall distribution in the area is generally characterized by high degree of inter-annual variability. Further, analysis of the linear trend of annual rainfall indicates a slight increase in Borena and South Omo zones, but a decrease in Guji Zone (Figure 3). As shown in the anomalies, there were considerable deviations from the long-term annual average in all the three stations. Since the 1980's most of the anomalies at Yabello were positive while the deviations at Negele Borena were largely negative. According to NMA (2007), the average annual rainfall trends in the past four or five decades showed a declining trend in the southern lowlands and other water stressed regions of the country.

Figure 3. Patterns of rainfall distribution in the study area







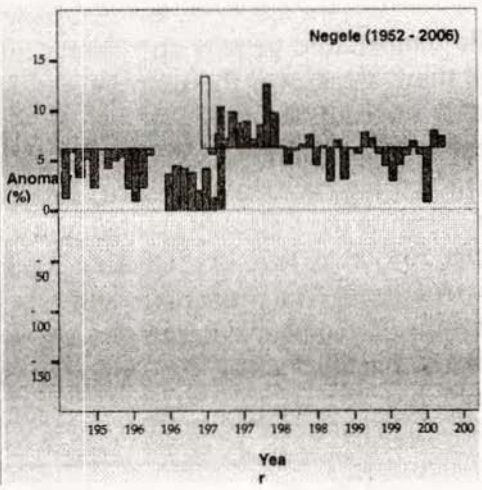
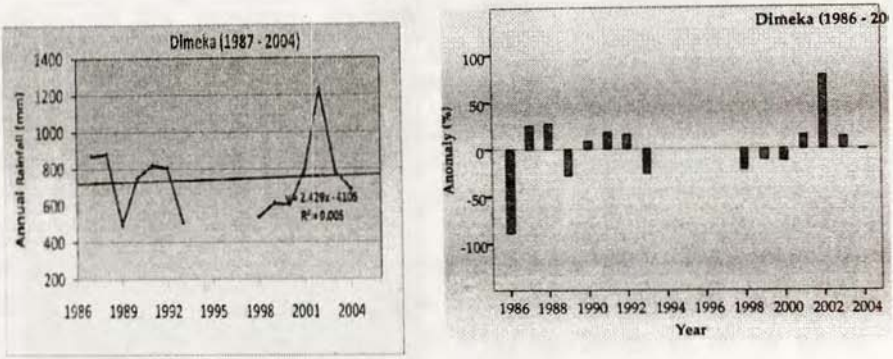


