Somali Regional State

Environmental Protection & Energy & Mines Resources Development Agency

Climate Change: Impacts, Vulnerabilities & Adaptation Strategies in Somali Region

Regional Program of Plan to Adapt to Climate Change

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Jigjiga, Ethiopia

Chapter I

1. Introduction & Background

1.1 Overview of Climate Change

For the last 10,000 years we have been living in a remarkably stable climate that has allowed the whole of human development to take place. In all that time, through the mediaeval warming and the Little Ice Age, there was only a variation of 1°C. Now we see the potential for sudden changes of between 2°C and 6°C. We just don't know what the world is like at those temperatures. We are climbing rapidly out of mankind's safe zone into new territory, and we have no idea if we can live in it. (Robert Corell, Arctic scientist and IPCC member; *The Guardian* 5 October 2007.)

A useful starting point for understanding the economy in its ecological context (and also, in fact, in its social context) is an idea that has not received much attention until recently: the idea of common wealth. It now appears that an important part of the common wealth of all humanity is *the global atmospheric capacity to absorb greenhouse gasses without disastrous climate effects*. Until the industrial revolution this capacity was never noticed, as it was in a balance in which greenhouse gasses emitted as methane, by the release of CO2 in the decay or burning of trees and plants, and by other natural causes, were offset, principally by new plant growth and by the carbon uptake of the oceans.

This balance has been seriously disturbed by various types of human activity which are rapidly degrading the atmosphere's capacity to absorb greenhouse gasses without disastrous climate effects. Human beings in effect used up this atmospheric capacity decades ago, creating a situation in which some amount of climate change is inevitable, and additional emissions of greenhouse gasses make it more severe.

What are these greenhouse gasses? Methane produced from livestock and paddy rice farming, as well as vented septic systems and landfills, accounts for about 15% of the GHG.

The major source of CO2 emissions is, as is well known, the combustion of fossil fuels, while deforestation also releases (and reduces the capture of) CO2, accounting for 15-20% of the climate change that has occurred to date (Stern, 2007). Of particular concern is the massive destruction of rain forests in tropical countries, which not only releases carbon that had been stored in living trees – it also reduces the uptake of carbon from the forest biota, both above ground and in the soils. While part of the reason for this destruction can be traced to population growth, with growing demand for land on which to grow food, a larger amount relates to development and trading patterns in which tropical forests are cut down to sell the wood abroad, or to grow crops such as soybeans or cattle (the latter most notably in the Amazon), to earn the foreign currency on which these countries are increasingly dependent.

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1.2 Climate Change Observations in Ethiopia

Given the range of negative impacts of current climate (and non-climate) hazards on pastoralist and agro-pastoralist livelihoods, the implications of climate change must be taken into account to ensure longer-term survival and sustainability of these communities. This requires an appreciation of how the climate has already changed in recent decades and what is projected to change in the decades to come. According to the UNDP Climate Change Profile for Ethiopia, the mean annual temperature in Ethiopia has increased by 1.3°C between 1960 and 2006, at an average rate of 0.28°C per decade. The temperature increase has been most rapid from July to September (0.32°C per decade). It is reported that the average number of hot days per year has increased by 73 (an additional 20% of days) and the number of hot nights has increased by 137 (an additional 37.5% of nights) between 1960 and 2006. The rate of increase is seen most strongly in June, July and August. Over the same period, the average number of cold days and nights decreased by 21 (5.8% of days) and 41 (11.2% of nights), respectively. These reductions have mainly occurred in the months of September to November (McSweeney *et al*., 2008).

It is very difficult to detect long-term rainfall trends in Ethiopia, due to the high inter-annual and inter-decadal rainfall variability. Between 1960 and 2006, no statistically significant trend in mean rainfall was observed in any season. The decrease in rainfall observed in July to September in the 1980's recovered in the 1990s and 2000s. In addition, there are

insufficient daily rainfall records to identify trends in daily rainfall variability and changes in rainfall intensity (McSweeney *et al.*, 2008).

According to the National Meteorological Agency, Ethiopia experienced 10 wet years and 11 dry years over the last 55 years, demonstrating the strong inter-annual variability. The wet years included 1958, 1961, 1964, 1967, 1968, 1977, 1993, 1996, 1998 and 2006. Dry years were 1952, 1959, 1965, 1972, 1973, 1978, 1984, 1991, 1994, 1999, and 2000 (Ethiopian NAPA, 2007).

Recent analyses of rainfall and food security indicators by FEWS NET (2009) suggest that southern and eastern Ethiopia have been experiencing recent reductions in rainfall, mainly since 1996 and during the March to May rainy season. The reports also mention that the observed food aid and projected food shortfalls show chronic and increasing requirements that may soon extend beyond the intermittent aid strategy underlying early warning systems. The reports state that lowland and midland areas in the south and east may be the most affected by rainfall reductions and population growth, leading to the failure of pastoral livelihoods and farming in marginal land. The recent and recurrent poor March to May rainy season in many regions negatively impacts the growth of slow maturing long-cycle crops, pasture conditions, and seasonal harvests. As of June 2009, a total of 7.5 million chronically food insecure people received assistance through employment in public works under the Productive Safety-Net Program (PSNP) and an additional 4.9 million people required emergency food assistance. According to these reports, the decrease in the March-May rainy season across the Greater Horn of Africa might be linked to the recent warming in the western Indian Ocean. Figure 2 below shows the food security conditions in Ethiopia as of June 2009.

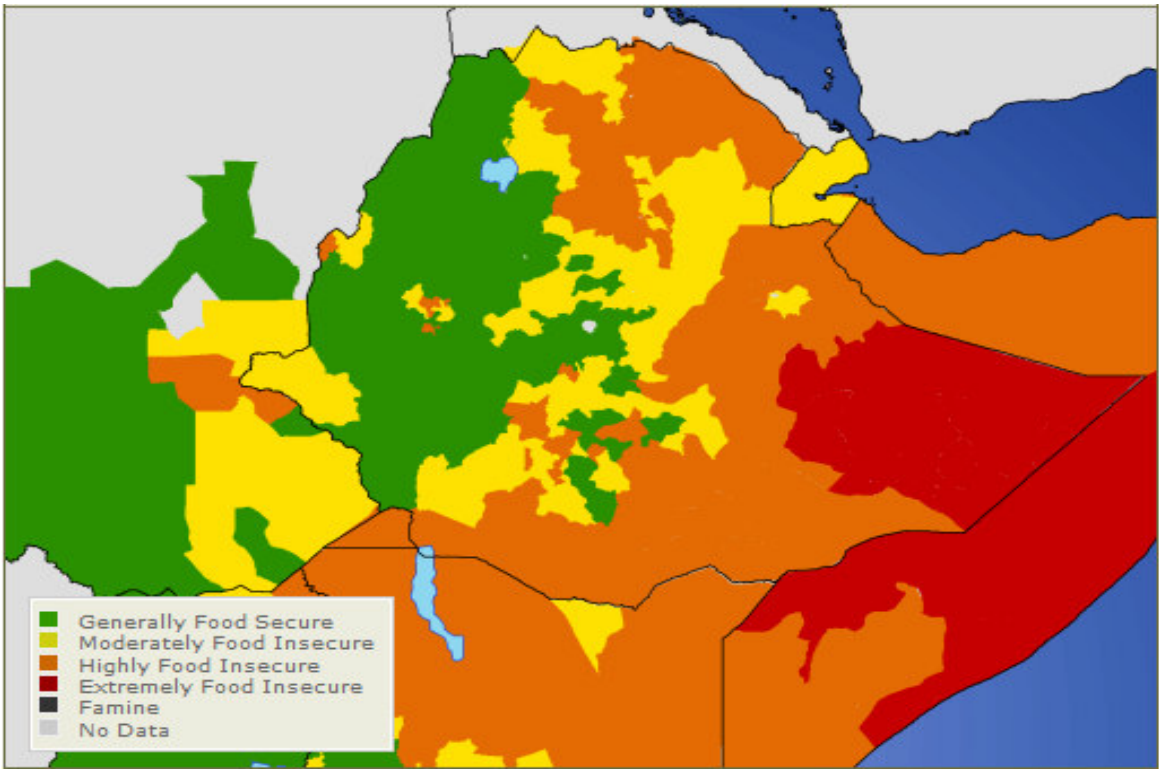

Figure 2: Estimated food security conditions, April-June 2009 (Source: FEWS NET 2009)

1.3 Pastoralism & Climate change

The effects of climate change on the dry lands of the Horn of Africa pose particular and difficult policy challenges. The arid climate together with the poverty faced by its inhabitants mean that the higher temperatures, intensifying rains and increasingly frequent extreme weather events that climate science projects for the region can only exacerbate the problems of development. However, the dry lands have under-exploited development potential and the dominant land use system – Pastoralism – has unique adaptive characteristics that, together with the right enabling policies, suggest that climate change can be adapted to, and development can be achieved.

1.3.1 Changing Somali Pastoralism

Somalis inhabit a huge area stretching from Djibouti in the north through Somalia, South east Ethiopia and Northeast Kenya (though differences lays with regard to self identity & self determination). There is evidence of long term changes in the nature of pastoralism as practised in many Somali areas. This is associated with increase in number of water points

and settlements and growth in area of cultivated land. In Northeast Kenya, for example, there has been a sharp increase in the number of water points since the 1970s with the drilling of boreholes and digging of new wells. This has paralleled a dramatic increase in the number of settlements. These changes have had implications for grazing patterns. Previously, there existed fairly distinct areas for dry season grazing and wet season grazing in the Northeast Province (NEP) of Kenya. From the 1970s, this pattern began to break down as boreholes were sunk in areas previously used for wet season grazing. The increase in water points, often without proper planning, has meant most areas can now be grazed in both the dry and wet season. New settlements have also impacted on rangeland as settlement dwellers keep cattle and shoats permanently grazing around the settlement creating islands of permanent grazing in previously open rangeland.

The breakdown in wet and dry season grazing patterns and an increase in livestock pressure in Northeast Kenya obviously has implications for availability of livestock fodder which in turn has had a negative effect on livestock production and health. Pastoralists perceive a sharp reduction in milk production for all species and a greater incidence of livestock diseases. The species composition of herds has also changed with increasing water points, with increasing number of cattle kept by herders who previously kept only camels and shoats. The changing nature of pastoralism in Northeast Kenya would appear to be reflected also in parts of Ethiopia's Somali region.

1.3.2 Changing Somali Pastoralism in Ethiopia

A similar process of transformation in pastoralism is evident in our case. There have been increases in water points and settlements, new land use patterns and changes in natural resource management mechanisms. The nature of these changes varies across the region. Here too, there is an increase in water points in the form of boreholes, wells and birkeds. In the south east of Somali region, birkeds have been constructed since the 1950s, with a substantial increase since the 1970s. Farah (1997) estimates that there may be as many as 12,000 birkeds in Gashaamo district alone.

Fig: **A Somali pastoralist walks past carcasses in drought stricken Ayshi'a, in northern Somali Region: 'Only God knows how we will survive'**

There has been an increase in the area of land cultivated and a consequent decrease in the area of land open to grazing for pastoralists. Members of previously nomadic clans such as the Gadabursi, Yabarre, Gerri, Bartire and, more recently, the Abaskul in the Jerrer valley, have turned to cultivation in the higher altitude and higher rainfall areas such as Jigjiga, Awbarre and Gursum (Hogg, 1992; Tilahun et al, 1996). This has been accompanied by a move from communally to individually held land. A recent phenomenon has been the enclosure of grazing land. This involves fencing of an area by an individual in order to conserve the pasture within for the owner's livestock or for sale to other livestock owners. Such enclosures reduce area of land available for grazing. They tend to be more common where there is heavy pressure on grazing land although concentration of enclosures varies greatly across the region. Generally an individual has the right to enclose a piece of land in the area controlled by their clan unless the clan has agreed there should be no enclosures. In the Harshen area, for example, there is a clan agreement that there should be no more enclosures because the negative effects of many enclosures have become apparent. The above changes have been accelerated by the influx of returnees to the region. Many returnees have taken up farming upon return as they lacked access to livestock and agriculture has been the only livelihood open. This has meant a sharp increase in the area of cultivated land since

1991. As the land best suited to farming has been brought under cultivation in some areas, more marginal land has been used. Returnees have also resorted to digging of birkeds as a means of generating income through the sale of water in the dry season. The large returnee population has also added to pressure on natural resources with activities such as charcoal burning.

1.3.3 Pastoralism: a rational use of the dry land

Pastoralism is a rational use of the dry lands. Pastoralists respond to and use, even choose and profit from, variability. This allows for a vibrant and productive livelihood system in some of the harshest landscapes in the world. Pastoralists use mobility to respond quickly to fluctuations in resource availability, dictated by the dry lands' scarce and unpredictable rainfall. They also employ a number of highly specialised risk spreading strategies to safeguard their herds against drought, floods, disease and social unrest. These strategies – including building up herd sizes as insurance against times of hardship, splitting herds across different locations to spread risk, keeping different species and breeds and loaning surplus animals to family and friends – ensure the rational use of the natural resource base and also develop and strengthen social relations as a form of social capital.

1.3.4 Pastoralism's contribution to the health of dry land ecosystems – Given that nature to be commanded must be obeyed

Dry land ecosystems are healthier where mobile pastoralism continues to be practiced effectively. Grazing opens up pastures, stimulates vegetation growth, fertilises the soil and enhances its water infiltration capacity as hoof action breaks up the soil crust, aids in seed dispersal to maintain pasture diversity, prevents bush encroachment and enhances the cycling of nutrients through the ecosystem. In many areas of Somali region, the effects of too-little grazing can be clearly seen: bush encroachment has rendered large areas of the dry lands unusable as a result of reduced numbers of grazing animals due to drought or conflict. Prime example can be taken as the cases of Dhagahbur and shinnile Zones.

1.3.5 Pastoralism's contribution to national economies

The livestock sector represents 10% to 15% of agricultural GDP across Ethiopia, and a significant portion of the countries' livestock is found in pastoral areas. However, national accounts are incomplete. Example of economic contributions from pastoralism not captured in national accounts includes:

- In Somali region only, it is estimated that the actual value of cross-border livestock sales is three to six times that given in official figures for the whole country. Pastoralist animals also provide about 20% of draught power in Ethiopia, worth about $155m annually.

1.3.6 Climate change and existing challenges facing the dry lands

Climate alone is rarely the reason people fall into poverty; instead, it interacts with existing problems and makes them worse. For example, migration and/or mobility as a climate adaptation strategy increases population pressure and environmental degradation. Failed rainy seasons will result in reduced agricultural yields in already highly fragmented landscapes, and increased climatic shocks will fuel conflict over resources and access.

1.4 Climate and Land Use

The Somali region is mostly desert with high temperatures and low precipitation. Given the dominance of pastoralism, and the ongoing shift toward settled agriculture the dependence on rainfall is more obvious and stronger than in years past. "There are two primary rainy seasons throughout most of the region, the Gu (long rainy season) from March to May, and the dayr (short rainy season) from October to December. A customary technique in water harvesting includes the collection of water in wells and storage containers to ensure the availability of supplies during the dry season. "But over the past two decades these rains have become increasingly unreliable; there were major droughts in 1984-85, 1994 and 1999-2000 (during which pastoralists claim to have lost 70-90 per cent of their cattle). A creeping problem of environmental deterioration is linked to an emerging trend of widespread tree felling for conversion into charcoal. This is benefiting individuals involved in the trade but is clearly very detrimental to the community at large due to its destructive impacts on society in a region where resources are very scarce

1.5 Purpose of the Study & Methodology

Climate change is every ones concern. It is a widespread phenomenon having a negative impact on the growth of less fertile and underdeveloped community like of the Somali region. Being a wide problem, the need to cope with jointly is indispensible idea. Practical experience has shown that the loss of animals and human lives are also occurring now days, and continue to occur. Cognizant to this, its an imperative idea to put the most of the regions fewer resources to adapt to the ever increasing pressure from the changes of the environment due the climate change. In line with this, the Somali region, Environmental Protection Energy & Mines Resources Development Agency in collaboration with the concerned stake holders has conducted a study addressing the impacts of climate change, the major vulnerable sectors, the region's adaptive capacity to the existing challenge and possible future adaptation measures.

This study uses a bottom-up, vulnerability-driven approach to assess the implications of climate change on pastoral and agro-pastoral livelihoods in Somali region. It seeks to compile some of the perceptions and experiences of local communities and individuals who are on the frontlines of climate change. On the other hand, the study is mostly used a secondary and desk – based review datas, however, there are certain primary data collected from four districts taken as the sample area, namely Harshin (pure pastoralist), Ayshi'a (pure pastoralist), K/Bayah (agro – pastoralists) and Jigjiga (rural farming), and the sample number is 100 respondents from all sample areas with equal proportion. This sample area is expected to represent the whole population of the study which is known to be 30% of the lowest administrative districts of the region (see Annex 1). The sampling method used is simple random sampling and interview is the method of undertaking the study.

Drawing from the definitions used by the Intergovernmental Panel on Climate Change's (IPCC), climate-related vulnerability is understood in terms of climate change exposure, sensitivity, and adaptive capacity (2001). Exposure is defined by the magnitude, character and rate of climate change in a given geographical area. Sensitivity to climate change is the degree to which a community is adversely or beneficially affected by climate-related stimuli. For the purposes of this analysis, sensitivity largely depends on the main livelihood activities practiced in a community (including its dependence on livestock and rain-fed agriculture), including the specific natural, physical, financial, human and social resources needed to carry

out these activities, as well as the impacts of climate hazards on these key livelihood resources. The adaptive capacity of a community is its ability to adjust to climate change, to moderate or cope with the impacts, and to take advantage of the opportunities that may arise with climate change. It is understood in terms of some basic socio-economic factors or determinants (income, access to resources and services, literacy, etc.), possible strategies to prepare for and cope with future changes, as well as the different enabling conditions and limits and barriers to adaptation.

Guiding questions that were used in this study to assess climate-related vulnerability, impacts adaptive capacity and possible responsible measures are presented in the Vulnerability Framework in Table 1. These question have been primarily answered by those individuals, entities, institutions and more generally concerned partners who are the frontlines of climate change.

Table1: - Climate Change Vulnerability framework

S/N	Exposure	Impact	Vulnerability	Adaptive Capacity
1	**Which climate-related hazards affect livelihoods? i.e, shortage of RF, long sun -shine duration, strong winds, floods, etc.**	**what are the impacts of these hazard's on the health, agriculture, education, water, infrastructure, socio - economy, .. Etc.**	**How vulnerable are livelihood activities to climate change?**	**What are some of the socio -economic factors determining adaptive capacity?**
2	**What have been the observed changes in the timing, frequency, and intensity of these hazards?**		Indicators of sensitivity/Vulnerability include, among others:	**What are the communities' past and current experiences with risk management and coping**
3	**what are the possible future projected impacts to climate change through research & discoveries?**		Dependence on livestock	
			Livestock type (are they resilient species?)	Activities currently undertaken to cope with climate hazards? What are the potential adaptive capacity of these communities?
			Dependence on rain-fed agriculture	
	How do community observations compare?		Crop mix/types (are they resilient species?)	Effectiveness and sustainability of strategies with future change
			Environmental conditions (type, level, rate of degradation)	**What are some options for risk management and coping with future changes?**
			Which livelihood resources are most affected by climate hazards?	
			Agro-pastoralist	Activities to prepare for climate change impacts
			Sedentary farming	

			Pastoralists	Resources that are key to these activities
			Urban dwellers	**What are the enabling conditions and barriers to adapting?**

Given the above table, different methods were used to analyse and give possible recommendations with respect to climate change impacts, major vulnerable sectors, adaptive capacity of Somali environment to those changes brought by climate change, response measures and the best adaptation technologies that are seemingly suitable in Somali region. Some of those methods included a combination of, among others;

- ✓ Consultations with 30% of the lowest administrative units of the region (directly and/or indirectly), who are actually hit by the adverse impact of climate change through gathering of primary 'indicator' data (related to population, livelihoods, geography and well-being);
- ✓ Consultation with those individuals who are the frontlines of climate change impacts both in terms of knowledge and experience.
- ✓ Review of climate data from the National Meteorological Agency (NMA).
- ✓ Secondary data, desk-based review of key documents including: UNDP's Climate Change Country Profile for Ethiopia, IPCC reports, Ethiopia's National Adaptation Programme of Action (NAPA), climate related vulnerability & adaptive capacity in Borana & Shinile Zones of Ethiopia (SCUK & Care International), Care CVC hand book, Impacts of climate change on the developing countries and other relevant research reports.

Chapter II

2. An Overview of Somali Region Profile

Somali Region is the eastern-most of the nine ethnic divisions (*kililoch*) of Ethiopia. It is often called **Somalia**, though it is not to be confused with the independent country of the same name. The capital of Somali State is Jijiga. The capital had been at Kebri Dahar (Qabridahare) but after 1992 it moved to Gode/Godey until April 1994, and later it was moved to Jigjiga. Other major towns and cities include (the Somali spelling in brackets): Degehabur (Dhagaxbuur), Kebri Dahar (Qabridahare), Shilavo (Shilaabo), Geladin (Geladi), Kelafo (Qalaafe), Werder (Wardheer), Moyale (Mooyaale), Gode (Godeey), Jerrati (Jarati), and Shinile (Shiniile). The region borders Kenya to the south-west, the Ethiopian regions of Oromia, Somali and Dire Dawa (Diridhaba) to the west, Djibouti to the north and Somalia to the north, east and south.

The region is remote with a mobile nomadic population and inadequate infrastructure. Climatically, it is mostly desert with high average temperatures and low bi-modal rainfall. Its economy is weak and reliant predominantly on traditional animal husbandry and marginal farming practices.

Until it's first-ever district elections in February 2004, Zonal and woreda administrators, and village chairmen were appointed by the Regional government. Senior politicians at the Regional level nominated their clients to the local government positions. In the 2004 local elections, each woreda elected a council including a spokesman, vice-spokesman, administrator, and vice-administrator. These councils have the responsibility of managing budgets and development activities within their respective districts.

In late April 2005, heavy rains caused widespread flooding throughout Somali Region has caused the Shebelle River to burst its banks. As of May 2005, the flooding in Somali Region alone had caused over 100 confirmed deaths and widespread property damage affecting over 100,000 people. The floods also destroyed shelters housing 25,000 Somali refugees in Kenya near Dororo in Ogaden.

2.1 Biophysical features

The Somali Region is geographically located in south-eastern part of Ethiopia, between 4° and 11° N latitude and 40 ° and 48° E longitude. The altitude of the region ranges between 400-1600 meters above sea level (masl), with most areas lying below 900 masl, it is the second largest region in Ethiopia. It is bounded by Kenya and Somalia to the south, the Republic of Djibouti and the Somali region to the north, Somalia to the east and southeast and Oromiya region to the west. The region covers a total area of 350,000km2 consisting of 9 administrative zones, 52 districts (Woredas) and 703 Kebeles. The zones are *Jigjiga, Shinile, Liban, Afder, Godey, Korahay, Warder, Dagahbrur* and *Fik.*The major perennial rivers in the region are *Wabi Shebelle, Genale, Dawa* and *Weyib*. There are also smaller seasonal rivers such as *Erer, Daketa* and *Fafen*. It is estimated that these rivers can irrigate over 600,000 ha. of land out of which currently only 1.5% is irrigated and they contain an estimated volume of 100 billion cubic meters of water every year.

The total area suitable for irrigation in the *Wabi Shebelle* basin is estimated 345,000 ha. This consists of about 12% of the total irrigable land in the country (Imperial Ethiopian Government 1973). From this 265,000 ha is classified as class 1 that is described as very suitable for irrigation. The remaining 90,000 ha are classified as moderately suitable for irrigation. According to the Ministry of Water Resources 113,000 ha of land is suitable for irrigation to be developed from the *Genale river* (WRTDA 1987). The same study also identified about 50,000 ha of irrigable land in the lower Weib basin.The region has a potential of about 142 billion-meter cube of natural gas, which consists of about 71% of the total estimated natural gas in the country. A detailed study in the Calub area revealed a potential of 30 billion meter cube of natural gaz to exist for exploration (MOME 1986). Geological surveys and exploration activities made so far by the Ministry of Water Resources have not indicated the presence of oil potentials in the region for commercial exploitation. The lowlands are also rich sources of solar and wind energy, as well as geothermal and fossil fuels such as gas while it is laborious that many mineral deposits is also found (i.e limestone, marble, salt, and potash sulphur, gold, etc

2.2 Demographic Characteristics

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the Somali Region has a total population of 4,439,147, consisting of 2,468,784 men and 1,970,363 women; urban inhabitants number 621,210 or 14% of the population. With an estimated area of 279,252 square kilometers, this region has an estimated density of 15.9 people per square kilometer. For the entire region 665,397 households were counted, which results in an average for the Region of 6.6 persons to a household, with urban households having on average 6.3 and rural households 6.7 people. Ethnic groups include Somalis (97.2%), Oromo (0.46%), Amhara (0.66%), foreign-born Somalis (0.20%) and Gurages (0.12%). 98.4% of the population is Muslim, 0.6% Orthodox Christian, and 1.0% are followers of all other religions.

In the previous census, conducted September 1997, the region's population was reported to be 3,439,860, of which 1,875,996 were males and 1,563,864 were females. The urban residents of the Somali Region numbered 492,710 households, with an average of 6.6 persons per household; a high sex ratio of 120 males to 100 females was reported.

The ethnic groups included Somalis (96.23%), Oromo (2.25%), Amhara (0.69%), and Gurages (0.14%). Somali was the working language and is predominantly spoken within the Region, spoken by 95.9% of the inhabitants. Other major languages included Oromifa (2.24%), Amharic (0.92%), and Gurage (0.033%). 98.7% of the population were Muslim, 0.9% Orthodox Christian, and 0.3% are followers of other religions.

According to the CSA, as of 2004, 38.98% of the total population had access to safe drinking water, of whom 21.32% were rural inhabitants and 77.21% were urban. Values for other reported common indicators of the standard of living for Somali as of 2005 include the following: 71.8% of the inhabitants fall into the lowest wealth quintile; adult literacy for men is 22% and for women 9.8%; and the Regional infant mortality rate is 57 infant deaths per 1,000 live births, which is less than the nationwide average of 77; at least half of these deaths occurred in the infants' first month of life.

The region is among the areas of the country sparsely populated with an average population density of about 15 persons per km^2. The population density ranges from 41 persons per km^2

in Jigjiga zone to 6 persons per km^2 in Warder and *Afder* zones. The pattern of age distribution as obtained by the survey result showed that about 45% of the population in urban areas and 50% in rural areas are under the age of 15 years, while population in the age range of 15-64 years account for 52% of the urban and 47% of the rural population. Population above the age of 65 years constitute 28% of the urban and 2.3% of the rural residents.

The average sex ratio of the population is 113 which show the existence of excess males over females. The corresponding figure for urban and rural population is 107 and 115 respectively. With respect to the literacy status the survey revealed that majority (71.3%) are illiterate, 10% can read and write and only 8.6% have attained grade 1-4 education level. Mother tongue for more than 96% of the population in the region is Somali language. About 20.4% and 6.9% of the urban and the rural population also speak other languages in addition to their mother tongue. In terms of marital status, more than 54% of the population aged ten years are single and about 40% married.The survey revealed that out of the population aged ten years and above, about 62% are economically active. Unemployment rate for the region is about 6% with variation among zones (3.41% in Warder to 9.53% in Liban). The major type of activity (occupation) of the surveyed rural population is pastoralism (48%) followed by crop farming (25.2%) and agro-pastoralism (17.1%).

In the urban area, 32.6% of the population are engaged in trade followed by pastoralism (19.1%) and crop farming (15.1%). In both rural and urban areas, participation of females in trade activities is higher than that of male.The main source of income earnings for the surveyed rural population of Somali Region is livestock rearing which constitute about 40% of the total income followed by crop production (26.2%), trade (14.4%) and gift (7.4%). Trade is the main source of income in urban areas. The major items of expenditure are dood, drinks and related constituting about 61.9% and 70.4% of the total expenditures of the surveyed urban and rural population respectively. Out of the total surveyed rural households, 85.4% earn less than Birr 9000 and 81.6% spend less than the same amount. In the urban areas, the top 11.6% earn Birr 20,000 or more annually while about 8% spend same amount annually.

The Somali society is highly structured and anchored in the system of clans and sub-clans that bind and divide Somalis. The systems forms the basis of much of the core social institutions and norms of traditional Somali society, including personal identity, rights of access to local resources, customary law (xeer), blood payment groups (diya), and support systems. The region is divided into 9 zones and 52 Weredas.

Hundreds of clans, sub-clans, sub-sub clans and so on exist and allegiances are complex. Fundamentally, the strongest allegiance is to the lowest clan division (i.e., allegiance to the sub clan is stronger than allegiance to the clan), but this is a somewhat simplified depiction and it is important to accept that clan practices are adaptable and dynamic, not static and timeless. One sub-clan generally resides in one Kebele, meaning Weredas are home to multiple sub clans, sometimes of the same overall clan, sometimes of different clans. At any particular time two sub-clans may be allies or adversaries and these relationships are constantly shifting in a process of fusion and fission between and among clan lineages with nearly four in five children living with both parents, the region also has the highest percentage of intact families

2.3 Agriculture Situation

The CSA of Ethiopia estimated in 2005 that farmers in Somalia had a total of 459,720 cattle (representing 1.19%% of Ethiopia's total cattle), 463,000 sheep (2.66%), 650,970 goats (5.02%), 91,550 asses (3.66%), 165,260 camels (36.2%), 154,670 poultry of all species (0.5%), and 5,330 beehives (0.12%). For nomadic inhabitants, the CSA provided two sets of estimates, one based on aerial surveys and the other on more conventional methodology:

S/N	Livestock Type	Areal survey (Conducted 5-23 Nov, 2003	Conventional Survey (Conducted 11 Dec, 2003
1	Cattle	670,280	130,610
2	sheep	6,410,800	250,110
3	Goats	5,525,460	177,580
4	Camels	1,041,870	64,510

5	Asses	42,640	14,290
6	Mules	430	160
7	Horses	50	

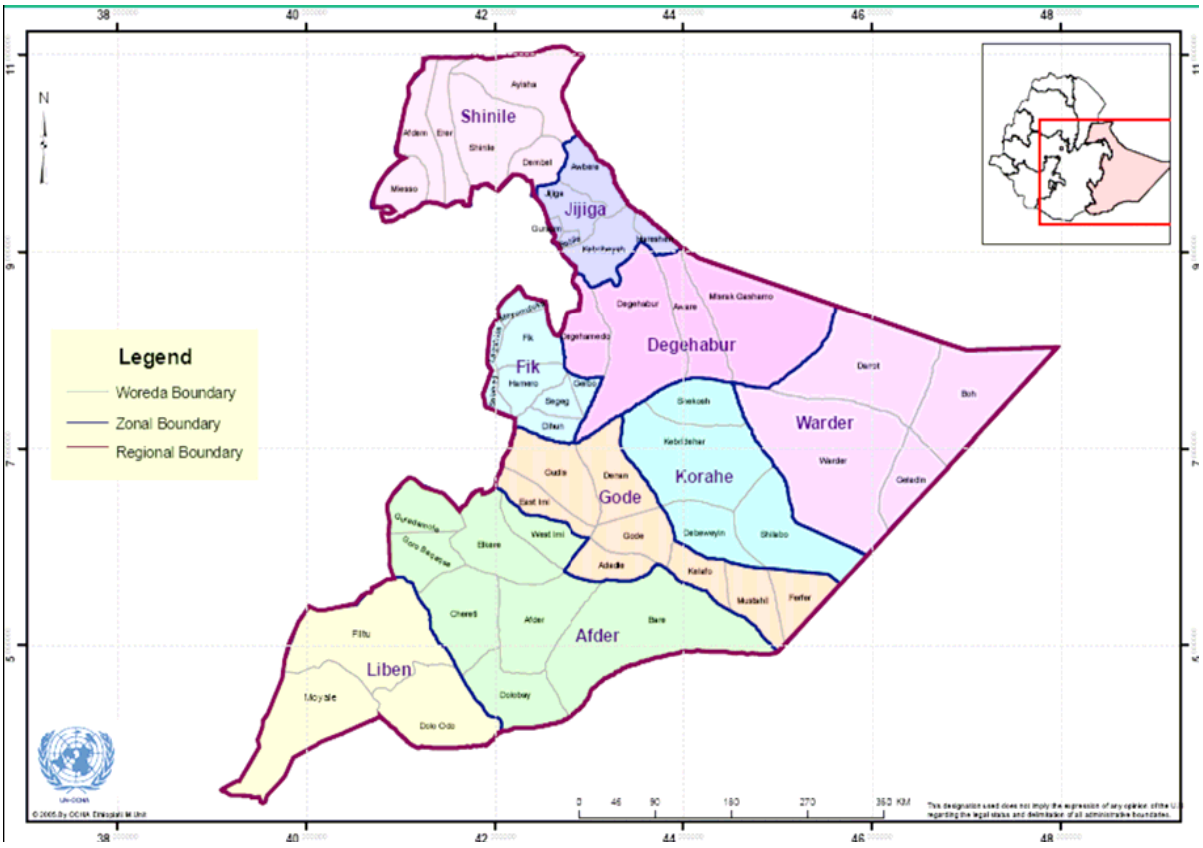

Figure: Map of Somali Region

2.4 Food Security & Major Livelihoods of the Region

According to the World Food Summit plan of action of 2006, *food security* is generally defined as all people, at all times, have physical and economic access to sufficient safe and nutritious food for a healthy and active life. The two major elements/components of food security are availability and accessibility. Availability refers to the quantity and quality of food at any given time in the form of local production through agriculture, fishing, animal

husbandry, wild foods (fruits and hunting) as well as imports and exports through the market system. Availability of food is highly correlated to the following factors:

- Natural factors such as change in climate affecting both crops and livestock.
- Displacement caused by conflict, affecting production.
- Widespread illness, such as malaria and HIV/AIDS, affecting labour capacity. Disruption of market dynamics.
- Government policy either favouring or affecting food security.

Accessibility refers to entitlement of food primarily through production, purchase, trade, exchange, and claims. It is influenced by market factors and the price of food as well as by purchasing power related to livelihood situation.

Livelihoods are a means of making a living. They comprise ways in which people access and mobilise resources which enable them to pursue goals necessary for their survival and long-tem well being. Livelihoods are affected by natural, policy, social, economic, physical, and human factors.

At times when an individual, household, or community is unable to avail and access food for the above mentioned reasons then the situation could be described as a state of *food insecurity*. Food insecurity is also an underlying cause of malnutrition and in extreme cases results in mortality. A high degree of food insecurity when compounded with other undesirable factors can threaten livelihoods. High risks of food insecurity and livelihoods can be expressed in terms of malnutrition, morbidity, and in extreme cases mortality.

Malnutrition is a high degree of manifestation of food insecurity. The causes can be immediate or underlying. The two immediate causes are related to inadequate food intake, expressed by low quality and quantity diets, and disease that can reduce appetite, absorption, and loss of nutrients from the body. The other major underlying causes of malnutrition are related to the household food situation, the health environment, and the care and social environment. The household food situation refers to meeting the food requirement through different food and income sources. These include own production, purchase from markets, trading, gifts, and wild foods, as well as illegal means such as theft. The health environment refers to access to health services, clean water supply, sanitation, and housing. Caring behaviour in the family, including childcare and allocation of food in the family, and political and social networks in the community also contribute to the care and social environments.