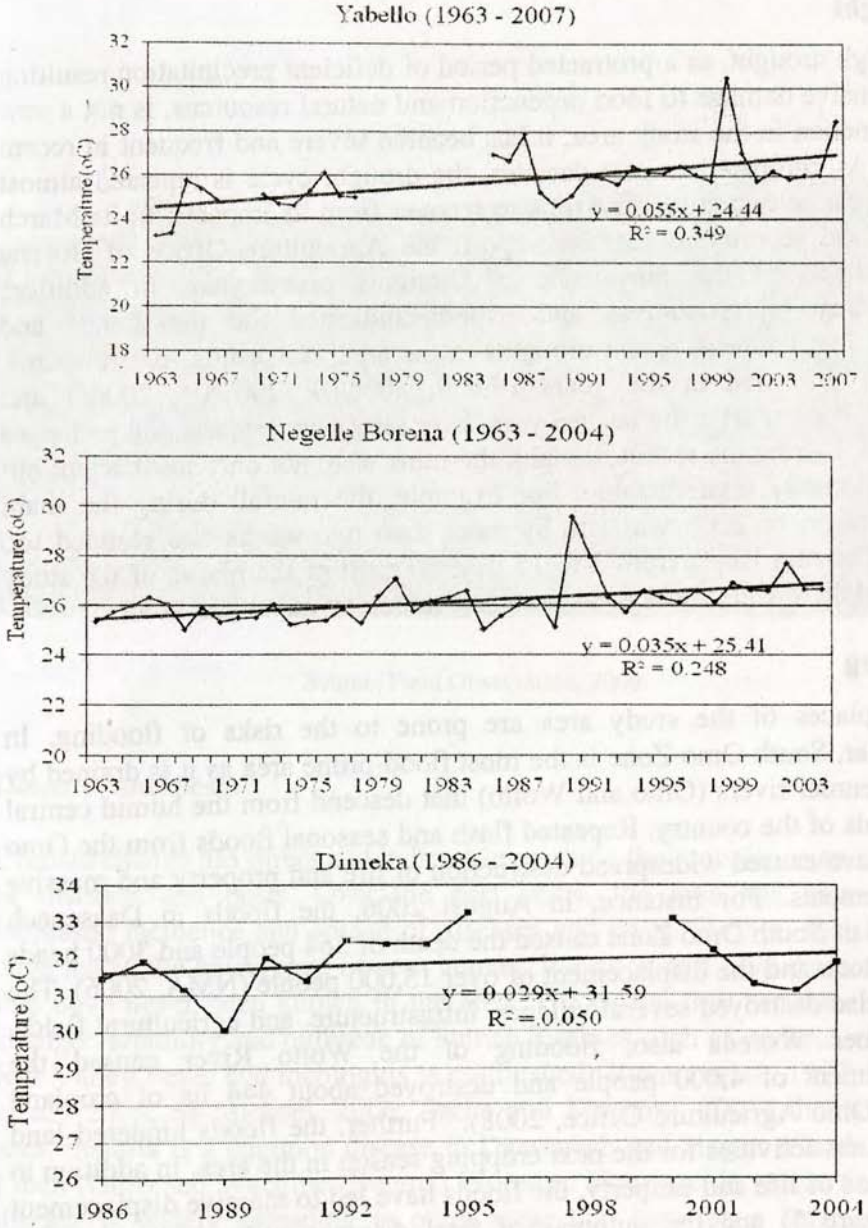
Figure 3 .... Cont'd



Source: Charted Based on Data Compiled from NMA, 2008

The temperature pattern also shows an increasing trend of warming in all the three areas over the past decades (Figure 4). It is well recognized that small increases in temperature can result in measurable impacts on the health of human beings and livestock as well as the availability of water, food and feed resources. Hence, the changes in the patterns of rainfall and temperature have already created pressure on the available water, forest, and range resources thus exacerbating food and feed shortages and making the environment more vulnerable and less resilient to future climatic changes. As a result, the people in the area are exposed to the risks of several climate related hazards such as drought, flooding, epidemics, wildfire and pestilence.

Figure 4. Patterns of annual temperature distribution in the study area



Source: NMA, 2008

Climate change-induced hazards

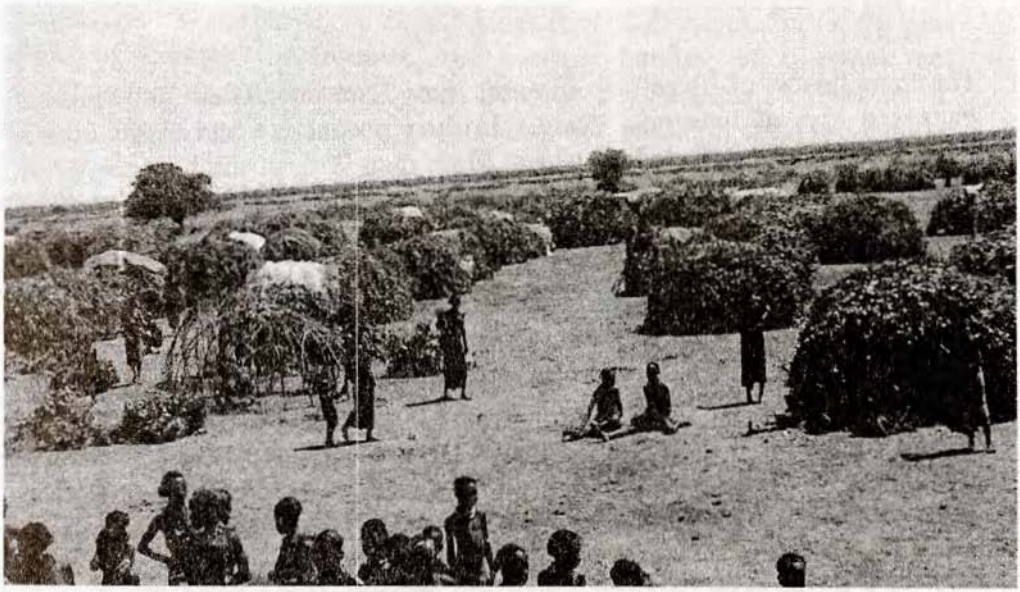
Drought

Although drought, as a protracted period of deficient precipitation resulting in extensive damage to food production and natural resources, is not a new phenomenon in the study area, it has become severe and frequent in recent years. As compared to past decades, the drought cycle is repeated almost every year or two, giving no time to recover from its impacts. In its March 2008 food security assessment report, the Agriculture Office of Borena Zone disclosed the prevalence of droughts every year. In addition, community representatives and experts indicated the persistence and unrelenting nature of recent droughts in the area. According to informants, drought prevailed in the years 1998/9, 2000/01, 2003/04, 2006/7 and 2007/8. Particularly, the last ten years have seen more frequent and prolonged droughts. During the recent drought, the rains were not only insufficient but also extremely unpredictable. For example, the rainfall during the main rainy season of 2008 was late by more than two weeks and stopped too early. The rain lasted from 2 to 15 days in most of the places of the study area and there were some areas that have not received rainfall at all.

Flooding

Many places of the study area are prone to the risks of flooding. In particular, South Omo Zone is the most flood-prone area as it is drained by big perennial rivers (Omo and Woito) that descend from the humid central highlands of the country. Repeated flash and seasonal floods from the Omo River have caused widespread destruction of life and property and massive displacements. For instance, in August 2006, the floods in Daasenech Woreda of South Omo Zone caused the death of 364 people and 3000 heads of livestock and the displacement of over 15,000 people (NMA, 2006). The floods also destroyed several villages, infrastructure, and agricultural fields. In Hamer Woreda also, flooding of the Woito River caused the displacement of 4,000 people and destroyed about 444 ha of cropland (South Omo Agriculture Office, 2008). Further, the floods hindered land preparation activities for the next cropping season in the area. In addition to direct loss of life and property, the floods have led to massive displacement (see Figure 5) and the outbreak of fatal diseases such as diarrhea and malaria.

Figure 5. Pastoralists displaced by flooding (South Omo) in November 2008



Source: Field Observation, 2009

Diseases and pests

Climate change has direct and indirect impacts on the prevalence and spread of diseases and pests. Over the past years, the area has experienced increased incidence and spread of diseases and pests. Further, the changes have led to the emergence of new human, livestock and crop disease types that have never been known in the area. The causal link between climate change/variability and outbreak of human diseases such as malaria, cholera, Rift Valley Fever and meningitis is established (Bouma *et al.,* 1997; Haines *et al.,* 2006; McMichael, 2006; Sachs and Malaney, 2003). In the study area, malaria is a common disease in Daasenech and Hamer (South Omo), Liben (Guji) and Wachilie (Borena) Woredas. However, in recent times the disease is widely spreading in other areas that have been least affected before, for example in Wadera Woreda. Even in places where malaria was common, the disease has become more severe and fatal. Other major human

health challenges identified during the community discussions include occasional outbreak of epidemic diseases, AWD (acute watery diarrhea), measles, Rift Valley fever, and cholera outbreaks.

The prevalence of livestock diseases has also intensified and caused increased loss of livestock, decline in their productive and reproductive capacity, and reduced market values. More than 70% of the households in South Omo and Guji, and 56% in Borena indicated that livestock diseases have intensified in recent years as compared to the past. With recurrent and extended droughts, existing and newly emerged livestock diseases are causing more illness and livestock deaths. Researchers at Yabelleo Regional Veterinary Centre cited bloody diarrhea, dermathopilosis, pasteurellosis, coenuruses, mastistis, African horse sickness and many tick- borne diseases as emerging risks affecting the health and productivity of livestock in the southern lowlands. These newly emerged diseases affect camels and goats, which are considered as most resistant to droughts. During severe droughts, household are forced to move their livestock to distant places, potentially exposing their herds to different environments with health risks to which they have never been exposed. Changing patterns of the local climate has caused crop damages and failures due to moisture stress, diseases and pest infestations. For example, in Wadera Woreda (Guji), due to late onset and insufficient rains, there happened total destruction of crops during the 2006/7 cropping season. In Liben Woreda of Guji Zone, significant crop losses and destruction of pasture have resulted due to the prevalence of unusual armyworm infestations. Locust and armyworms have devastated croplands and most important potential grazing areas in Yabello, Arero and Abaya woredas. More than half of the survey households in all the three zones indicated that the prevalence of crop diseases and pests has increased in recent years. Zonal and woreda agricultural experts also confirmed increased intensity of crop diseases and pests in the area.

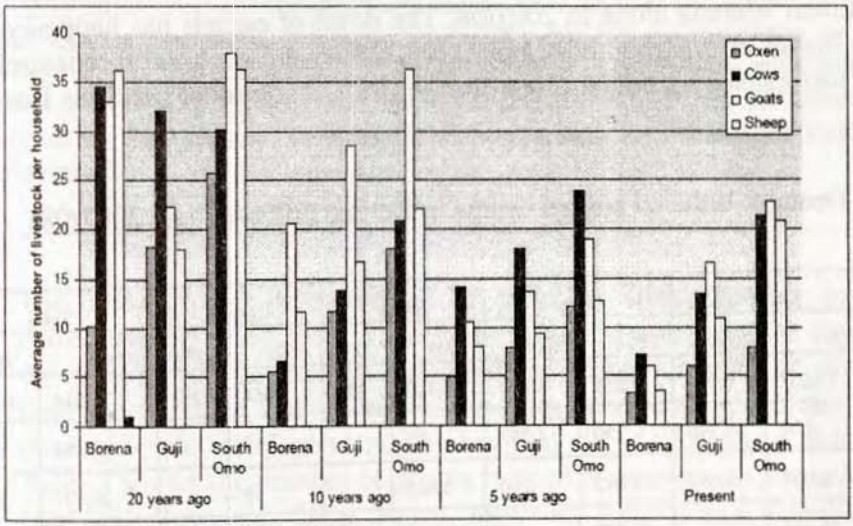
Impacts of Climate Change-induced Hazards