2.3.1 The Somali pastoralist's livelihoods

Contradicting the romantic vision of pastoralism as nomads leading a solitary and self – sufficient existence, wandering through the desert and living off the meat, milk and blood of their camels, livelihoods in Somali Region are extremely diversified. Most households engage in a number of income-generating activities, and most are active participants in markets, especially for tradable commodities. The livestock off-take system generates regular income, keeps capital flowing through the economy, and allows households to reconstitute their asset base after shocks. On the other hand, most livelihood activities are dependent on the natural resource base, and are therefore vulnerable to covariate shocks such as a drought, which undermines crop farming, livestock production, and agricultural labour and herding opportunities simultaneously.

Other livelihood activities that are not derived directly from the natural resource base depend on incomes of people who are natural resource dependent, and these livelihoods are vulnerable to 'derived destitution. Examples include service providers to pastoralists – barbers and hairdressers, musicians and poets, as well as traders. economic relationships is a source of strength but also a source of vulnerability, as any threat to one set of actors in the system can undermine the livelihoods of many others. A crucial feature of the Somali Region economy, easily overlooked by analyses that focus on pastoralism in isolation, is the interconnected nature of different livelihood activities. Capital flows occur around this system because pastoralists sell animals to traders and buy food produced by farmers and agro-pastoralists; relatives with jobs in urban centres invest in the rural economy; other relatives living abroad remit cash back to the region. This dynamic and complex set of economic relationships is a source of strength but also a source of vulnerability, as any threat to one set of actors in the system can undermine the livelihoods of many others.

On the other hand, people in this region – pastoralists, agro-pastoralists, farmers and traders – have suffered a series of livelihood shocks in recent years, some natural (droughts, livestock disease), others political (a crackdown on contraband trade, bans by Gulf states on livestock imports, violent conflict between sub-clans or between Ogaden National Liberation Front (ONLF) militia and the state). As a result of these multiple shocks, and because rainfall in the Horn of Africa has been low in recent years, questions are being asked about the sustainability of pastoralism as a livelihood system. The Government of Ethiopia, for instance, is now a day's advocating rural sedentarisation of pastoralists as one long-term option.

With regard to this study, four dominant livelihood systems are classified in the region:

1. Pastoralists engaged, primarily, in livestock rearing
2. Agro-pastoralists pursuing a mixed livelihood system, livestock herding and crop farming
3. Farmers leading a settled existence as producers of food crops for consumption as well as trade
4. Urban residents of small towns who earn a living through formal and informal employment

However, that these would be deceptive classifications if viewed as distinct from each other with each group deriving sustenance from the land it occupies with no help at all from the others. Instead, the economic system is to be viewed holistically as "a complex interconnected system" in which a system of social networks and political negotiations, where the sustainability or vulnerability of each livelihood depends as much on the individual's interpersonal relationships, and on international geopolitics, as on his or her assets and income at any point in time.

Ongoing studies in the region are reporting on the gradual shifts in way of life away from nomadic herding toward settled agriculture. Moreover, a recent research has showed that this shift is driven by multiple factors and results in a measured move away from the traditional nomadic pastoralist way of life towards a foundation of agro-pastoralist activities and sedentary farming. The jury is still out on the wisdom of such a transition given the finding that settled agriculturalists represented the group with the lowest income of the four economic groups listed above (livelihoods).

Farming in this Region is largely limited to the banks of the two permanent rivers – Dawa/Genale and Wabi Shebelle - running through the center and south of the region, as well as few Woredas in the north where rain-fed agricultures relies on seasonally occurring but unreliable rains. This suggests that significant challenges remain for settled agriculture in Somali as is evident in the following paragraph from the community cited above:

With no access to fertilizer, irrigation equipment, input credit or agricultural extension services, the prospects for farmers in Somali Region look unpromising, unless immediate actions are taken. In this context, and with most available arable land already allocated and under cultivation, it is difficult to see how much more sedentarisation of Somali pastoralists along the banks of major rivers can be achieved.

This study also identified four distinct water access systems

1. Privately owned berkads (constructed water reservoirs)
2. Shallow wells to access ground water
3. The Shabelle and Dawa/Ganale, water systems, also shared with animals at the risk of contamination.

4. Piped water in major urban centers such as Jigjiga and Gode towns that benefit from a relatively cheap and clean source of water throughout the year.

2.3.1.1The panacea of Drought – Part of the problem: The region has suffered a series of recent droughts and famines in 1999/2000 and in 2004 – described by some as the worst in recent memory - which led to numerous deaths both of humans and livestock. It also led to widespread poverty and displacement of many pastoralist families. Though it did not rise to the level of the "media famines" of the 1970s and 1980s, these rounds of draught and famine have also resulted in severe livelihood shocks. Some observers believe that the current sequence of low rainfall years constitutes a permanent decline in rainfall, and some are even predicting the end of pastoralism in the Horn of Africa.. The region's economic fortunes are also intertwined with and are affected by local, regional, and even international changes in economic circumstances which, for this region, are always changing, and in ways that are difficult to predict.

2.3.1.2 Markets and marketing corridors: The regional economy is closely linked to the economies of neighbouring countries – Somalia, Somaliland, Djibouti, Kenya and the Gulf States – and any disruption to the flow of cash, livestock and commodities, either within Somali Region or between the region and the world beyond its borders, constitute a major threat to many local livelihoods. different administrative and livelihood zones have their own main market towns. Most zonal capitals and district towns are important trading centres for surrounding villages/towns. However there are a number of important market towns which serve wider areas and serve as marketing hubs for livestock, food and non-food commodities. Through these corridors also come food stuffs – rice, wheat flour, pasta, sugar - new and second hand clothes, and all types of household items: the main commodities purchased. The main commodities sold by the pastoralists and agro - pastoralists are livestock and to a lesser extent livestock products (milk and ghee). Lack of demand for hides and skins and the region means these are hardly sold at all. Agro – pastoralists also sell cereals – mainly maize and sorghum. Sesame, onions, fodder, and fruits and vegetables grown along the riverine areas are sold to neighbouring markets.

Chapter III

3. Impacts of Climate Change on Somali Region's Economy

Although all pastoral regions in Ethiopia are highly prone to the adverse impacts of climate change, the problem is more prevalent in the north eastern lowlands of the country, Somali. Somali region is home to pastoral and agro-pastoral people who largely depend on livestock production for their livelihood. On the one hand, the ecology in the area is fragile with an increasing trend of natural resources degradation and on the other hand rainfall pattern is changing from time to time and temperature generally increasing. Such variability in the climate is exposing the people to the risks of several climate related disasters. Because of erratic and unreliable rainfall the people are exposed to drought and chronic food shortages, risks of flooding hazards, and conflict over increasingly scarce and fragile resources. With regard to this study, the climate change impacts are presented with regard to those projection and variations brought about by the changes in rainfall, temperature, floods and other major climate change exposures.

3.1 Patterns of the local Climate

3.1.1 Temperature variability and trends

There has been a general trend of atmospheric warming in Ethiopia. According to the National Meteorological Agency (NMA, 2007) the average minimum temperature in Ethiopia has been increasing by 0.37ºC per decade in the last sixty years. In the southern lowland regions of Borena, Guji and South Omo temperature has increased by 0.4ºC in per decade in the period 1950-2000 (Aklilu & Alebachew, 2009). Thus, compared to the national average as well as the highland regions in the country, the temperature increase in the lowland regions has been much faster with bigger implications. Temperature increases has been observed in the region throughout the last 50 years. These temperature increases has been rapid from july to September in every year. Cognizant to this, there has been observed an increment in the number of hot (sunny) days by 64 in every year, from 1960 (Said,A, 2010). Coupled with declining and unreliable patterns in the rainfall, increasing temperatures in the region has exacerbated the water and feed shortages, already existing, thus making the environment more and more vulnerable to increased aridity and degradations.

3.1.2 Rainfall variability and trends

A study by Grum (2010) involving Somali pastoralists around Dire Dawa has reviled that the actual length of the rainy season is getting shorter and shorter through time. Similar trend of declining length of rainy seasons is being reported in many other low land areas (ex. Adugna and Aster, 2007) and climate change is to be implicated in this regard. The frequency of drought is viewed as increasing particularly over the past two decades. Except in more dry years, changes in the seasonality, distribution and regularity of rainfall were more of a concern than the overall amount of rainfall. The main rainy season is also seen as becoming progressively shorter – it now starts later and finishes earlier than it used to be – and the rains in general are becoming more unpredictable.

3.1.3 Persistent and Prolonged Droughts

Of all the environmental and socio-economic shocks and stressors people are facing, drought is the most common in pastoral and agro-pastoral areas. The eastern lowlands of Ethiopia are vulnerable to drought and there have been notable droughts in this part of the country throughout human history (Webb & Braun 1994). Previous droughts and the frequency of rainfall deviation from the average suggest that drought occur every 3-5 and 6-8 years in the arid and semi-arid regions of Ethiopia and every 8-10 years for the whole country (Haile 1988). Many (including Haile, 1988; Funk et. al. 2005) believe that Ethiopian drought is caused by El Niño-Southern Oscillation (a coupled air and ocean phenomenon with global weather implications), along with sea surface temperature anomalies in the Southern Atlantic and Indian Oceans combined with anthropogenic activities affecting rainfall distribution and temperature conditions in Ethiopia by displacing and weakening the rain-producing air masses and raising surface temperature.

Drought has thus been widely recognized as a major climatic hazard and a key development and environmental challenge in the Somali Regional State of Ethiopia. If asked, Somali elders can easily make lists of major droughts over the past 30–50 years, with detailed accounts of the effects and implications. While opinions vary on the severity and frequency of drought in the historical past, recent reports and community opinions show that drought hazards have increased in frequency, intensity and magnitude over the recent decades and

have adversely impacted on food, feed and water security and the sustainable livelihoods of Somali pastoralists.

In Somali regional State, drought occur if the main rainy season (locally known as the karan season which fall from June to September) fail, and if both the Karan rainy season and the two short rainy seasons (Gu in December and Dhira from March to April) fail the resulting prolonged dry season can give rise to severe drought conditions. The Somali communities have seen more frequent and catastrophic droughts during the last ten years.

Livestock production is directly affected by drought through decreased pasture availability, leading to pasture shortage, overgrazing, and land degradation; decreased water availability, leading to water shortages and migration; decreased livestock disease resistance; decreased livestock productivity, in terms of milk and meat; emaciation and death of livestock and decreased livestock prices.

3.2 Environmental challenges facing Somali pastoralists

Pastoralism has historically been a sustainable livelihood option. However increased environmental stresses and changes in policies and practices, including restricting access to land and water, have increased the environmental impacts of pastoralism.

3.2.1 Overuse of water resources

Since many pastoral systems operate in dry lands, access to water is a limiting factor when determining herd sizes for many individuals and communities. As such, there is a high risk that competition for water may lead to overuse. This is especially true when considering the additional water needs of wildlife. In some drought prone areas of the region, for example, 58% of the water demand is met from groundwater in a district in which only 20% of the area has good groundwater potential (S.Ahmed, 2010). As such, in times of drought, there is insufficient supply to meet demand resulting in the drying of water-holes, the disruption of natural water flows, and siltation of pans.

3.2.2 Overgrazing

As a result of increased population and herd sizes and reduced land access due to factors such as degradation and conversion to other land uses, overgrazing has increasingly become an issue for the Somali pastoralists. The impacts of overgrazing include loss of vegetative cover and associated soil erosion in the most extreme cases, with negative impacts on wild

grassland species as well as inland waterways, which can suffer from sedimentation. In less severe cases, overgrazing can lead to a shift in the composition of grassland species with high nutritional value species becoming less predominant while less palatable plants increase in number. A study of pastoral systems in north of the region, for example, revealed that while overgrazing was not reducing biodiversity, it was changing the composition of the ecosystem (S.Ahmed, 2010)

3.2.3 Livestock – Wildlife conflicts

There are two main types of livestock–wildlife conflicts to consider in the region. The first is competition with other grazers for water and fodder, and the second is conflict with predators who feed on livestock. Conflict with other grazers tends to be most noticeable during periods of stress such as drought. During such periods it is common for pastoralists to move herds into protected areas in search of water and fodder, a prime example to be taken is the case of Gerale national park in and around Moyale & Hudat Woredas of Liban zone. In doing so, pastoralism comes into direct competition with wildlife. It is worth noting, however, that access to protected areas during times of drought can be vital to the survival of pastoralists' herds, and can therefore have a significant impact on pastoralists' livelihoods.

3.2.3 Positive environmental impacts

Despite the environmental challenges facing pastoral systems, pastoralists have traditionally managed dry lands sustainably and delivered a number of positive benefits for biodiversity. For example, in many cases, sustainable grazing practices actually increase species diversity and maintain ecosystem structures. Pastoralism can also contribute positively to the reduction of disasters such as fires, drought and flooding through the active management of vegetative cover.

3.3 Institutional & Social Impacts

3.3.1 Impacts on physical resources

Few physical resources are impacted by drought. However, it was mentioned in some communities in the region that the utility of traditional wells and ponds decreases due to reduced water levels, but that people take good care of them during drought times.

It was also mentioned that drought leads to cracking of ponds, which lowers their future carrying capacity.

3.3.2 Impacts on financial resources

The main financial resources upon which the Somali community depend include livestock and livestock products, crops/grains, savings, credit and cash. Because most of these are directly dependent on climate-sensitive natural resources, such as pasture land, farmland and forests, one could conclude that the Somali communities' financial resources are strongly impacted by drought.

As mentioned above, drought leads to decreased pasture and water availability, which in turn leads to livestock emaciation and death, reduced livestock productivity (in terms of milk and meat), reduced livestock disease resistance, more livestock being sold on the market, and lower livestock prices, thereby leading to weaker terms of trade and decreased household incomes. As stated by many communities in the sample area, income generated through livestock sales is no longer sufficient, compounding poverty, food insecurity, and pastoralist drop-outs. These in turn contributes to livelihood diversification to less risky – sensitive one.

All in all, it seems to be that diversification of financial resources and income generating activities is key to adapting to changing conditions, whether this means engaging in petty trade, sale of firewood and charcoal , construction and renting of houses, honey and alcohol sale, business creation and management, or learning to save money using financial institutions.

3.3.3. Impacts on human resources

Drought is also affecting human resources that are important to people's livelihoods, including education, health, human labor and various abilities/capabilities. Increased migration resulting from droughts and conflicts leads to increased school dropouts, a prime example is the one at a field work in Harshin woreda of Jigjiga zone. In addition, the decrease in food (mainly meat and milk) in times of drought affects human health (especially among children under 5 years, pregnant women and old people), reduces human disease resistance, human labour productivity, and human capability to undertake different activities such as learning in schools, bush clearing, blacksmithing, masonry, and business management.

Drought is however positively impacting broker/mediator activities (undertaken by young men to gain income) and capabilities, since larger numbers of livestock are sold during drought.

3.3.4 Impacts on social resources

Traditional asset redistribution systems are important social resources in Somali community. These social systems are meant to support poor households or those who have lost many assets due to hazards such as droughts, conflicts or diseases. In Shinile Zone, traditional social protection mechanisms include: **Zakat** - religious alms from wealthier relatives/clan/sub-clan

members usually provided to disadvantaged groups; **Irmaansi** - households providing milking animals to households with no lactating stocks across seasons; **Maal** - sharing of livestock during milking period; **Rai**- children from poor pastoralists herd for richer relatives and receive food and other benefits as payment; **Keyd** - adopting livestock offspring from richer households, sometimes on credit; and **Dhowrto** - surplus milk and butter is stored for distribution amongst poor households with no milking animals, especially during dry season (Jilaal).

These traditional systems demonstrate that dealing with hazards is not a new challenge in these communities. However, with droughts becoming more and more severe and frequent, these redistribution systems are becoming impracticable, as the number of people needing social support is increasing every year. The effectiveness and sustainability of traditional resource management systems are also threatened by increased drought frequency, due to abnormal mobility and exacerbated resources. Social associations, such as youth associations, inter-youth support groups, and women's income generating groups are also negatively affected by drought impacts. Increased migration and longer durations spent searching for water, livestock feed and food leaves little time for social activities and meetings. Drought also impacts savings and credit groups/cooperatives negatively, since incomes from livestock, livestock products, crops, and activities such as petty trading, are highly reduced. Government officials in Moyale District mentioned increased drop-out of members from saving and credit cooperatives due to recurrent droughts. Although affected by drought, all of these social resources are important to people's adaptive capacity, as will be explained in the next adaptive capacity to flow.

3.4 Impacts on Natural Resources

Importance of the Natural Resource for the Local Community

The populations in Somali region greatly depend on natural forest resources for their basic livelihood in many forms. The natural vegetation also support the main economy of the society, the livestock (camel, cattle, sheep and goats) which are depend by 90% of the society (Ahmed 1999). Forest based activities supplement substantial income and employment opportunities for the society. The natural dry land vegetation provides firewood, fodder, food, soil cover, non-timber forest products and modifies the microclimate. Well over 90% of the Somali people construct their houses from wood and

related forest products (CSA, 1998). Wood is the primary material used to make local household furniture (e.g. milk containers, water containers, troughs, spoons, plates etc.). The natural dry land vegetation provides firewood, fodder, food, soil cover, non-timber forest products and modifies the microclimate. Well over 90% of the Somali people construct their houses from wood and related forest products (CSA, 1998). Wood is the primary material used to make local household furniture (e.g. milk containers, water containers, troughs, spoons, plates etc.). The most significant place of trees in relation to livestock is a supply of fodder. Moreover, medication of people and livestock is heavily dependent on the indigenous tree and shrubs. In the region, the collection and marketing of the natural gum and incense, fuel wood collection, charcoal making and their sell also contributes substantial income to many poor in the rural areas of the region. Apart from these visible economic contributions of the woodland resources, there, are other services such as soil and water conservation, nutrient cycling, and nitrogen fixation and improvement of microclimate for people and livestock, wildlife habitat and biodiversity conservation.

Why for Conserving the Natural Resources?

Somali region is characterized by insufficient and variable annual rainfall and unpredictable variation in rainfall pattern within and between seasons. Another feature of the area is high temperature that hastens rate of evapo - transpiration of the limited moisture resources and restricting the type of vegetation to low woodlands, bush lands, and grasslands. Most parts of the region are known to be areas of high risk of desertification (Baumer, 1990). Desertification risks arise from the depletion and degradation of the vegetation cover of the region through livestock pressure beyond the carrying capacity of the rangelands combined with erratic rainfall, indiscriminate cutting of woodlands for construction, fuel wood and agricultural purposes by local inhabitants are some of the causes that have resulted in environmental degradation. Under the current rate of environmental degradation, combined with climate change unless measures are taken to reverse it, there is a high probability that desertification will creep into the area. Natural resource degradation is manifested in the form of weakening land productivity, wind erosion, increased bared lands, bellowing winds with huge dusts and associated

increased runoff, and reduced biodiversity, prone to desertification, caused by natural processes like run off and erosion, as well as human and livestock activity.

However, the rangeland bio-physical conditions such as vegetation cover, soil fertility, feed mass production and plant bio-diversity are degrading at an alarming rate, resulting in deteriorations in the range-livestock production systems and the pastoral livelihoods in the region,(Amaha Kassahun, 2008). Climate change will accelerate this decline, with more intense storms, higher run off rates, more erosion, declining productivity, and further depletion of groundwater. Simultaneously, the pressure on rangelands will increase, as human and animal populations and demand of livestock products increase-leading to further degradation. Furthermore, important plant species are disappearing from the rangelands with a successive replacement and encroachment by undesirable woody bush and weed species. Currently, a significant number of grass, shrub, bush and tree species of high feed, habitat and economic values for the livestock, wild animals and pastoralists of the Somali region respectively, are critically endangered or threatened leading to extinction. Moreover, important plant species are disappearing from the rangelands with a successive replacement and encroachment by undesirable woody bush and weed species. The bush encroachment problem is varying from zone to zone and from one site to another site in the region. In pure pastoralist rangelands native bush encroachments is the most emerging out of control, where species like *Acacia seyal* and *Acacia mellifera* are replacing the other most preferable and valuable species for both human and livestock, resulting in an imbalance of the grass: bush ratio, with decrease in biodiversity and increasing of undesirable woody species. On the other hands in the Agro-pastoral areas the invasive species like *Prosopis juliflora* are vastly spreading particularly in the river areas, while *Prosopis juliflora* is covering large suitable agricultural lands in both 32elafo and Dollo-Ado districts and expanding in to the rangelands. The Prosopis *juliflora* tree is fast growing and has capability to spread very fast through livestock who feed on it and then disperse the seed through their fieces. Due to its rapid expansion, *Prosopis juliflora* is the most serious invasive species in the region. It has been observed that, this species has occupied the very large agricultural land in the river banks at both *Qelafo* and *Dollo-Ado* districts and farmers use to pay a very high cost to clear it every season, the situation may be associated

with influences of environmental degradation, desertification and climate change challenging sustainability of the pastoral production systems in Somali region.

3.5 Impacts on Livestock Production & Rangeland Sector

The animal and range production sector in the Somali region is literally the most negatively affected livelihood system by climate change. Agriculture is termed a "primary" activity because it is the primary chain of production in terms of dependence on natural resources. Its very nature of primary dependence on natural resources and forces (such as climate) makes the agricultural sector the most exposed to impacts of climate change. The agricultural system in the Somali Regional system is literally livestock production exclusive and characterized by pastoralist production systems. Pastoral livestock production sub-sector is the most risk prone and highly influenced by climate change than any of the agricultural sectors.

The major manifestations of negative impact posed by climate change in livestock and range land management in the Somali region can be generally summarized as follows:

3.5.1 Replacement of palatable grazing species with woody and unpalatable once

A study by Grum (2010) involving Somali pastoralists around Dire Dawa has reviled that the actual length of the rainy season is getting shorter and shorter through time. Similar trend of declining length of rainy seasons is being reported in many other low land areas (ex. Adugna and Aster, 2007) and climate change is to be implicated in this regard.

This trend of shortening and patchy rain fall distribution has resulted in an alarming replacement of palatable and nutritional important grazing and browsing species with woody and unpalatable once. The "extinction" of most valuable grasses and their replacement by less important annuals was also reported in the work of Yvan and Tessema (2005) and had become a common phenomenon in most part of the Shinile zone.

3.5.2 Serious shortage of feed and water for livestock

Shortening of rainy seasons and associated replacement of valuable grazing species is worsening the already aggravated feed and water shortage in the area. Pastoral livestock production is characterized with absence of external imputes specifically feed. It entirely depends on utilization of natural range lands taking advantage of larger land-to-population ratio as compared to the densely populated crop-livestock mixed production system. Hence,

the escalating trend of feed and water shortage is endangering the collapse of the entire production system than just reducing its productivity.

3.5.3 Migration-related land degradation, increased mortality rates and unwanted livestock-sales (de-stocking)

Worsening feed and water shortage is rendering pastoralist in the region spent higher proportion of the year in migration. Migration has negative implications on rangeland ecology leading to sever rangeland degradation. Previous studies indicated that annually, 5 to 10 million hectares of land become unusable due to severe degradation. According to the forecast of (IFPRI 1995), 1.4 to 2.8 % of the existing agriculture, pasture and forestland will be lost by 2020 If such a trend continues.

Livestock herders and their animals are increasingly involved in tracking long distances in order to reach the appropriate watering points and livestock grazing areas, as a result many animals are being lost due to their poor body condition and disease attacks in the absence of good feed and many succumb to early deaths on their way to a better pasture and browse. Migration routes taken by Somali pastoralists usually include very distant cross-border migrations to, for example, Somali land and Djibouti. Such hyper-long distance tracking is associated with significant disease infections and sever mortality in the livestock population.

Several studies are continuing to reveal that pastoralist in the region are being forced to abandon their ancestral livelihood style (livestock production) due to threshold environmental stress. Many more are fleeing to urban and peri-urban areas leaving them exposed to urban unemployment and rendered unproductive and dependent. Even those determined to continue livestock production amid threshold environmental disaster are forced to sale (de-stock) larger proportion of their livestock to urban/peri-urban buyers usually at an inequitable and unfair price.

3.5.4 Increased animal diseases

Predictions indicate that climate change will result in warmer temperatures and increased humidity, which in turn will affect vegetation quality. These changes can influence arthropod survival and arthropod patterns. Of all changes associated to climate, the impact on

arthropods and its distribution is the most evident. Warmer temperatures result in increasing viral titters within vectors as well as vector survival from season to season and increase in biting frequency. Therefore, increases in temperature can result in changes in the number of vector generations and overall abundance of insect populations, which in turn can influence vector population dynamics and disease transmission. Many significant livestock diseases have insects (mosquitoes or ticks) as part of their transmission cycle.

The evident change in Rainfall patterns as a result of climate change can have a clear impact on the life cycle of pathogens and disease.

3.5.5 Indigenous Animal Genetic Resources are endangered to extinction

Traditional livestock production systems have for thousands of years sustained the conservation of indigenous livestock breeds which co-evolved with the production system itself. It is of current consensus in the area of Animal Genetics and Breeding that Indigenous Animal Genetic Resources are the results of both deliberate and non-deliberate manipulation of the gene pool by traditional livestock breeders specially pastoralists. The apparent threat posed by climate change on the preservation of the traditional pastoral livestock production system is alarmingly putting the Indigenous Animal Genetic Resources in a real and urgent danger of extinction.

Local communities in pastoral systems have benefited from the multipurpose and highly adaptable indigenous farm animal genetic resources they developed over millennia (LPPS and Koehler, 2005). These genetic resources have sustained their keepers' livelihood through their abilities to utilize otherwise wasted resources, cope with difficult environments and resist diseases.

Many of these indigenous livestock genetic resources are now threatened due, for example, to replacement and abandonment. Maintenance of livestock genetic diversity is mandated by the Convention on Biological Diversity (CBD), which calls for the conservation of agro biodiversity in the environment that have nurtured and shaped it.

3.6 Impacts on the Resource base (ecosystem)

3.6.1 Bush encroachment

The trend of shortening and patchy rain fall distribution has resulted in an alarming replacement of palatable and nutritional important grazing and browsing species with woody and unpalatable once. The "extinction" of most valuable grasses and their replacement by less important annuals was also reported in the work of Yvan and Tessema (2005) and had become a common phenomenon in most part of the Shinile zone.

Bush encroachment is the invasion of aggressive and undesired thorny and woody species resulting in an imbalance of the grass-bush ratio and a decrease in biodiversity and the carrying capacity. It causes severe economic and ecological losses for pastoral communities in Somali Region. Previous studies and official reports from the regional administration offices in the Somali Regional State confirm that bush encroachment is the most important factor hampering sustainable livestock production, food security and improved livelihoods. Accordingly, the problem is becoming a threat to feed and food security in the area.

The main feed resources used for livestock feeding in the region are natural pastures (herbaceous vegetation composed mainly of grasses and forbs and browses (shrubs, tree leaves and pods). Although different grass species are valued as the most important species in terms of palatability and enhancing high milk and butter production of cattle when they are consumed, in many parts of the Somali region, *Prosopis julifiora* (locally called *woyan*e *zaf*) infestation is so dominant that almost all other plants are suppressed and do not grow anymore. *Prosopis* tends to form dense impenetrable thicket. Hence, livestock are not able to graze underneath and have difficulties in movement and accessing the river water.

3.6.2 Range land degradation

Significant climatic variability continues to be a common phenomenon in the northeastern lowlands of Ethiopia including the Somali Region. Frequent and persistent droughts, unpredictable and variable rainfall and temperatures are considered normal climatic conditions, especially in the arid and semi arid pastoral lands. Ecosystems within rangelands are characterized by low-stature vegetation because of temperature and moisture restrictions. Vegetation tends to be sparse but the sparse grass/herbaceous cover is efficiently harvested by grazers and in many cases, episodic fires are important for providing new and lush growth for grazers. However, recent changes in the climate system have brought about rapid changes which have affected natural resources, as well as the cultures and life styles of the pastoralists in the lowland regions. The rangelands, which constitute a major renewable resource in a highly vulnerable, diverse and difficult environment, have been most affected by these changes.

Rangeland degradation is the most serious challenge for pastoral livelihood in Somali Region. Major reduction in the quantity and nutritional quality of the vegetation available for grazing in the rangelands as well as expansion of localized deserts and barren areas were reported. Reported causes of degradation include climatic conditions causing drought and arid conditions and human factors leading to the overuse of natural resources. The effects of climate change and human pressures on the soil include a depletion of soil nutrients, with a decline in water retention, which ultimately causes a breakdown in soil structure and inability of some local breeds (known grass and seed varieties) to cope with such changes.

The pattern of such changes in the Somali Regional State and within the five administrative zones in the region varies from place to place with the seasonality and variability of the climate system, the movements and concentration of grazing animals, with seasonal conditions and with the varying vulnerability of the land itself. In some locations such as those in Amibara and Gewane Weredas, where years of drought induced overgrazing and hence led to important land degradation, infestation with prosopis julifiora has a strong negative impact on grazing availability. Generally, the continuing or accelerating course of rangeland degradation in the Somali Regional state shows common features, including:

- Deterioration in the quantity, quality and persistence of native pastures, generally associated with a diminution of plant cover, but also with invasion by shrubs of low pastoral value; frequently unpalatable and of little economic value or practical use;

- Structural changes in the plant cover, notably the loss of shrubs and trees, partly through browsing, but also through gathering of fuel wood and clearing and burning for opportunistic farming;

- Changes in soil surface conditions, notably compaction through trampling by livestock, leading to deterioration in soil - plant - water relationships and reduced germination rate, particularly of the palatable species;

- Additional processes of sand drift siltation, leading to further destruction of the vegetation and commonly to deterioration of surface and shallow groundwater supplies.

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3.7 Impacts on the Water Sector

Water is the essential prerequisite for human life, environmental integrity, social well – being and economic activity. Its value is well appreciated in rural and semi nomadic communities where the inhabitants experience the frequent hardship of fetching water from long distance or driving their cattle for several days to water points.

Such situations are even worse in several zones of the Somali region where the climatic condition is arid and characterized by unreliable and erratic rainfalls. There are very few perennial rivers flowing in the region and ground water source in most parts of the area is relatively deeper than in other regions of the country. In some parts of Ogaden, for instance, wells will have to be drilled to about 300 mm below the ground surface to strike ground water. In some zones of the region, camels will have to be driven for over two days in search of water.

This lack of adequate rainfall and its uneven distribution over the area has long been and still is a serious constraint to normal development activities in the region. As a consequence, the inhabitants become dependent on relief aid and their cattle die of thirst especially during drought periods.

This, therefore, indicates the magnitude of the water problem in the area and the strong need for the formulation of sustainable water resources development projects. In view of the spatial and temporal variations of the rainfall and the small quantity of annual rainfall over the region, formation of sustainable projects is quite apparent.

Meanwhile, the hydrologic features of the Somali region are mainly influenced by the amount and distribution of rainfall. Other factors such as strong wind, high temperature, long duration of sunshine hours and humidity strongly affect evapo – transpiration and thus giving rise to a deficit in water balance. This in turn adversely affects soil moisture content and no surplus water becomes available for vegetation growth and crop requirement in most of the area.

Therefore, special attention should be given to determine the most appropriate and the economical practices of water development and conservation in the region.

There is, now, widespread acceptance that climate change is occurring, but still extensive uncertainty as to how climate change will manifest itself in terms of impact to specific regions. Projections indicate there will be increases in total precipitation in the northern hemisphere (in which Somali region is located), but the increase will not be uniform. While the Intergovernmental Panel on Climate Change (IPCC 2001) is predicting an increase of 1.5 to 4.5 degree Celsius in global mean temperature, and an expectation that this change will create an increase in global mean precipitation by 3 to 15%, IPCC is also predicting that there will be extended periods of drought. As a consequence, it is expected there will be growing frequencies of high intensity precipitation events. The consequence of increased frequencies of high intensity precipitation events will influence the performance capabilities of Somali region municipal infrastructures.

3.7.1 Impacts on Precipitation (Rainfall)

Climate change impacts in precipitation and temperatures will also affects Somali region water resources in terms of quantity and quality (frequency of floods and droughts, run off

regimes, and groundwater recharge). There will be change in soil regimes (e.g. soil erosion, crop damage, loss of organic matter that changes the soil water holding capacity, implications to soil cracking and runoff patterns, increased soil desiccation with changes, infiltration pattern, etc.) including implications for ground water recharge, and subsequently, availability of water for supply systems relying upon ground water as their source. In the context of urban infrastructure, changes in precipitation intensities may also greatly influence the performance of the infrastructure. Hence, the implications of climate change on precipitation patterns are pervasive, influencing virtually all dimensions of water related considerations.

Climate change, water, and poverty are intimately intertwined in Somali region because climate change will manifest itself primarily through variation in the availability of water. Lack of clean, fresh water is one of the primary reasons for adverse health outcomes. Water-borne diseases such as diarrhea, typhoid, and cholera, increase infant and child mortality as well morbidity and mortality among the adults. Lack of water also impairs general hygiene and contributes to spreading of other contagious diseases (Caimcross,2003; Johnstone et. Al 2002). The other main contributor to adverse health outcomes – malnutrition – is tied to the availability of water for cultivation and livestock rearing and the time needed for collecting water for human consumption. As health and nutrition are important preconditions for the capacity to work and to generate income (Fogel, 1994; Szreter, 1997), their lack is also a reason for poverty. Poverty, ill health and malnutrition are also sources of vulnerability to climate change because they reduce the capacity of households to adapt to changing climate and climate change impacts (Paavola, 2006).

3.7.2 Climate Change Vs Flood

Increased water flows contribute to floods which adversely affect human settlements and health. Reductions in water flow will impact the use of water for power generation, irrigation, and public water supply. Increased evaporation and reduced rainfall may also affect the ground water.

Floods will become more frequent especially in the low lands of the region. This will result in the destruction of infrastructures, buildings, belongings especially in the floods plains. The history of the Wabi Shebelle is marked by frequent destructive flooding. The Shebelle is said to have flooded every other year prior to the 1960s. That decade had two devastating floods,

the ***HIDIGSAYLEY*** *in 1965, and the* ***SOOGUDUD*** in 1966. In the 1970s, the most devastating flood was the ***KABAHAY*** of 1978. In 1996, floods devastated three woredas in Ethiopia. In 1999, the river unexpectedly flooded in the middle of the night, destroying homes and crops in 14 kebeles of Kelafo woreda, as well as 29 kebeles in neighboring Mustahil woreda. Two more recent floods were the ***DAWDLE*** in 2003, and the flood of 2005.

Droughts will impact all settlements requiring more time for water collection and resulting in reduced water use (Johnstone et. Al 2002). This will impair hygiene and contribute to the spreading of contagious diseases (Caimcross 2003). Flooding of pit latrines pollutes wells and surface water with human wastes and increases the incidence of water- borne diseases such as diarrhea, typhoid, and cholera. Warming, flooding and increase drain fall also increase the spread and incidence of many insect-borne diseases such as malaria. Predicted climate changes will impact on human health through other pathways as well.

3.7.3 Local Level Perceptions Related to Climate Change and its Impacts on water

Local communities have identified changes in temperature, rainfall, soil moisture, river discharge and humidity as relevant indicators of climate change. Respondents across the Jigjiga, K/bayah, Harshin & Ayshi'a communities identified an increase in temperature, leading to changing agro-ecological characteristics, drying and disappearance of fodder species as indicators. In terms of changes in rainfall, respondents identified an increase in seasonality in the rainfall pattern, which includes changes in timing, intensity and duration of rainfall. Both were identified as contributing to decreased soil moisture content, which in turn has resulted in early wilting of seedlings and disappearance of fodder species. In relation to humidity, perceptions across study sites indicate that the air is getting dryer. Respondents highlighted that there has been an increase in the frequency of floods and droughts.