Impacts on livelihoods and social relations

The hazards induced by climate change have diverse impacts on the people and the environment. The changes have had serious impact on livestock and

crop production in the study area over the past years. Droughts and diseases are resulting in loss of livestock and erosion of basic household assets. Households have experienced considerable loss of livestock during the past years. In Borena, for instance, the average number of livestock per household has declined from 10 oxen, 35 cows and 33 goats 20 years ago to 3 oxen, 7 cows and 6 goats at present. Similarly, in South Omo the number decreased from 30 cows, 38 goats and 36 sheep 20 years ago to 21 cows, 23 goats and 21 sheep at present (Figure 6).

Figure 6. Livestock possession of households during the past 20 years



Source: Survey Data, 2008

Shortage of adequate fodder and underfeeding of animals increased vulnerability to disease risks associated with drought and climate stress. The problem is exacerbated by shortage of veterinary services and poor infrastructure. According to informants in the three zones, the decline in animal productivity and reproductive capacity is the most serious risk they are facing today. They narrated their experience in terms of underfeeding of animals and falling productivity.

....in the past we had good pastures around. Now the fields are barren and availability of pasture is limited to few pockets. In the past, a young cow used to conceive at the age of three years and give birth to calves frequently. Now cows stay four to five years without conceiving. They do not give us as much milk as we need. Even if they do give birth to calves, they can't feed them, let alone provide extra milk for us. In addition, the quality of the milk has deteriorated, the aroma, taste, color and thickness of the milk has changed.

Table 2 shows drought-induced livestock deaths during 2006 and 2008 in Borena Zone. According to information obtained from the office of Agriculture of Guji Zone, about 3,000 cattle and 3,000-4,000 camels have died in Liben Woreda alone in 2007/08. The death of camels has happened just in a matter of one month (March-April, 2008) and such unprecedented incident was caused by unidentified disease (for an individual case, see Box 1).

Table 2. Drought-induced animal deaths in Borena (2006/07 and 2007/08)

	Cattle		Goats		Sheep		Camels		Total	
Woreda	2006	2008	2006	2008	2006	2008	2006	2008	2006	2008
Arero	19,537	8,102	7,565	1,899	1,100	325	2,014	283	30,216	10,609
Yabello	600	7,396	250	1,552	93	-	13	-	956	8,948
Teltelle	2,937	1,099	6,818	200	3,405	-	19	-	22,127	2,598
Dire	56,464	-	31,038	-	18,942	-	943	-	107,387	-
Miyo	41,022	2,174	18,328	464	7,231	-	362	-	66,943	2,638
Moyalle	22,842	747	5,000	1,798	235	-	3	77	30,718	2,622
Total	143,402	19,518	68,999	5,913	31,006	325	3,354	360	246,761	26,116

Source: Borena Zone Disaster and Preparedness Office, 2008

Box 1

Our life is tied with our livestock, but we are losing them terribly (Alka Urgema, Hamer)

.....I am a respected old man in this kebele. I have seen so many changes and new incidents in my life. But I have never seen a time as this season when livestock disease spread without control causing significant loss of our livestock. New diseases killing camels without symptoms of illness...my first ever experience to see a drought that led to camel death. If things continue like this, we are afraid that we will all die. Milk has not been sufficient for the family. Water is very scarce and there is no grass for our livestock; we have nowhere to go. Our life is tied with our livestock, but we are losing them terribly. We are worried how to save our herds from death because of the drought.

The situation is worsening from time to time thereby exposing a considerable portion of the households to food shortages. Over two-thirds of the interviewed households indicated increased intensity of drought and food insecurity in their localities. This has been leading to rising trends in poverty levels and dependency on external aid of food and non-food items. Table 3 shows the number of people in need of emergency food aid between June and November 2008. Arero, Moyalle, Teltelle and Yabello woredas were the worst hit in the zone. Poorly developed rural markets that have weak links to facilitate the exchange of livestock with food crops intensified the problem.