3.7.4 Impacts of CC on the Economic use of water

In both the pastoral and agro-pastoral communities of Jigjiga (rural farming and agro-pastoral community), k/Bayah (agro-pastoral), Harshin (pure pastoral) & Ayshi'a (pastoral) districts, climate change has negatively impacted on the physical, financial and natural assets of

communities. Amongst pastoral communities, the change in water availability, in terms of timing and amount, and increases in temperature, has impacted on the rangeland and on livestock watering points. These changes, along with other risks, have resulted in a decline in the herd size per household in all livestock types and a change in herd composition. A root cause analysis indicates that the major reasons for the observed trend are lack of fodder and livestock water availability and increasing incidence of livestock diseases. Looking at its positive side, it is good that pastoralists are resorting to more drought resistant animals. On its negative side, however, concentrating on few livestock types as opposed to a diversified herd may have negative consequences when it comes to other vulnerabilities like market failure or livestock diseases.

In the agricultural livelihood study sites, the dominant food crops include sorghum and maize and the dominant cash crops include vegetables and chat. According to respondents, CC has potentially contributed to a change in the pattern of crop production. A shift from producing highland crops like wheat to lowland crops like sorghum is reported, as well as a shift to more drought-resistant and early maturing crops like chat, tomato, and the likes. Also, a shift towards single cropping as compared to double-cropping is observed.

3.7.5 Impacts of CC on the Domestic use of Water

Domestic sources of water in the study sites include deep and hand dug wells, irrigation canals, and developed and undeveloped springs. Increased variability in rainfall (delayed rainfall and reduced rainfall amounts) has resulted in decreased spring discharge and increased algal content in water bodies. In times of water stress, communities tend to de-prioritise sanitation concerns, which have knock-on impacts on education and health. Women and children also spend more time to collect water.

3.8 Impacts on the Education Sector

Pastoralist communities across the region are facing similar climate - initiative problems of accessing education services. These are partly because of their high mobility – which is in turn in search of feed and pasture - together with the low population density of arid areas.

This presents evidence of poor education outcomes in some of the regional districts of which the literacy rates are as following

Districts	**Cross literacy** *%*	**Literacy rate** *%*
Pastoralist	12.0	13.7
Gashamo	7.6	09.9
Shilabo	17.2	19.0
Shinile	10.7	13.0
Agro-pastoral	11.3	11.4
Kebribayah	09.2	08.1
Dhobaweyn	8.3	11.8
Charati	15.9	14.3
Farming	10.4	12.5
Jigjiga rural	12.4	15.4
Kelafo	09.0	10.6
Dollo ado	10.0	12.1
Urban	49.5	49.9
Jigjiga town	55.0	47.6
Gode	44.7	52.8
Total	**18.2**	**19.2**

Source: Regional Education Bureau

The prevalence of illiteracy is not significantly different between district that are dominated by pastoralists (12 percent literacy), agro-pastoralists (11 percent) and farmers (10 percent). Factors explain that the inadequate provision of education facilities to the pastoralists of the region goes back to the fact that, the largest group of the Somali community are the pastoralists who are mobile people and in turn searching feed and pasture – a prime indicator of how shortage of rainfall can cause severe events. Besides the literacy rate, school drop outs have been observing in large parts of the mobile pastoralists. When the times of shortage of water for both domestic use and livestock drinking are in there, children are usually set in place of searching for water and eventually walking longer distance, and hence dalliance of school hours is observed. During sunny days in which the temperature is high enough to

cause lower human activities, girls in particular are obliged not to go school – since girls are far weaker than boys in the pastoral areas of the region.

In general, The Somali pastoral communities had very less access to education at present; very few schools are being constructed in the different districts and villages but due to scattered settlement of the communities on the vast areas of the region, being a pastoralist community moving here and there, primarily in search of the ever decreasing water and pasture for their livestock, and because of the need for child labour, has let the school enrolment rates very low as well as gender disparity - education system.

Impacts on Health Sector

Human Health

Increased human health problems are already being experienced due to high temperatures, increased dust from stronger winds over barren lands, and drinking water scarcity.

Given the predictions that it will get hotter and dryer during some seasons in the region, sanitation-related and vector-transmitted diseases could change in distribution, range, prevalence, incidence and seasonality. Similarly, higher temperatures and increased rainfall intensity may lead to flash floods that result in more water-borne diseases in the region. However, there remain high uncertainties regarding the impacts of future climate change on diseases.

Increased food insecurity and malnutrition is likely to decrease human disease resistance and human labour productivity and increase human deaths, unless health services, which are currently very poor in the region, are improved in the coming years.

Human Nutrition

As droughts are becoming more frequent in the region, pasture and water scarcity is leading to low conception rates and poor health of lactating animals. This has an adverse implication on the availability of milk and milk products for home consumption. Higher temperatures and increased rainfall unpredictability, combined with increasing land degradation and bush encroachment, will result in increased food insecurity and nutritional deficits, unless

pastoralists switch to better adapted livestock species. However, poor households, who are the most prone to food insecurity and malnutrition, usually do not have the financial capacity to modify their herd composition.

Similarly, rain-fed crop production might become more and more challenging with the predicted increase in temperatures and reduced ***Gu*** and ***Karan*** rains. According to the IPCC projections for Africa, agricultural production and access to food is projected to be severely compromised by climate variability and change; there is an expected decrease in the area suitable for agriculture, length of growing seasons and yield potential, particularly along margins of semi-arid and arid areas; and in some countries, yields from rain-fed agriculture could decrease by up to 50% by 2020 (IPCC, 2007).

The anticipated changes in agro-ecological conditions and increases in extreme events (such as extreme heat, droughts and floods) might increase food assistance needs. However, both formal and informal assistance systems may not be able to sustain an increasing number of people in need.

Climate change impacts on key financial resources might also reduce households' capacity to purchase staple foods such as sorghum, milk, sugar and tea, leading to increased malnutrition especially among children and infants.

Chapter IV

4. Vulnerability Analysis & Identification of Vulnerable Sectors in Somali Region

According to the Intergovernmental Panel on Climate Change (IPCC), a region's vulnerability to climate change depends on its adaptive capacity, sensitivity, and exposure to changing climatic patterns. Vulnerability is a function of:

- ✓ The magnitude, character and rate of climate change
- ✓ The sensitivity of the system, i.e. the degree to which the system is adversely or beneficially affected by climate-related stimuli
- ✓ The adaptive capacity of the system, i.e. the system's ability to adjust to climate change, to moderate or cope with the impacts, and to take advantages of the opportunities (IPCC, 2001).

Adaptive capacity describes the ability of a system to adjust to actual or expected climate impacts or to cope with the consequences of climate change. Sensitivity is the degree to which a system is affected—whether positively or negatively—by extreme weather conditions and associated climatic variations. Exposure refers to the degree to which a system is exposed to climate change and the nature of the climate stimulus. The indicators chosen to reflect adaptive capacity include household wealth, access to and use of technology, availability of infrastructure and institutions, potential for irrigation, and literacy rates. Wealth enables communities to absorb and recover from losses more quickly. The livestock owned (number of heads), key assets owned (radios, refrigerators, and so on), and quality of residential homes are commonly used as indicators of wealth in rural African communities. Proximity to agricultural input supplies is identified as an indicator of technology. For instance, drought tolerant or early maturing varieties of crops generally require access to complementary inputs, such as fertilizers and pesticides. Well-developed institutions and infrastructure also play important roles in adapting to climate change by facilitating access to resources. For instance, all-weather roads facilitate the distribution of necessary inputs to farmers and increase access to markets. Health services enable the provision of preventive treatments for diseases associated with climatic change, such as malaria, and the availability of microfinance supports the adoption of technology packages. Irrigation potential and literacy rates are important factors contributing to adaptive capacity. Locations with more

potentially irrigable land can adapt to climate change through improved water control. Regions with a higher literacy rate—a proxy for the level of education—are considered to have greater adaptive capacity. Generally, increased frequency of droughts and floods negatively affects agricultural production, demonstrating agriculture's sensitivity to climate change. Finally, a region's exposure to climate change is represented by the predicted change in temperature and rainfall by 2050.

Underlying drivers of vulnerability in Somali Region

Somali communities oftentimes mutually-reinforcing, environmental, social and political issues that have implications for their vulnerability and adaptive capacity. These underlying drivers of vulnerability include:

1. **Environmental degradation**: Increasing deforestation rates, pasture and farmland degradation, as well as desertification are important drivers of vulnerability in the region. The arid and semi arid lands of the region have been degraded over several decades. Recurrent drought, increased felling of trees for firewood, charcoal production and livestock feed (especially during drought), overgrazing, agricultural expansion and inappropriate agricultural practices have led to increased soil erosion, lower quality of pasture and farmland, bush encroachment, and the likes.

   Climate change impacts and copping strategies contribute to further environmental degradation. For example, the increased frequency of droughts do not give rangelands enough time to recover, leaving large areas bare, thus susceptible to soil erosion by wind and water. Some of the coping strategies employed by communities, such as cutting more trees to produce charcoal and firewood for sale further contribute to environmental degradation, and reduces their resilience to climate change as resources become scarcer.

   Furthermore, areas with relatively better rainfall quantities tend to have high concentrations of human and livestock populations. Overgrazing and soil trampling can cause severe land degradation, especially if populations remain in the same areas over prolonged durations, as is the case when conflicts and agricultural expansion limit livestock movement.

2. **Population pressures**: Increasing human populations and their corresponding livelihood demands are currently exceeding the availability of natural resources in the region.

Population growth in the region can be attributed to various factors, including in-migration and settlement of agricultural practitioners in rangelands, pastoralists fleeing conflicts in other areas, as well as natural population growth. FEWS NET (2009) also recognizes rapid population growth as one of the factors exacerbating food insecurity in Ethiopia. Pastoral and agro-pastoral communities in the region are particularly vulnerable to population pressures.

3. **Conflicts**: Unsettled internal boundary conflicts are a serious impediment to pastoral livelihoods. Conflicts restrict mobility, lead to destruction of assets, and reduces the capacity of pastoral communities to deal with climate variability and change.

4. **Social and gender inequalities**: Most resources are exclusively controlled by older men / male elders. Women and youth rarely have a say in decision-making over resources, which limits their capacity to implement adaptation strategies. In addition, the only source of cash available to women in many communities is the cash arising from women groups' income generating activities. This creates poor intra-household income distribution, disfavoring women. Also, women's direct and indirect contribution towards livestock production and household incomes is seldom recognized.

Women and children are often less mobile compared to men. Consequently, when the worst effects of drought hit the area, women and children suffer much more due to scarcity of food, water, medicine etc., since they are left to fend for themselves while men migrate further afield in search of pasture and water.

Also, girls-boys school enrolment ratio significantly favours males, creating imbalanced education levels and access to income opportunities. Ethiopian women have on average 57% fewer years of schooling and illiteracy rates hover at just over 70% for Ethiopian women nationally (FEWS NET, 2009).

5. **Inadequate off-farm employment opportunities and skills**: Pastoral and agro-pastoral communities in the region have limited education, skills, and opportunities to engage in alternative and sustainable off-farm income generating activities.

6. **Poor access to infrastructure, resources and services**: Many pastoral and agro-pastoral communities in the region have very limited access to markets, financial resources (such as credit and savings), information (on weather projections, climate change and markets), technology, education and health services. Pastoral communities in Ethiopia are often being marginalized and generally have a lower access to infrastructure, resources and services than highland communities. Apart from the main roads linking major towns and borders, many of the other roads are in poor condition. This hinders access to social services and infrastructure, such as health facilities, veterinary centers, schools and markets. With few resources at their disposal and limited access to quality social services, pastoral communities tend to be very vulnerable when hazards occur. For example, during the onset of drought, pastoralists are often unable to quickly transport livestock to major distant markets for sale. They are also unable to access pasture and water due to limited mobility. When livestock and human diseases break out, the appropriate medical attention and medication are not readily accessible. This results in reduced quality of livestock and increased mortality (some which could have been prevented).

7. **Inadequate government policies, capacities and coordination:** Government policies, especially related to land tenure, internal borders, investment, trade and markets, limit the options of pastoralist communities. As mentioned earlier, unclear internal borders limit movement and increase inter- clan conflicts. In addition, modern day national policies and development plans on livestock have mainly focused on improving livestock production and not the lives of pastoralists (as a significant group of livestock producers). Ranching and sedentarisation have been promoted over nomadic pastoralism and transhumance. In addition, pastoralists have not been well integrated into the national economy. Development efforts, projects and infrastructure are often targeted at other regions, thereby marginalizing pastoralists. Policies that restrict cross border trade have further disadvantaged pastoralists. For example, the ban on livestock exports to the Gulf States imposed on Ethiopia in 1998 and 2000 following the Rift Valley Fever outbreak, denied Somali pastoralists access to international markets and caused heavy income losses. This coupled with unfavorable market conditions, including low prices for livestock domestically, contributed to increased poverty and deterioration of pastoralists' welfare.

In addition, there seems to be a lack of capacity, coordination and information sharing between different governmental agencies on weather and climate change issues. Government officials at every level sometimes mention their lack of access to meteorological and climate change

information, their lack of basic climate change knowledge, the absence of climate change considerations in policy making and implementation, their lack of awareness of and involvement in the formulation and implementation of the Ethiopian National Adaptation Programme of Action (NAPA), and the lack of human and financial resources to implement adaptation strategies in the region.

8. **Deteriorating role of traditional social institutions:** Modern governance systems do not recognize and appreciate the role of traditional social institutions. Furthermore, traditional institutions – such as *Kaalmo, Jiisin, and Zkaat* – are being stretched and undermined by more poverty, drought, and conflicts, which are increasing the number of community members requiring assistance. The deterioration of these support systems fosters vulnerability to climate change impacts, since affected community members may not recover from losses incurred due to adverse impacts of changing climatic conditions.

Major Vulnerable Sector in the region

Water Sector

Water is the basic life for all living things. The accessibility of water in a determined area is related to the environment where it is located and the development of social services and infrastructure of same area. Water availability for people, domestic animals and crop production is the most usual limiting factor in the pastoral and agro pastoral communities of the region, which reflects the recent reduction of rainfall. This also leads directly to food shortages which limit all other possible developmental activities of respected areas.

According to the Central Statistics Authority of Ethiopia report in 2005, Somali region has the lowest access to drinkable water 38.8% of any region in Ethiopia. Similarly, the examined water sources in the survey districts are not safe for human drinking unless purified. The mainstream population of countryside, villages and towns are directly or indirectly dependent on the Genale, Dawa and Web rivers, whose water qualities have been described too poor for human consumption with medium salinity and low alkalinity. Nomads and sometimes inhabitants of remote small villages come to carry their daily needed water as far as 30

kilometres from the rivers and water spring areas. Equally, the water from distantly located wells and other water points in some villages are often located far from the grazing and residential areas and are non potable. The results of water shortage are human and animal thirst and suffering, food shortages and continuous migration from one place to another etc. on the other hand; these shortages in water for both drinking and crop production are directly proportional to changes in rainfall patterns, both in terms of intensity and duration. Any changes in water level, either the rainfall or the ground water table, will lead to shortage of water for either drinking for livestock and/or humans or for irrigation purposes. In general, we can conclude that water sector is highly sensitive to changes in rainfall which in turn contributes to change in climate.

Agriculture Sector - Livestock & Crop production

After water shortages, food shortages are the second biggest problem when it comes to sensitivity to the changing climate. For a combination of different reasons, the best part of the pastoralists and farmers can only produce enough food for three months of each year. All remaining months of the year, they are dependent on foods shared by relatives, loans from others or food aid distributed by concerned bodies like government, WFP, NGO's atc.

During the dry season "Jilaal", many families and their animals in the sample area are suffering from food shortages if they do not receive supplementary food from somewhere else. The causes of food shortages are usually related to the limitations of land and land resources, such as water shortage, low livestock production and low crop production – and in turn which all contribute to climate change. Poverty, famine, starving people and animals, malnutrition and environmental degradation as well as the food aid dependency are the common results of food shortages easily seen in those sample areas, especially during the drought and flood seasons.

On the other hand, amongst livestock species in Jigjiga community, cattle and sheep are especially vulnerable. Goats and camels are more drought-tolerant and less affected by pasture degradation and bush encroachment (since they are browsers rather than grazers). There used to be very few in Shinile, but now camels are increasing in numbers, although most are owned by richer households.

Crops grown by agro-pastoral communities are also affected by drought. The main crops grown in the agro-pastoral areas are teff, maize, sorghum and beans. Agro-pastoral areas are characterized by the failing of crops during drought/dry years and some are even questioning the suitability of agriculture in view of changing climatic conditions, i.e. decreasing rainfall predictability, shorter rainy seasons, increasing drought frequency and increased rainfall intensity. As stated by one farmer in Billa Kebele, Erer woreda of Shinile Zone: "Since 2005, rains have been erratic, and when they come they are too much and they destroy our crops."

On the other hand, pastoralists are slowly introducing and expanding farming activities to support themselves in times of drought. People are expanding agricultural activities to cope with drought, but the land and rainfall in some parts of the region are not suitable for agriculture, so it is a risky strategy because its highly sensitive to changes in rainfall patterns.

There seems to be some disagreement concerning whether pastoralism or agro-pastoralism is better adapted to the changing climatic conditions, and the answer to this question seems to be greatly dependent on seasonal circumstances, location, and the types of livestock and crops grown. Local actors suggested that although agriculture can be successful for 2-3 years, it often accelerates land degradation, making the land unsuitable for both crop and grass growth after a few years of cultivation.

Rangeland Production System

Beside the grazing and browsing of domestic and wild animals, rangelands produce commercially used incense and gums famous in the region districts. However, the natural vegetation is facing different problems caused by changing climate – practically by the declining rainfall duration and intensity, higher and extreme temperatures and increasing human and animal population. Any changes to these variables can lead to over all change to the whole system of food chain in the region, and hence more sensitive to those changes. Visible results of these problems on natural rangelands are

- Lack of enough rainfall to regenerate
- Cutting of wild plants for fuel wood, fence and building materials
- Overgrazing caused by increased number of livestock
- Clearing rangelands for crop production and residential purposes
- Massive land, soil & vegetation degradation

- Increased wind & water erosions in some areas
- Over production of incense and gum

Health sector

Temperature and rainfall variability will have serious impacts on human health and public safety. Increase in mean temperatures will lead to infestation of disease vectors especially Mosquitoes. Incidences of water borne diseases are expected to increase on account of flooding. Severe drought episodes will lead to increased food and nutritional insecurity exposing to health problems. Community conflicts driven by competition for scarce water and pasture resources will increase risk of health and safety.

Climate change is expected to exacerbate the occurrence and intensity of future disease outbreaks and perhaps increase the spread of diseases in some areas. It is known that climate variability and extreme weather events, such as high temperatures and intense rainfall events, are critical factors in initiating malaria epidemics. Other key determinants of malaria risk include drug resistance, human migration and immune status, vector or disease-control programmes, and local land-use changes. Climatic changes, mediated through changes in crop and livestock practices, could also influence the distribution and impact of several diseases such as malaria across most systems and schistosomiasis in irrigated systems.

Climate change is bound to have further impacts on heat-related mortality and morbidity and on the incidence of climate-sensitive infectious diseases, and these may be considerable. While climate change impacts may have few direct impacts on other diseases such as HIV/AIDS, climate variability impacts on food production and nutrition can affect susceptibility to HIV/AIDS as well as to other diseases. Changing disease burdens are bound to add considerably to the development problems caused by successive natural disasters and emergence from conflict, associated with low levels of adaptive capacity.

Major challenges faced are the relative weakness in disease surveillance and reporting systems, which hampers the detection and control of epidemics, this very fact makes it difficult to obtain the long-term linked data sets on climate and disease that are necessary for the development of early warning systems.

In general, access to health services in Somali pastoral communities is lower compared to other regions in the country. Many health centers and health posts have been constructed in the last few years. But lack of electricity, laboratory and other facilities, shortage of appropriate health staff and budget are major problems hindering provision of adequate health services. Moreover, the health service is constrained by poor awareness of the society in making use of the health services.

The following factors will increase vulnerability in health and public safety.

- Inadequate health services especially in areas which are far from main roads
- Inadequate infrastructure.
- Poverty especially among rural communities.
- Lack of alternative means of income especially in marginal areas.
- Inadequate public awareness of disease risks.
- Widely practiced harmful traditional practices

Education sector

The Somali pastoral communities had very less access to education. At present, schools are being constructed in the different weredas and kebeles but due to scattered settlement of the communities on a vast area, and because of the need for child labor for herding, the school enrollment rate is still low.

In general, the low literacy level of the pastoral community could be due to the following factors:

- Lack of access to schools at vicinity of the pastoral communities;
- Lack of awareness of the importance of education particularly of girls;
- The need for child labor for herding and domestic chore;
- Lack of alternative basic education or non-formal schools;
- Lack of appropriate schools such as mobile schools to educate the children;

- Shortage of food is a critical problem reducing enrollment and increase school dropouts;
- Early and mandatory marriage of girls;
- Lack of access to water and health services around the schools;

Therefore, addressing the above issues would promote school enrolment in the pastoral communities. Construction of permanent schools in each community supplemented with mobile schools in the communities would improve the literacy rate in the pastoral communities. On top of the above concerns, climate change enhances the instability of pastoral communities which in turn affects school enrollment and access.

Social services and infrastructure

Poor social services and rural infrastructure are the other major problem in relation to climate change sensitivity. Formal and informal education services, general public awareness, health centres, rural roads and bridges to access the resources and markets are very limited. The existing social services and infrastructure are usually concentrated in the big urban centres. These under-development conditions of the area are also contributing to the main problems of food and water shortages. The results of poor social services and rural infrastructure are low social development, high level of deaths from curable diseases, increased common diseases, high level of illiteracy, low child school enrolment, low price of local products and poor accessibility to resources, markets and social services. Higher temperature brings to collapse bridges, buildings, dams, irrigation canals, reservoirs, telecommunication facilities, electricity tolls, etc. On the other hand, the Somali communities are mostly pastoral societies whom are moving from one place to another in search of better life – mostly feed and water. The later in turn is totally responsive and sensitive to any changes brought by the changing climate.

Social Structures and Interactions

The practice of herd and family splitting is becoming more and more common among pastoralists. During dry seasons, the herd is divided into smaller groups. Sheep, as well as milking and weak animals stay with the core family (mothers, children and older men) near

villages, while hardier animals (i.e. camels, cattle, goats) are driven further afield by young men in search of water and pasture. In recent years, prolonged droughts and their impacts on pasture and water availability has led to splitting of families for longer periods due to longer and farther migration in search of pasture and water.

With droughts becoming more and more frequent, pastoralist drop-out is increasing, leading to the migration of men to nearby towns in search of wage labour. Based on future climate change projections, rural-urban migration is likely to increase, with potentially serious impacts on urban development, food security and poverty.

Informal assistance or asset redistribution mechanisms in the region's pastoral communities are already reported to be on the decline due to increasing number of households in need of assistance. With the projected increase in the frequency of extreme weather events, asset losses and the number of people in need are likely to continue to increase, making these social protection mechanisms ineffective. Similarly, increasing resource scarcity and mobility are leading to the breakdown of traditional resource management systems in the region. This loss of governance capacity is contributing to the degradation of natural resources.

Finally, in recent years increasing frequency and intensity of droughts has put further stress on resource availability, leading to more frequent and violent conflicts between and within ethnic groups (although limited resources are not the only driver of conflicts in the region). Conflicts disrupt development activities, education, and migration, limit access to markets, and destroy assets that are crucial to deal with droughts and other extreme events. The impact of future climate change on conflicts will greatly depend on changes in water and pasture availability and on the establishment and/or support of conflict-resolution mechanisms, especially in relation to internal border issues.

Markets and Terms of Trade

Increased rainfall variability and heavy precipitation events, prolonged droughts, extreme heat and increased land degradation will likely reduce crop yields, decreasing the availability of crops on the market and increasing crop prices. Conversely, decreased pasture availability and livestock quality in times of drought will result in more livestock being brought to the market and sold at reduced prices. These market conditions in times of drought (i.e. increased

grain prices and decreased livestock prices) will further weaken the terms of trade for pastoralists, leading to reduced household incomes and increased poverty.

Less directly, more conflicts over scarce resources may also reduce market access for pastoralists, limiting their capacity to sell-off their livestock quickly at the beginning of a drought or buy food when their livestock or crop production fails.

Biodiversity

In Somali, overgrazing and deforestation contributes to reduction of ground cover and accelerates erosion processes. Further threats to indigenous trees such as *Accacia nilotica*, *Accasia tortilis* are also posed by the high dependency on fuel wood and charcoal. Moreover, important grass species and wild food species, are either pushed to extinction or are in a very short supply (IEA, 2002).

Temperature increase with reduced precipitation will result in reduction of livestock reproduction and breed loss that may lead to genetic erosion of important adaptation traits. Increases in the frequency of droughts, floods and disease epidemics will increase the risk of losing entire breeds and populations that have a limited geographic distribution. Climate change is also expected to create additional challenges, such as new diseases, indicating the use of genetic diversity will become more important in future breeding improvement programs. With increased urbanization the magnitude of tree cutting for house construction and fire wood is increasing in the region.

Energy

In people's daily lives, energy provides essential services for cooking and heating, lighting, food production and storage, education and health services, industrial production, and transportation. However, in poorer, mainly rural and peri-urban communities obtaining energy for basic human needs are a daily challenge. In those areas, wood, biomass and agricultural wastes provide most of the energy that is available, and there is little access to electricity or modern fuels for cooking, heating, mechanized equipment. Without access to efficient and affordable energy sources, they have very limited opportunities for economic and social advancement. Expanded energy sources are needed in rural areas to provide:

mechanical power for agriculture, water pumping and irrigation; modern fuels for cooking and heating; and electricity for lighting, refrigeration, communication, and community services.

The rural areas in the region are most affected by no access to electricity because they are very dependent on environmental resources for their livelihoods, people in the region are particularly vulnerable to the depletion of natural resources, and the impacts of climate change.

Nearly all-rural and urban households in Somali use firewood and charcoal for cooking. Dependence on biomass can promote the removal of vegetation. The absence of efficient and affordable energy services can also result in a number of other impacts including health impacts associated with the carrying of fuel wood, indoor pollution and other hazards. Further challenges from urbanization, rising energy demands and volatile oil prices further compound energy issues.

The potential for increased frequency and intensity of extreme high-speed wind and lightning events may cause significant damage to electricity transmission infrastructure and services. Transmission lines and structures while extreme rainfall events may flood power substations. These could potentially generate significant increases in the cost of power supply and infrastructure maintenance from increased frequency and length of power blackouts and disruption of services. Extreme heat wave events are likely to increase in frequency, generating an increase in the peak demand for electricity for air conditioning in urban areas. At the same time, efficiency of the transmission is likely to be reduced due to the impact of likely higher summer temperatures on transmission line conductivity.

Chapter V

Adaptive Capacity of the Somali Environment to Changes

The adaptive capacity of a community is its ability to adjust to climate change, to moderate or cope with the impacts, and to take advantage of the opportunities. Adaptive capacity is often determined by a range of factors, processes and structures such as income, literacy, institutional capacity, social networks, as well as access to information, markets, technology, and services, (IPCC 2007). Because the availability of these resources and services is limited in the region, the region's adaptive capacity in the face of climate change is correspondingly low compared to other regions of the country. In the following sections, this document reflects all aspects of adaptive capacity of the different sectors of economic pillars, i.e. the agriculture, water, health, energy & education. In addition to, it will be given due emphasis the adaptive capacity of the other resources of the community like of the social resources, physical resources, financial resources, etc.

Agriculture Status: Potential Occupation

The majority of the population of the Somali region bases its livelihood on livestock rearing. However, there are a significant number of agro-pastoralists and sedentary agriculturalists. To support the agricultural sector, the regional Bureau has 2667 development agents (DAs) constituting in animal husbandry, plant science, animal health assistants, animal health technicians, small scale irrigation cooperatives, and natural resource - at the woreda level Livestock, Crop and Natural resource Offices has, 190 animal health assistance (out of which zero are Doctors of veterinary medicine at woreda level)[1],705 animal health technicians, 603 plant science professionals, 487 natural resource professionals, cooperative section has 110 professionals and livestock production /animal science 552 professionals, and there are 20 small scale irrigation professionals are giving services. With regard to these figures, one can conclude that according to the area of the region and the existing number of related professionals is far away from each other. Therefore, the need to strengthen the region's capacity in terms of professional man power is to be addressed.

In the case of animal health care, the region has 286 health posts, 17 specialized Doctors of veterinary medicine, 603 animal health technicians. Jigjiga University, established in 2007 in the capital city of the region is currently actively engaged in mitigating skilled man-power

shortage in the area of animal health through its Faculty of Veterinary Medicine. The University has so far graduated xxx meat inspection technicians and xxx animal health technicians through its special short term and refresher programs for target trainees from the Somali region Livestock, Crop and Rural Development Bureau.

On the other hand, unlike the most regions of the country, the Somali region is primarily characterised by livestock production and to some extent subsistence farming. The majority of the vast areas of the region are residing by rural pastoralists who are engaged in livestock and livestock product trading. It's known that the income generated by those pastoralists is not usually reflected by the GDP of the country. However, if invested properly and accounted, it's assumed to generate an income worth of billions of dollars annually. Besides the economics of livestock who is, in one way or the other, cash inflows, the economics of agriculture, in much of the world historically and in much of the world today, is the economics of subsistence. It's about the effort of rural people who try to obtain the food necessary for survival from limited (and uncertain) resources such as soil, water, etc. It's known that out of the total population, the poor ones are the far most leading category who involve in agriculture. And when coming to Somali region, it's with no difference. Communities who are running out agricultural activities are ones known to be nomadic. It's also those communities who are hit the most and the hardest when it comes to climate change. However, there is one common issue that one should have to agree - Somali region locates at the heart of highly fragmented horn Africa region. The majority of the nearby regions, having with an international border, are recognized as food aid dependant – categorized under the ***sum of food beggars.*** The south part of the independent Somalia is highly fragmented, clan based – lines are the dominant type of self administration. The transitional federal government (TFG) is very week to cover the demand of its people both in terms of their survival and in terms of their security. Traditional and powerful militia men are controlled by the vast land of the southern part. No investments from the government side can be seen as such to encourage livelihood improvement and hence the dependency of aid from the likes of world food program (WFP), especially food & medicine, are ever increasing. Unlike the southern part which is characterized by elaborated clan-based conflict, the northern part of Somalia is relatively stable with self – declared interior government. Though hierarchy of a specific government requirements are kept constant, however, the government

is so weak as such it cannot meet the required demands of its people nor it can generate large scale investments to attract the foreign direct investment (FDI). Usually people living in this part of the country depend upon exported items, from household utensils, food, medicine, etc.. to luxurious cars, cash, and the likes. The north-eastern part of Somali region is located by the Republic of Djibouti - a very small country with over 1 million populations. Investments on agriculture are not seen so far as the government's policy, more or less, discourages the agriculture led-economy. The south western part of the region is resided by Kenya – similar agro-ecological and livelihood context with that of the Liban zone of the region.

On the other hand, with the availability of vast and fertile land, suitable policy and the necessary physical and financial resources, the Somali region can provide the minimum requirements from agriculture – both food and non-food items – to the greater horn of Africa. Meanwhile, it's also recognised that the current trends of the global climate, the possibility of becoming food-basket is to be re-scheduled to the extent of the damage brought by the changing climate and the existing possible adaptation strategies. In addition to this, the current sedentarisation program, approximately 99 thousand households (1/8 of the total population of the region) alongside the river banks of Shebelle Dawa and Genale, undergoing in the region can be taken as a prime example. This, of course, is intended to bring the potential resources of the region in to practice with the help of the principle of comparative advantage – just for a while - and encouraging self – reliance in the short run and leading to market oriented production system in the long run.

Physical Land Resource for Crop Production

For the purpose of physical land resource assessment for crop production, the 1994 FAO study results were used to define the LGP for the Somali Region. In addition, climatic data from a number of stations were complemented to highlight site variations in rainfall pattern, temperature regime and the LGP across the region. There are only few areas in the Somali Region that have relatively highest rainfall which are concentrated in Jigjiga zone. In these areas the mean annual rainfall ranges from 700 to 900 mm. More than 95% of the region's land mass stretching south, south-east and southwest of the Jigjiga zone receive a mean annual rainfall of less than 700 mm (Shinile, Degahabur, Warder, Korahe, Gode, Fiq, Afder and Liben zones).

The Somali Region can be divided into three broad categories based upon a broad range of the mean temperature during the growing period. These are the southern, southeastern and northern parts of the region which includes Shinile, Liben, Afder, Gode and Warder zones. These areas are characterized by two temperature ranges, i.e. those with mean temperature exceeding 27.5^{o}c during the growing period and those that have mean temperatures ranging from 25.1^{o}c to 27.5^{o}c during the growing period. The second one is the central part of the region which includes Degahabur and parts of the Korahe zones. In these areas the mean temperature during the growing period ranges from 22.6^{o}c to 25^{o}c. The third is the north central part of the region which covers the Jigjiga zone. The mean temperature during the growing period in the area ranges from 20.1^{o}c to 22.5^{o}c. Moisture availability is an important control on the development of crops and vegetation. The length of growing period refers to a part of the year during which the moisture supply from precipitation and soil water storage and the temperature are adequate for crop growth. The Somali Region exhibit two growing periods; normal and intermediate growing periods. About 84% of the region exhibit intermediate growing period ranging from 0 to 75 days and the balance exhibit normal growing period.

Analysis of the slope map of the region shows the existence of four major and broad land form types that occur in the region. These are level to gently undulating plains, rolling plain to hilly, slightly to severely dissected mountains and river gorges. As far as topographic feature is concerned, about 87% of the region's area fall within flat to undulating plain.With respect to land use and land cover, grazing and browsing is the major single land use category covering about 44% of the total area of the region. Woodland, bushland and shrubland category constitute the second largest land use category covering about 31.4% of the total area of the region. Crop land area is insignificant occupying only 1.4% of the total land mass of the region.

There is significant variation in the coverage of the various major kinds of land use in the different zone of the region owing to variation in climate, terrain and population pressure.

Almost all cultivated land (cropped land) of the region occurs in Jigjiga zone owing to population and climatic factors. With the exception of the Shinile zone, grazing and browsing land use category covers more than 35% of the total area of each zone. Significant proportion of dense bush vegetation resources of the region are found in Warder, Afder and Korahe zones. Shinile and Afder zones consists of significant proportions of unutilzable land, about 41% and 38% of the total area of the region in each of the zones. The predominant land cover in this land unit is exposed sand and soil surfaces.In order to broadly identify areas that are suitable for rainfed crop production, moisture regime, defined by average LGP, land slope, soil depth, soil drainage, and surface stonniness and/or rockiness were used as the major physical land resource criteria. By eliminating areas with an average LPG of less than 60 days as not suitable, about 26 landscape units (LSU) and 92 significant land faces (SLF) in Jigjiga zone, 8 LSU & 29 SLF in Liben zone, 9 SLU & 28 SLF in Afder Zone, and 17 SLU & 46 SLF in Shinile zones are classified as broadly suitable for rainfed crop production. The remaining five zones of the region are not suitable for rainfed annual crop production due to moisture constraints.

As per the above classification, a total area of 29,360,100 ha. of land or about 92% of the total land mass of the region is unsuitable for rainfed annual crop production due to severe moisture constraint. The total area of land that is agro-climatically suitable for rainfed annual crop production is estimated to be 2,663,900 ha. Constituting about 8% of the total land mass of the region. However, out of this about 1,371,200 ha. or about 5% is unsuitable for crop production due to steep slope, soil depth limitation or combination of both.