Table 3. Population in need of emergency food aid in Borena (June-November, 2008)

Woreda	Population in need of food aid	% of the total in need in the zZne
Arero	44,000	10.3
Moyalle	52,530	12.4
Teltelle	50,761	11.9
Yabello	52,000	12.2
Total (Borena Zone)	425,138	

Source: Borena Zone Disaster Prevention and Preparedness Office, 2008

Furthermore, the degradation of natural resources creates competition and leads to conflict and tension. More than 60% of the households in South Omo and 50% in Borena and Guji mentioned drought as the main cause for most of the conflicts. The conflicts are usually triggered during dry seasons that cause increased mobility as the competition for water and pasture becomes stiffer. For instance, violence which broke out between Borena and Konso (in the Segen River Valley) in March 2008 has led to the loss of many lives, the displacement of 27,000 people and raiding and looting of 1,500 heads of cattle. More than 44% of the households in South Omo and about 25% in Borena and Guji have suffered from conflict related livestock raiding in the last five years (2004-2008). In Borena a household has lost on average 20 goats and 1 camel, in Guji 19 oxen and 5 camels and in South Omo 6 oxen, 6 cows and 13 goats. Due to raiding, a household has lost up to 150, 92, and 80 heads of livestock in Borena, South Omo and Guji zones, respectively. Escalated conflicts could have deleterious long-term social, economic and environmental repercussions. Apparently, traditional institutions have become weaker to deal with prevailing conflicts in the area. Eighty-one percent of the households in Borena indicated that the traditional conflict management institutions have became weak, ineffective and less credible. On the other hand, in South Omo, 85% of the households stated that traditional institutions are still intact and effective in managing

and resolving conflicts. In spite of this, however, it is only 14% of households in South Omo who appeal to the traditional institutions at times of conflict; the remaining households appeal to formal government institutions.

Impacts on women and children

Women and children are most vulnerable and affected by the impacts of climate related hazards. The hazards create additional burden on women as they have multiple household responsibilities (see Figure 7). For instance, in Arero Woreda of Borena Zone, women have to spend on average 12 to 14 hrs a day to fetch water and fodder for small ruminants and calves during drought years. Children, especially girls, are forced to drop out of school during droughts, flooding and conflicts. According to the Borena Zone DPPA Office, recent violence which broke out between Borena and Konso (in the SegenRiver Valley) in March 2008 has caused massive displacements and over 1,500 children were forced to drop out of school in Borena Zone. Further, in some places of Borena and Guji zones where there is chronic food shortage, young children assist their parents by collecting wild fruits and roots for household consumption and to generate income.

Figure 7. The multiple responsibilities of pastoral and agro-pastoral Women

Figure 7 ... cont'd

Source: Field observation, 2008

Impacts on the environment and natural resources

The aggressive encroachment of undesired thorny and woody species on grazing areas has resulted in the degradation of rangeland resources. Bush encroachment is particularly severe in Borena and Guji zones. Estimates indicate that about 40% of the Borena rangelands were affected by bush encroachment by the mid-1980s (Assefa *et al.,* 1986; Coppock, 1994). According to survey results, about 90% of the households in Borena and Guji and 75% in South Omo indicated that the condition of rangelands is deteriorating over time. Most of the high potential grazing areas particularly in Arero (Borena) and Liben districts (Guji) are heavily degraded (see Table 4). The replacement of productive and high value grass species with low quality feed resources and unpalatable weeds have greatly reduced pasture availability and quality.

Table 4. Condition of rangelands over time (% of the responses)

Condition of range lands	Borena	Guji	South Omo
Deteriorated	91	89	75
Improved	4	9	20
Remained the same	6	2	5
Total	100	100	100

Source: Field survey, 2008

Discussions held with informants and experts in the study area confirmed that bush encroachment is the single most important factor degrading range resources. According to them, the problem appears to be beyond their control and has become a serious threat to livelihoods. It is widely believed that the official ban on bush fire by the government in the 1970s has facilitated the process of bush encroachment in the area (Bille and Eshetu, 1983; Corra, 1986; Coppock, 1994). According to pastoral elders, the loss of these species has reduced milk yield and quality while also exposing livestock and goats to diseases which some of the types could be fatal. The changes in the climatic system have also caused reduced water availability in wells, ponds and springs. In the study area, stress from water scarcity is increasing over time. During drought years, pastoralists should travel to distant places to graze and water their livestock. On average, in the past three years a pastoral household in South Omo needs to travel for 30 kms to get access to good pasture and 26 kms to water livestock. The corresponding figures in Guji are 27 and 24 kms and in Borena 18 kms(see Table 5).