4.1.2.Crop Production Potential

The land mass of the Somali Region is said to be made of 3% mountainous, 15% undulating, 2% gorage and 80% flat plain areas. The altitude ranges from 400 masl in the southeast to about 1000 masl in the north. There are also some high grounds in the form of mountains and hills that may attain 1,600 masl. The region is said to have two generalized major climatic zones, viz hot arid and semi-arid climatic zones. About 60-80% of the region falls within hot arid climate with mean annual temperatures of about 23^{o}c to 30^{o}c and a mean annual rainfall of less than 200 mm. The hot semi-arid climate occupies areas adjacent to the high grounds of the eastern plateau. This zone is said to have a mean annual temperatures of

about 18°c to 27°c and mean annual rainfall of 400 - 800 mm. The rainfall is said to be highly variable and evaporation usually exceeds the rainfall.The Somali Region can be divided into six agro-ecological zones. These are:-

- Hot to warm arid lowland plains (A1),
- Tepid to cool and mid highlands (A2),
- Hot to warm sub-moist lowlands (Sm1),
- Tepid to cool sub-moist mid highlands (Sm2)
- Hot to warm moist lowlands (m1), and
- Tepid to cool mid highlands (m2).

The Somali Region has a bimodal pattern of rainfall regime and hence practices two cropping seasons, *GU* and *Deyr*. The relatively long rainy season, *GU* and the short rainy season *Deyr* pertaining to the lowland part of the Ogaden basin while the highland parts of the region, Jigjiga and its surroundings have *GU* and *Kiremt* as their cropping seasons. Farmers in all parts of the region are said to invariably practice intercropping and also practice double cropping during any given year using the two prevailing cropping seasons as well as the flood occurring twice during a year. Crop rotation and fallowing are not known and practiced in the region. As far as agricultural inputs are concerned, the Somali Region is one of the lowest userof improved seed, fertilizers, pesticides, herbicides and fungicides in the country. Crop husbandry is generally poor and backward. Land preparation, planting/seeding, weeding, harvesting and thrusting, and storage are done following very backward traditional practice. Even the uses of common animal power, oxen which is abundantly available in the region, for land preparation is not recognized and used by most farmers in the region.

The Somali Region has a large tract of cultivable area of which very small is currently under cultivation. Based on the available gross data, including irrigated areas, the overall cropping intensity of the region for the 1998 crop season is calculated to be about 0.03 showing the fact that only about 3.0% of the total cultivable area was cropped during the crop season. Extension and credit services are far from adequate and most of the woredas visited during

the field work complained that they do not have development agents. The Development Bank of Ethiopia, that provides farm credit has no any office in the Somali Region. Somali is a pastoral region which accommodates the nomadic and semi-nomadic pastoral systems on arid and semi-arid lowlands that constitute very fragile eco-systems with very harsh dry and high temperature. However, such mutual relationship does not exist in its real sense in the region for the crop reproduction system in most cases is very traditional using only primitive farm handtools for crop cultivation while the draft animals, which are infect plenty, stay idle.

The region has four major rivers, *Wabi Shebelle*, *Genale, Dawa* and *Weyib* which carry large amount of water throughout the year. The region has also high underground water potential.Sorghum and maize are the two staple food crops invariably cultivated by all farmers in the region, whether lowland or highland. Other lowland crops such as sesame, groundnut, cotton and fruits like papaya, mango and some citrus are grown in scattered manner. Highland crops such as millet, teff, wheat and barley are cultivated along with some highland fruits by highland farmers in some parts of Jigjiga, Shinile, Liben and Afder zones. About 70% of the rural population of the Somali Region are predominately pastoralists. The remaining rural population are agro-pastoralist (18%) practicing both livestock rearing and crop production, and pure crop producers (12%) depending on the production of the different crops. As far as role of women in agricultural production is concerned, rural women in the region are reported to fully participate in almost all of the major farming operations at different levels as elsewhere in the country. They play major role in planting, weeding and harvesting but leading role in threshing and storing. They are also responsible for all domestic activities such as food preparation for the whole family, fetching of firewood and water for domestic use, child care, construction and erection of residential houses. Due to various reasons, the Somali Region is not able to exploit some of its moderate agricultural resources to sustain its population requirement for food. The major constraints to agricultural production in the region are related to environmental, agronomic, economic, technological, institutional and infrastructure factors.

It is estimated that more than 90% of the population in the region are pastorals and solely depend and obtain their income from livestock. However, the agro-climatic condition of the

region can allow to diversify agricultural products by growing a variety of food crops that are adaptable to the agro-ecological zones of the region either under irrigation or rainfed. The major crops that can be grown in the region include the following:-

- Cereal crops (maize, sorghum, millet and wheat),
- Oil crops (groundnut, seasame & castor oil),
- Pulses (pigeon pea, chick pea and mung bean),
- Industrial crops (cotton, sugar cane, tobacco, sisal and kenaf),
- Vegetables and fruits (green bean, sweet potato, muskmelon, asparagus, banana, papaya and grapes),
- Flowers,
- Insecticide plants,
- Agroforestry.

Potential Livestock Resources

The region has large number of livestock that makes it one of the riches in livestock resources with the highest per capita holding in the country. The livestock sector provides draft power and organic fertilizer (manure) to enhance crop production and the crop production sector provides feed for the livestock in the form of grain, silage, straw, chaff and stubble. Livestock is a very important and critically required resource for the well being of the Somali society. The main species reared in the region include cattle, sheep, goats, equine and camels. There are three district types of livestock production system based on the prevailing climatic conditions of the rangeland in the region. These are crop based mixed farming system; livestock based mixed farming system and pastoralism. There is no reliable data on the livestock population of the region. According to the estimate made by the socio-economic survey conducted as part of this study, the total population of livestock in the region is about 6,874,000 TLU, out of which cattle constitute about 44%, camel (30%), sheep (13%), goats (12%). The average density of cattle per km^2 of total area is about 11.7 which ranges from 4.9/km^2 in Warder zone to 22.4/km^2 in Jigjiga zone.

Cattle are the most important livestock species in the region by their dual product of milk and meat. Small ruminants are the next most important animals that produce food and generate income. Camels play significant role as a source of milk, meat and cash reserves. Livestock mortality rate is very high owing to such factors as shortage of feed and water during the dry and drought periods, diseases, plant poisoning etc. The prime feed resources available to the livestock in the region are natural vegetation. The contribution of crop residues and aftermath grazing of cropped lands are negligible. The overall sources of feed are not sufficient to support the livestock population found in the region at least during parts of the dry season.

The main source of water for livestock and people are ephemeral ponds, perennial and seasonal rivers, seasonal streams, shallow wells and cistern. Ponds and seasonal streams are mostly used in the rainy seasons, wells and cistern during the dry period. Most of these sources are empty at the time of extended dry period or recurrent drought. As a result the pastoralists are often forced to migrate with their animals to the place of perennial rivers or even across the boarder to neighbouring countries. The Somali Region has chronic natural and man-made obstacles in the livestock sector. The major constraints are related to absence of appropriate livestock policies, nutritional stress, diseases, poor husbandry practices, absence of database, lack of marketing infrastructure and etc. In order to surmount these and related constraints, it is suggested to strengthen the trained manpower basis of the region, improve feed supply and establish pastoral training centre.

Livestock Diseases and Veterinary Services

In the course of the field work, efforts were made to assess the structural set-up of veterinary services, manpower distribution, common animal diseases and diseases control practices. The major livestock diseases identified in the Somali Region include viral, bacterial, protozoa and parasitic diseases. It is noticed that almost all the veterinary services are provided by the South East Rangeland Development (SERP). The project has established veterinary clinics in many woredas and assigned professionals and sub-professionals in various woredas and has provided with some drugs and equipment. However, sustainable veterinary services are not provided due to insufficient supply of veterinary drugs supplies and equipment.

The establishment of veterinary clinics in woredas where they are available, the strengthening of already existing clinics, the encouragement of essential drug manufacturing firms, establishment of drug and equipment importing companies and veterinary pharmacies in collaboration with investors is recommended to enable constant supplies.The training of local youth as veterinary professionals and sub-professionals and assigning them in veterinary laboratories and clinics and the proper utilization of pastoralist animal health auxiliaries (PAHAs) are recommended to solve the manpower shortage in this field.

Potential Forest Resources

The Somali Region is endowed with natural resources including bio-diversity which is rich in species of plants and animals. Of all the flora in Ethiopia, 25% are represented in the region and 18% of these are endemic to the region and 135 plant families, 626 genera and species of plants are recorded in the region. There are also a number of mammals, birds, reptiles, amphibians which are adopted to the arid and semi-arid conditions of the region. The region is known to have the potential for natural gum and incense yielding tree species that are dominant in *Liben, Fiq* and *Afder* zones as well as *Gode* and *Korahe* zones. The wild animals which are known to exist in the region include lion, hyena, leopard, fox, hunting dog, crocodile, oryx, zebra, baboon, giraffe ostrich, hippopotamus, monkey and a variety of birds.

The main climax vegetation classes in the region are:-

- *Acacia - bussel* open woodland,
- *Acacia - commiphora* bushland,
- Ever-green/semi-ever-green scrubland,
- Semi-desert *Acacia bussel* scrab land, and
- Riparian forests.

Presently the forest resources of the region are used as fodder for livestock, source of bio-

fuels, construction materials, traditional medicines and source of natural gum, incense and myrrh. Despite their importance for local economies and the livelihood of the people, the forest resources of the region are neglected. The major constraints are related to policy, management and low awareness of the general public. Hence, in order to make better use of the forest resource of the region it is recommended to encourage private investors in the sector, involve the local people, introduce reforestation strategies and conduct appropriate research in the sector. SRS is known for its non-wood forest products (NWFPs), especially gum and incense. Gum Arabic, resin from soft-wooded species, myrrh and incense (*Commiphora* spp; *Boswellia* spp). Several industrially significant chemical products that can be obtained by different extraction methods, now made available to the market. Potential production is estimated at 1.3 million tons of gum, 0.366 million tons of myrrh, and 0.67 million tons of incense annually (Tarekegn and Mulugeta, 1997).

Rangeland Resources of the Region

Woodlands and bushlands are the dominant forest resources. These constitute various groups of thorn-less and thorny bushes and shrubs, native *Acacias*, *Commiphora*, *Boswellia* and other tree and shrub species. The vegetation varies from relatively dense in the upper parts through scattered shrub-land with sparse to dense grass ground cover along the fringe of the highland, and to barren lands in the southeastern corner of the Region (Heluf, *et.al., 2000).* There are species of grasses typical to the arid and semi-arid climates that are the major source of livestock feed. *Acacia-Commiphora* woodlands are known to be with the highest number of endemic species that contain families with high species diversity in Ethiopia. According to Barkhadle (1999), the number of individual endemic species is estimated at 800 out of 1600 plant species found in the Region, which represents 25% of the country's total flora. There is one small herbarium at Jijiga SERP (South East Rangeland Project) branch office consisting 8000 specimens. According to Reusing (1998) natural high forests do not exist in the Region, though Friis (1992) reports that there are some in the western parts that are closer to the highland areas. Plantation forests *per se* do not exist in the Region.

Agricultural Marketing

Marketing of agricultural products is analyzed by considering the situation in each zone of the region. As per the findings of the field visit, marketing of various agricultural products such as grains, live animals, hides and skins, honey, fruits and vegetables, forest products are practiced in the region to a varying degree. Observation of the data collected on prices of the products revealed the existence of price fluctuation.Factors such as food availability situation in the neighbouring Somalia Republic, and distribution of relief food at the refugee centers have significant impact on the supply and prices of grain in the area.

With respect to livestock marketing, the import ban by Saudi Arabia (for the fear of the rift valley fever) disruption of livestock purchase by the Ethiopian Livestock Marketing Enterprise seem to play great role in reducing the demand for livestock. Absence of resting places, the poor communication system coupled with lack of trucks to transport the animals is the major constraints to live animal trade. With respect to other agricultural products, the export market to the neighbouring countries is not yet exploited and hence expansion of the various agricultural commodities cannot be hampered by lack of marketing outlet in the future. As far as grain marketing is concerned, the Somali Region is not surplus producing and consequently possibility of its supplying grain to other regions is very remote at the moment. However, to encourage flow of grain into the region, an enabling environment should be created to encourage private grain dealers. This include removal of *kella* charges, easing the procedure of license issuance and strengthening the extension system to give technical and managerial assistance in warehouse management.The Erer Woreda has a high potential for fruits and vegetables production under irrigation. In this regard the markets of Dire Dawa and the export market of Djibouti can still absorb increased production. The Liben Zone has a high potential for the production of natural gum and different incenses. However, the marketing of these products has not been developed starting from harvesting upto sales. Hence, concerned Bureaus need to organize strong extension system staffed with trained personnel who follow-up and demonstrate to those involved in the collection the best way of harvesting and selling including the organization of service co-operatives.

Livestock marketing centers in the region are not well organized and lack basic facilities. The extent of illegal livestock trade in the region is of an alarming proportion. In order to promote livestock trade in the region, there should be regulations which involve, among others, the establishment and maintenance of organized livestock markets and slaughter facilities and collection of levies on these services as well as regulations which pertain to livestock movement and mode of its transport.

Table 1: Summary of Agriculture Potential of the Region

S/N	Sector Component	Status (Total)
1	**Livestock Population**	**23,641,000**
	A - Camels	2,032,000
	B – Cattle	3,796,000
	C – Goats	8,547,000
	D – Sheep	9,053,000
	E – Equines	213,000
2	**Production**	
	A – Legumes	8500 Tonnes
	B – Vegetables	55,500 Tonnes
	C – Fruits	66,550 Tonnes
	D – Oil Crops	29,960 Tonnes
3	**Animal Health Services**	
	A - No of Animal Health Facilities	
	I - Animal Health Posts	286
	II - Animal Health Clinics	32

	B – Livestock Population/Clinic	738,781
	C – Livestock Population/AHP	82,660

Source: SR, BoFED, Population & Development Report, Volume I, Issue I. February, 2010.

5.3 Mineral Resources Potential of the Region

Various exploration works conducted in the past revealed the existence of various major and minor mineral occurrences in the Somali Region. The major mineral occurrences and deposits identified in the region include salt, gold, feldspar, mica and natural gas. There are also minor occurrences such as graphite, kaolin, magnetite, talc, phosphoric and gemstone. Major salt occurrences are identified in three localities of the region, viz. Afder, Boji-dol and El-dere. Minor occurrences are also reported at Dolo-Odo, Melka-Softu, Sede and Kenere localities in Liben and Afder zones. Most of the occurrences are in brine form.The geological favourability for primary gold deposit coupled with eluvial, deluvial and alluvial placer gold mining by local inhabitants attracted the attention of many geologists to the Moyale area. Apart from the potential resources of primary gold in Moyale area, there is a potential of places gold along the banks and steam beds on the eastern side of Moyale within a radius of 15-50 km. between Haramsam and Dukisso localities.

The major feldspar occurrences in the Somali Region are known at Shebelle area, near Bombas and Babile towns. The shebelle pegmatite lenses are a good quality quartz-orthoclase type which are suitable for high quality glass and bottle manufacturing. Mica occurrences are known at Shebelle and caravan areas. Investigation conducted in these localities revealed that the mica is poor in quality and low ingrade. However, it can be utilized in paper industry as mica powder.The Somali National Regional State is the greates oil and gas resource suspect area in Ethiopia owing to the existence of the required rock source for oil and gas prospectivity and large sedimentary basin called the Ogaden Basin. The Calub Gas Share Company has been established to utilize the Calub Gas for fertilizer (Urea & NH_3), electrical generation and production of petroleum products and other chemicals. The Calub Gas reserve is estimated at about 271 TCF or 76 Bm^3.The Somali Region is also endowed with other several mineral occurrences which could be utilized for various industrial application. This includes graphite, kaolin, talc, phosphate etc. Which are

hosted within the meta - sedimentary sequence of upper protozoic age. There are also wide occurrence of construction raw materials in the Somali Region particularly in Korahe, Liben and Shinile Zones. The association of different geological formations with various geological environment in the region indicates the existence of other potential areas for construction raw materials. In this study an effort was made to prioritize the most attractive mineral deposits with possible outcome and benefits of the mineral resources based on the degree of exploration undertaken, the reserve and quality of the deposit, possible market areas to be served, type of industries to be developed and the ultimate use of the minerals resources.

4.6.Energy Resources

The Somali Region is endowed with various energy, resources such as natural gas, hydropower, solar, wind and biomass resources. Petroleum exploration activities in the Ogaden basin were carried out by a number of international companies during the last 38 years and it is found to be prospective for petroleum. Among the exploratory and development wells drived, the Calub area is ready for development to produce the gas condensate.The major basins in Somali Region such as the Ogaden depression and the Wabi Shebelle River basins have tremendous potential for hydropower generation. The estimated dependable potential of these basins is 6974 GWH/Y which is roughly about 3.47% of the country's potential. It is estimated that some 738 MW could be generated by harnessing the Wabi Shebelle River. Wind energy can be one of the main energy sources in the Somali Region. Although most of the zones in the region have high wind energy, there is no energy source that depends on wind speed in the Somali Region.The Somali Region has also abundant solar energy potential. The solar radiation potential in the region is estimated to be 5500 to 6000 wh/m^2. Hence the introduction and application of solar photo-voltaic (Pv) technology can play vital role to meet the energy requirement in the area. Biomass is the major energy source currently used in the region for cooking and other purposes. Since most of the population in the region have no experience in the use of agri-residues and dung as energy sources, they mostly depend on woody biomass energy.

5.5 Water Resources Sector

Rainfall in the Somali Region has been assessed and evaluated based on measured daily data collected by the Meteorological Authority for the period 1980 – 2009 for the stations Errer, Hurso, Jijiga, Harshin, Dgahabur, Kebridehar and Gode.

Analyzing the data, an average of 390 mm of rainfall for the observed period and covered areas were observed. The number of rainy days per year in the region is 39 in average. Annual maximum precipitation events average 53 mm with the highest recorded daily value being recorded as 138 mm.

Analysis of changes in precipitation and temperatures over the years with available measurements show a slight trend of increasing temperatures with enlarging spread between minimum and maximum daily temperatures, decreasing rainfall (-1%), increase in the number of rainy days (+9%) and decrease in the maximum intensity of rainfall events (-8%). While the overall decrease in rainfall with 1% is very small, the distribution of rainfall over more rainy days and subsequent lowering if the amount of rain falling in the single events is leading to more pronounced implications in the regional water balance. Qualitatively, evaporation increases while runoff as well as percolation and ground water recharge decrease. The increasing temperatures further add to increasing evaporation. The temperature observations are in line with the IPCC climate change predictions for the Horn of Africa region while for rainfall and ground water recharge the IPCC states that average values are likely to increase.