Table 5. Average distance traveled (km) to get water and pasture for livestock

	To water livestock			To get pasture		
	Borena	Guji	South Omo	Borena	Guji	South Omo
Drought season						
During the last 3 years	18.4	24.4	25.6	18.6	27.4	29.0
During the last 10 years	12.9	20.0	24.9	12.5	21.6	27.8
During the Derg period	19.8	16.1	26.6	17.2	12.5	27.9
Non-drought years						
During the last 3 years	7.2	14.9	24.7	7.7	14.7	9.5
During the last 10 years	9.3	10.7	5.1	12.8	10.4	7.2
During the Derg period	8.8	25.8	5.8	9.0	5.0	7.0

Source: Survey Data, 2008

Complicating factors

The impact of climate change does not just depend on the actual variations in temperature, precipitation, etc. alone but also on the social and economic systems of affected communities to cope with the impacts of the changes. In addition to the direct impacts of climate change induced-hazards, various other factors complicate the problem and reduce the adaptive capacity of communities to the changes. The main complicating factors in the study area include weak livestock market, lack of preparedness, demographic pressure, unfavorable socio-cultural practices, lack of social services, lack of education and early warning information. The physical and market infrastructure in the area is poorly developed or non-existent, and the main market places are not within easy reach of most of the households. On the other hand, during drought years, the price of cereals rises while that of livestock falls thereby worsening the terms of trade for pastoralists.

Although early warning units and committees are present at the kebele and woreda levels, they are poorly organized and inefficient with negligible impact. Lack of awareness and limited availability of educational and health services constrained communities to prepare against and adapt to the impacts of the changes. In the study area, there are unfavorable socio-cultural perceptions and practices which make some household members more vulnerable to the impacts. For instance, women lack control over important household assets such as cattle and camel, land, beehives, and cash reserves for use at times of severe disasters.

Responses to Climate Change

Local/Community responses

Households and communities in the study area employ a range of indigenous strategies to cope with the changes and/or adapt to it. In response to the degradation of rangelands and declining livestock productivity, crop cultivation has spread to areas that have never been under cultivation. Opportunistic farming is used to avoid the potential risks of sole dependence on livestock. With severe droughts and other climate related risks, households have become increasingly under pressure to sell or exchange their livestock. According to survey results, about 78% of the households in Borena, 40% in Guji and 33% in South Omo reported an increasing trend of livestock selling since recent times. Normally, households start responding to the problem by selling small ruminants, mainly goats and sheep. However, with increased intensity of the hazards, they are forced to sell cattle that are the main sources of their livelihoods and social prestige in the community.

Resource sharing is a tradition that has long been used as a safety-net mechanism to support vulnerable members of the community to cope with the disasters. Customary mechanisms of support range from simple sharing and provision of milk and other food items to contributing heads of livestock in order to restock the herds of affected families. Households who received the support in turn contribute to the community by helping others through labour work and livestock herding demonstrating mutuality in the support system. Income diversification is another emerging coping strategy

in the area. Such activities range from daily labor in urban areas and commercial farms to selling of charcoal, firewood and wild fruits. Women mainly conduct petty trade while few young men involve in traditional gold and salt mining activities. During acute disasters, households change their normal food intake and adjust their consumption to the available household resources. Consumption smoothing usually involves adjusting diets to cheap food items, supplementing with edible wild plants and fruits, and reducing the amount and frequency of meals.

Pastoralists traditionally use varied types of resource management strategies to cope with and adapt to changing climatic conditions. Rangelands are divided into different uses, such as dry and wet season grazing, considering the season and nature of the climate. These practices are undertaken to avoid overgrazing, allow regeneration of pasture, and in response to climatic variations within and between months in a year. The grazing pattern is regulated by availability of water, pasture, and the size and structure of herds.

Traditional institutions make decisions regarding which resources (rangeland or water) to use when and by whom. Herd diversification and splitting are used as coping strategies against the impacts of climate change and variability. Diversification offers sustained supply of various livestock products, allows the manipulation of different ecological potentials of livestock, and helps to spread risks associated with changing climatic conditions. In general, there is a shift from the production of grazers (cattle and sheep) to browsers (camels and goats) as browsers are relatively drought resistant. Herd and household mobility, as opportunistic and more flexible mechanisms for coping with the impacts of climate change, are commonly employed household and community strategies. Such types of mobility are used to optimize the utilization of natural resources and in response to emergencies such as disease outbreak, flood, drought and conflict. Although long distance mobility is a long-standing tradition of the pastoralists, its duration and frequency has hanged in response to increased climatic tress. Long-distance and extended mobility has gradually been replaced with short-distance and frequent movements.Nevertheless, with increased intensity of the problem and its impacts, the traditional coping mechanisms are becoming obsolete or incapable to reduce damages and

build their resilience. Some household coping strategies such as cultivation of unsuitable areas (around Negelle Borena and Yabello), overgrazing (particularly in South Omo), and charcoal making and fuel-wood selling (in Borena and Guji) are not only unsustainable but would also cause further degradation and desertification. Such local coping practices which are mostly employed out of lack of alternatives, survival needs, and from lack of information or imperfect foresight, can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options.

Informal safety-net mechanisms for asset redistribution (as is the case among the Borena pastoralists using the Gedda system) become obsolete strategies if there are too many losses and too many people in need every year. Such household 'coping' strategies are 'erosive' (SADC FANR VAC, 2003) and hence need to be discouraged and replaced by long-term and forward looking or asset building and resilience enhancing adaptation strategies. The inefficiency and unsustainability of many traditional coping strategies in the face of current climate change is already visible, and has been particularly mentioned by community members, NGOs and local experts in Borena and Guji. Hence, institutional support is vital to reduce impacts of the hazards and curb unsustainable trails of household and community responses against the impacts.

Institutional responses

Various NGOs operate in the study area with invaluable contributions in terms of land management, water harvesting practices, rangeland rehabilitation, micro-finance and credit schemes, conflict resolution, etc. (Table 6). They have been particularly designing and implementing development projects related to asset protection, livelihood diversification, social service provision, natural resource management, and disaster risk reduction. Though the contributions are encouraging, most of these efforts are fragmented approaches and suffer from lack of cooperation. Furthermore, climate change is not well integrated and factored in the development activities of the NGOs. This coupled with short project duration to address proximate impacts has in some cases led to the promotion of inappropriate and unsustainable technologies.

Table 6. Major NGOs operating in the study area and their core activities

NGO	Areas of operation	Focal activity
Farm Africa	South Omo	Disaster risk reduction, environmental rehabilitation, livelihood diversification
AFD	Borena, Guji	Disaster risk reduction, environmental management and capacity building
SOS Sahel	Borena, Guji	Environmental rehabilitation, livelihood diversification
Ethiopian Catholic Church	Borena, South Omo	Disaster risk reduction, capacity building, water and sanitation
Save the Children UK	Guji	Education and health issues
Save the Children USA	Guji, Borena	Education and health issues
Goal Ethiopia	Borena	Livelihood development
CARE Borena	Borena	Emergency work, education, health

Source: Survey Data, 2008

The government has also a significant role to play. Indeed, the government of Ethiopia has adopted policies, strategies and action programs aimed at poverty reduction, environmental protection and sustainable development. However, the country does not have explicit policy on climate change yet. The threat of climate change as a development agenda is hardly captured in most of the policy and strategy documents. Instead, government response has been sectoral, short lived and biased towards emergency aid which in most cases is insufficient and not delivered on time. The early warning system of the country is narrow in its approach and is biased towards capturing the threats of drought and food insecurity in an emergency situation. In addition, lack of synergy among the various sector offices has hindered integrated and collaborative efforts to effectively mobilize communities and manage their resources. Without strong coordination and cooperation between all actors and stakeholders, and creation of operational synergies, neither the indigenous coping strategies nor the interventions of external factors will sufficiently address the complex impacts of climate change.

Conclusions and Recommendations

Conclusions

Ethiopia is one of the poorest countries most vulnerable to the impacts of climate change. Although symptoms of the problem are widespread in many places of the country, the southern lowlands are most affected and will suffer more. Historical climate data in the area reveals that there has been increased rainfall variability and temperature rise. As the result, the people are exposed to the risks of several types of disasters such as drought, flooding, epidemics, wildfire and pestilence. There is increased frequency and spatial coverage of the hazards: existing hazards are intensifying and new types are emerging with deleterious effects on lives and resources. Chronic food shortages, unstable livelihoods, and conflict over increasingly scarce and fragile resources are major impacts of the disasters. Repeated flash and seasonal floods have caused considerable destruction of life and property and induced massive displacements. Moreover, the incidence and spread of diseases and pests has intensified; new human, livestock and crop disease types that have never been known in the area have emerged. Camels and goats, which are normally considered more resistant to droughts and diseases, are affected by newly emerged and unidentified diseases. Crop damage has become widespread due to pest infestations and occurrence of new types of pests and worms. The disasters have caused increased vulnerability to poverty, food insecurity and loss of productive assets. For instance, the number of livestock held by pastoralist households has shrunk over the past two decades. Shortage of adequate fodder and underfeeding of livestock reduced not only the number of livestock but also productivity and resistance to diseases. The problem is exacerbated by shortage of livestock health facilities, services and poor infrastructure. The impacts of the hazards transcend beyond mere decline in crop and livestock production; rather become the cause of tense social relations triggering ethnic and tribal conflicts. In the study area, the conflicts have intensified over time as available resources shrunk due to climate change and led to the loss of human lives and property. Women and children are particularly most affected due to the changes in many respects. Weak livestock market, lack of preparedness, demographic pressure, unfavourable socio-cultural

practices, lack of education, health and other social services, poor infrastructure, and weak early warning information complicate the problem.

Households and communities employ a range of indigenous strategies to cope with the changes and/or adapt to it. However, the strategies are becoming incapable to reduce damages. Some of the strategies such as cultivation of unsuitable areas, overgrazing, charcoal making and fuel-wood selling are not only unsustainable but would also cause resource degradation and desertification. Hence, institutional support is vital to reduce impacts of the hazards and curb unsustainable trails of household and community responses against the impacts. Various NGOs operate in the study area focusing on land management, water harvesting practices, rangeland rehabilitation, micro-finance and credit schemes, conflict resolution, etc. The projects of the NGOs have invaluable contributions in relation to household asset protection, livelihood diversification, social service provision, natural resource management, and disaster risk reduction. Though the contributions are encouraging, most of these efforts suffer from lack of cooperation and fragmented approaches, short project duration, and weak cooperation among each other. On the part of the government, there are various policies, strategies and action programs aimed at poverty reduction, environmental protection and sustainable development. Unfortunately, the country has not had an explicit policy on climate change nor has climate change been well captured in the existing policies. Government response has instead been sectoral, short lived, and biased towards emergency aid.

Recommendations

Improve access to information and socio-economic services: The lack of economic and social services and infrastructural provisions in the pastoral areas exacerbate the impacts of climate change. In this regard, the local pastoral economy should be strengthened by reducing the vulnerability of pastoralists and agro-pastoralists to volatile terms of trade, increasing access to marketing outlets and information, education and developing alternative and complementary livelihoods for pastoralists and agro-pastoralists. In order to ease the impacts of population pressure and unsustainable resource

uses, continuous education and awareness raising campaigns concerning the importance of limited family size and family economics, as well as the provision of reproductive health services need to be essential components of such intervention.

Harness the value of indigenous knowledge to plan and achieve resilience: The diverse communities in the study area have accumulated coping strategies that range from the simple technical and descriptive knowledge about the local ecology, vegetation and forage species to social and economic strategies that spread risks, promote sharing of resources, encourage diversification of livelihood activities and flexibility in the management of household assets and communally shared resources. In light of recurrent droughts, floods, human and livestock diseases, pests and invasive weeds, development schemes are needed (or need to be improved) for the reduction of risks and the proper management of crisis. Such interventions need to build on existing indigenous coping strategies, provide new options for risk management and ensure access to critical resources during disasters.

Focus on feed rehabilitation and integrated rangeland management: Establish regular supervision and monitoring of range condition, vegetation type, and productivity and management problems. Ii is vital to recognize and integrate traditional range management knowledge and practices (rotational grazing, herd diversification, splitting and flexibility), area enclosure, dry season reveres, alternative feeding and hay making practices.

***Focus on animal health and disease prevention and control*:** In view of the expansion of animal diseases and the emergence of newly emerging varieties, it is crucial to develop systematic monitoring and periodic assessment systems, and disease prevention and control programs.

Protect assets and build and diversify local livelihood options: Protecting vital livestock, range and environmental resources is crucial to develop local adaptation capacity, resilience and resistance to the impacts of climate change-induced hazards. Given the diverse impacts of climate variability and change, it is also equally important to broaden available

livelihood options to diversify income streams, absorb surplus labor, reduce over-dependence on livestock or natural resources, and reduce exposure to climate shocks. Alternative livelihood sources focus on non-pastoral livelihood options including the protection and collection of non-timber products (gums, incense, etc...), bee keeping, opportunistic farming, poultry, petty trade and other urban-based income-generation activities can cut unsustainable production and the immediate daily dependence on natural resources.

Target and empower women and other vulnerable groups: Women in the study area are both victims and active managers of their local environment. Their role in the spheres of the household economy and the reproductive and productive arenas is innumerable and immensely critical. The deterioration in the productivity or carrying capacity of the rangelands or environmental resources will affect them first. Measures that empower women in decision making in the household and community spheres are very important and urgently needed.

Promote climate friendly development initiatives: Development actors in the area should factor climate change as a major component of their activities. It is necessary to consider local realities and sustainability issues in the design and execution of development projects and programs. Furthermore, collaboration among the various development actors operating in the area is imperative in order to streamline activities, effectively manage human and financial resources, and successfully meet intended objectives.

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