For practical purposes, the Somali region can be divided in to four basins of which the eastern Ogaden is virtually devoid of perennial streams.

The four basins are: -

- The eastern Ogaden Basin;
- The Wabi Shebelle basin;
- The Genale-Dawa Basin; and
- Part of the Awash River Basin.

5.5.1 Wabishabele River Basin

The mean annual rainfall of the basin goes from 1000 mm of in the highlands to about 150mm of at Ferfer and Mustahil in the lowlands. The overall annual mean rainfall for the entire Wabi Shebelle as worked out by WAPCOS is 425mm.

Annual potential evapo-transpiration, however, behaves in a reverse mode/condition and thus increasing in the lowlands (1800mm.) and decreasing in the highlands (800mm.).

According to Orstom (1972), the Ogaden basin, which includes most of the Wabi Shebelle catchment have five main ground water potential areas of the following:

- The Kebridehar limestones which form confined ground water aquifer below the main gypsum;
- The Mustahil limestone;
- The Wabi Shebelle alluvial deposits;
- The Fafen and Jerer alluvial deposits; and
- The alluvial deposits of local intermitent tributaries.

The main gypsum formation, which lies in the southern part of the region most frequently, contains salty water bodies. In general, it is the alluvial sediments along both sides of streams, which are considered to be good aquifers of moderate yield and better quality. Therefore, shallow ground water development should concentrate in these areas. In some areas with gypsum influence, the quality of the water can be of inferior quality.

In the town of Gode, the salinity of the ground water is so high that surface water is more preferably used for water supply purposes. It is in the head water areas that ground water of better quality can be obtained.

With respect to irrigation, Orstom (1992) identified 260,000 hectares of land considered to be suitable for irrigation. However, the amount of water available is about 92m^3/sec.

Depending on the extent of future development, options for additional regulatory reservoirs are suggested (BCEOM, 1973). One of these ideas is to build a major dam at Kuldash. This is supposed to provide a controlled discharge of up to 73.5 l/s; and it would be possible to irrigate a maximum of 75,000 hectares.

5.5.2 Eastern Ogaden Basin

The eastern Ogaden basin occupies a large tract of flat land with virtually insignificant drainage system. Only a limited amount of flood runoff occurs in poorly defined drainage systems. The amount of rainfall over the basin is generally less than 400 mm. while the potential evapo-transpiration is greater than 1500mm.

The ground water is a little bit saline with TDS ranging from 1500 ppm to 3000 ppm. This mainly attributed to the presence of gysiferous formation and low recharge from precipitation. The high evaporation rate also contributes to the salinity. Main source of water supply in the region is ground water. The other supplementary source of supply is from "**birkas**".

Birkas are reservoir structures dug in the ground and cemented with clay and/or cement. Runoff and rainfall water collected in these "**birkas**" is chemically sound to be potable provided that it is protected from contamination by means of some convenient cover at the top.

In the eastern extreme part of the Ogaden region, watering for both domestic use and livestock is obtained from **Hafir Dams** constructed by **UNCHR** in **Hartishek, Camaboker, Rabaso** and **Daror.**

Each of the Hafir Dam has a water supply capacity of over **49,000m^3** . Since the annual rainfall in this area is very small and the availability of ground water is not so promising, the use of such Hafir Dams is quite appropriate. The **Hafir Dam** at **Rabaso** is large enough that can even be used for irrigation purposes[1]. The catchment area of this dam is about **20.5 km^2** and most of the year there is enough water in the reservoir. There are intentions to protect the reservoir from evaporation so as to prolong the supply until the next rainy season.

5.5.3 Eastern Part of Awash Basin

This area lies east of Awash junction extending to the water shed of the Wabishebelle basin .The total area of the eastern catchment is about 47,360 km^2 and the bulk of this area lies in semi-arid and arid zones.

Most of the streams draining in the area rise in the escarpment slopes adjacent to the Wabi Shebelle water shed. These streams flow northwards across the pediment slopes and in the flat lying areas.

Since there are no perennial streams flowing through the area, water supply sources can only come from springs, water holes, hand-dug wells and boreholes. With respect to ground water resource in the area, two aquifers are identified:

- The aquifer of intergranular permeability in the alluvial sediments can provide moderate water from shallow depth of up to **50m** below the ground surface, and
- The fissured and karstic aquifers in the sedimentary and volcanic formations can provide ground water from greater depths.

These two aquifers are extensive but can only provide moderate quantities of water. Due to the tectonic nature in the area, the ground water resource could be discontinuous in the sedimentary and the volcanic rocks, while the acidic rocks are poor aquifers, weathered and fissured parts of the basement could provide some water. The **evapo transpiration** in these areas is **four to five times** of the annual rainfall.

The amount of rainfall available for recharge is very small. Recharge from base flow from elevated areas of Ayisha horst and from the southern escarpment is quite possible.

5.5.4 Genale – Dawa River Basin

This is the largest basin in the country after Abay and Wabi Shebelle occupying 168,000km^2. Though a total area of 660,000hectares is classified to be irrigable, the present estimate of the annual volume of water from Dawa, Genale and Weyb (6-7 billion m^3) is sufficient only irrigating for about 200,000 hectares Water Resource Development Authority (WRDA,1987)

About 36.6% of the basin is below 1000m above sea level while 50% of the basin area ranges in altitude between 1000m and 3000m. About 80% of the basin has average temperature of 25^0 C, two rainfall seasons with peaks in April and October.

The overall annual mean rainfall for the entire basin as worked out by WAPCOS is 528mm. certainly; there are differences in rainfall in the upstream and downstream areas.

5.5.5 The Case of Domestic Water

Water is scarce in the region although the scarcity differs among the zones, woredas and localities. Rivers are the main sources of drinking water especially in rural areas. However some rural areas have potable water supply facilities from boreholes, hand-dug wells developed springs and treated river water. Water supply situation in urban areas is different from the situation in rural areas. According to the information from the Bureau of Water Resource Development, 38 towns have potable water supply services from different sources. This includes boreholes, hand-dug wells, river in-take, springs and dams. As per the data from the Bureau, 55% of those urban populations have access to potable water supply.

Table 2: Summary of the access to water/construction of water supply project

S/N	Activity	No. of projects	Functional	Ongoing
1	Piped Projects	12	4	8
2	River Intake	11	-	8
3	Huffier Dam	12	7	5
4	Springs	3	3	0
5	Deep Bore-holes	321	224	97

Source: SR, BoFED, Population & Development, Volume I, Issue I, February 2010.

5.6 Infrastructure

The Somali Region has a rudimentary socio-economic infrastructure with very low level of development. Transport and communication networks in the region are very poor and remain to be the major constraints to its socio-economic development. As far as road network is

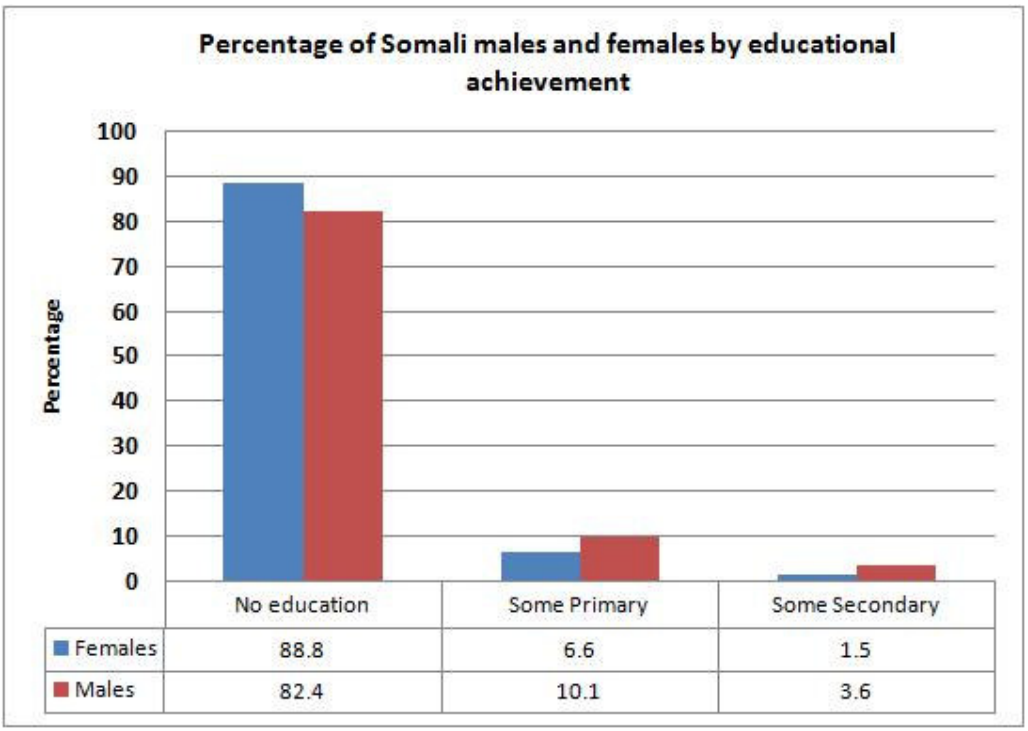
concerned, currently, there are only 1,629 km. of all weather roads and 2,844 km. of dry weather road. The region is connected with Addis Ababa by road and air transports. All zonal towns except Shinile and Filtu are connected with the regional capital, Jigjiga. With respect to air transport, there is an international airport at Gode while Jigjiga, *Kebridehar* and *Shilabo* have airstrips that can serve lighter aircrafts. An other airstrip is under construction in *Kelafo*. The Addis Ababa - Djibouti railway line passes through the northern part of the region. However, its transportation value to the region currently is not that high and the train does not sometimes even stop at some of the smaller stations. In general, the transport infrastructure in the region is poor both in terms of size and quality. This hampers overall development and isolates rural community from regional as well as the national economy. Communication service is also at its lowest level of development. Currently, there are only ten towns connected with automatic telephone communication and four towns have manual telephone systems. The remaining over 56 towns do not have any telephone services. Only ten towns of the region have postal communication service. Most of the communication services, especially telephone and postal facilities are concentrated in *Shinile* and *Jigjiga* zones while *Afder, Fiq* and some parts of *Warder* zones have only radio communication.The Somali Region, like the rest of the regions of the country makes use of both traditional and modern energy forms. However, the uses of modern forms of energy such as Kerosene, LPG and electricity are negligible. Energy sources in the region are dominated by traditional forms that are derived from biomass-firewood, branch, leaves, twigs, roots, dung, charcoal and agri-residue. Banking services are not adequate in the region. Currently, there are only four towns, *Jigjiga*, *Degahabour, Kebridehar* and *Gode* that have banking services while insurance services are totally not available in the region. On the electricity side, of the total woredas of the region, 19 towns get electricity service of which 5 towns get 24 hours service, 3 towns get 8 hours service, while 10 towns get 6 hours service and 1 town get 18 hours service.

5.7 Education Status

The educational level is low, and Islamic Koranic (**Qur'an)** schools are more prevalent than modern secular schools. Many mention the consumption of Chat (khat) as a pervasive social ill hampering learning and economic productivity. A neighbourhood leader in Godey characterized khat consumption as the greatest evil in the Somali society today. Nearly nine

in ten females (the highest for any region in the country) and over four-fifths of males have no education. At 15.5 the region also has the lowest net attendance ratio at a primary school level (the percentage of primary school age children (7-12) who are actually going to a primary school. At 9.4, the ratio for secondary school attendance is the second lowest (after Somali).

See the graph below about the percentage of Somali males and females by educational achievement.



The Potential Adaptive Capacity of the Health Sector

The Somali Region is also the least served with respect to health facilities. Currently, there are four hospitals (one zonal and three district hospitals), ten health centres, 77 clinics, and 79 health stations in the region. This shows that one health centre is for 259,840 people and one health station is for 45,549 people. The available facilities are concentrated in *woreda* towns which in many cases are far from agro-pastoralist and pastoralist settlements. For this reason,

the facilities are less accessible to this majority of the region's population. Of the total number of health facilities provided in the region, there are 6 hospitals, 145 health centres of which 38 are functional and 107 are under construction, 54 physicians, 541 nurses and 66 health officers. With regard to the ratio of population to health personnel; there are 1: 264,661 (physician: Population ration), 1:965,681 (Nurse: Population ratio) and 1:834,294 (Health officer: Population ration). Having seen these, on can conclude that the regions capacity in terms of health professional are very low as the region's population and size of the land are very large & huge respectively.

Table 3: Summary of Potential Health Service Coverage

Institutional capacity

There is insufficient capacity to design, plan and implement good programs at regional, wereda, kebele and community levels. While there is some capacity in place, there are significant institutional gaps that affect the quality of the implementation of policies and programs in pastoralist areas. The wereda structures put in place as a result of the decentralization process are still suffering from serious shortage of staff both in number and qualification, and staff turnover is high. This situation, thus, hamper the institutional effort in combating the effects of climate change.

Early warning system

The early warning system in SRS is generally weak where there is one person per wereda at the Disaster Preparedness and Food Security desk in the LCRDO. In addition, to having insufficient human power these posts are not placed with properly trained and skilled personnel. Furthermore they are not equipped with the necessary communication facilities to enable outreach to all community members, to collect and pass information to the region and other concerned institutions. Lag in early warning system in the Region than other regions of the country will result increased vulnerability to the impacts of climate change.

Chapter IV

Response Measures Needed to Enhance Regional Capacity to adapting to Climate change

Pastoralism and farming are among the livelihood options that development assistance can support to promote sustainable resource use and poverty reduction in dry lands. Pastoralism often enables the productive use of areas of dry lands that are unsuitable for farming. Yet, for a long time, a poor understanding of herding systems resulted in inappropriate policies that undermined pastoral development — such as by constraining herd mobility, leading pastoralists to become sedentary. Sustainable rangeland management in dry lands requires specific arrangements that secure pastoralists' access to water and grazing while enabling herd mobility. This allows herders to respond rapidly to changing grazing conditions and fodder availability produced by erratic rainfalls. Various forms of 'pastoral' legislation recently adopted by several Sahelian countries provide insights into how to achieve this. Such legislation recognizes the importance of herd mobility and protects grazing lands and 'cattle corridors' from agricultural encroachment (e.g. Mali's Pastoral Charter; Hesse and Thébaud, 2006).

6.1 Taking Climate Change Seriously

Climate change is affecting dry land areas and livelihoods. Although long-term predictions are difficult, most climate change models suggest that many dry lands will become warmer and drier. As a result, existing water shortages will worsen and droughts are likely to become longer and more frequent. If rainfall becomes even more erratic, resources such as pastures will become scarcer, more scattered and harder to predict. This, coupled with population growth, would promote greater competition between resource users — possibly resulting in social conflict and even violence. This demands action both to mitigate climate change and to support adaptation strategies in dry land areas. The latter entails helping people respond to change — by, for instance, enabling herd mobility while securing pastoralists' rights to natural resources, supporting pastoral livelihoods and their diversification, and researching drought resistant crops.

6.2 Farming

Dry land farmers have developed knowledge and innovations that enable sustainable farming in very difficult environments. However, in many areas farming is under pressure as a result of insecure land rights, conflict with other resource uses (particularly pastoralism), and unfair agricultural subsidies to the farmers by/or the donors. Supporting farming adapted to drylands requires, among other things:

- Supporting farmers' innovation;
- Promoting sound combinations of local knowledge and appropriate technologies;
- Securing land rights; and
- Regulating relations between competing resource users.

The experience with 'local conventions' developed by the region's pastoralists provides insights into ways of regulating farmer-herder relations. These are community-based agreements on the management of shared natural resources that are negotiated by all interested natural resource users, usually with support from development projects. In Harshin area forest, for instance, local users with support from an NGO established rules and institutions that enable sustainable resource use on the one hand, and peaceful coexistence of competing resource users on the other. The regional programme *Reinforcement of Pastoral Civil Society in East Africa,* jointly implemented by IIED and RECONCILE, has designed a set of practical tools to build the capacity of pastoral civil society leaders to argue for the inclusion of pastoralism in the design and implementation of policy. Through training and action-research, pastoral groups gain a better understanding of the dynamics of their own livelihood system in relation to the broader policy environment, identify their own solutions to current problems, and are able to challenge outsiders' perceptions of pastoralism.

Priority actions to tackle

1. ***dry land degradation:*** Tackling these issues requires working with governments and civil society to develop and implement policies and programs that:

- secure local resource rights, promote peaceful coexistence between competing resource uses (e.g. herding and farming) and enable pastoral mobility, both through support to design and implementation of appropriate national legislation and through support to local-level arrangements such as "local conventions" or other multi-stakeholder agreements (see above);
- support dry land livelihoods, including through better water management and supply and through off-farm diversification (particularly where this is the only viable option for the landless poor);
- promote improvements in farming techniques and land use systems, through support to and valorization of local knowledge and innovation, and through appropriate combinations of local knowledge and locally appropriate technological innovations;
- promote restoration and rehabilitation of degraded dry lands, through soil and water conservation measures that are tailored to local contexts (from terracing to nutrient replenishment; MA, 2005) and that are designed and implemented with the participation of local resource users;

- strengthen the capacity of civil society in dry land areas to engage more effectively with policy debates on dry land development, including through training and exchange of ideas.

2. **Tackling water issues:** The sustainable and equitable management of scarce water resources for domestic and agricultural use is key to both poverty reduction and ecosystem protection in dry lands to decrease the burden of climate change. Again, environment and development goals are closely linked. Improving access to water is crucial but doing so without a proper understanding of local contexts may have negative social and environmental effects (Cotula, 2006). Development programs that build water infrastructure inappropriately could result in resource degradation. In many pastoral systems, for instance, control over water sources needed by livestock enables regulation of access to surrounding grazing lands. Traditionally, resource management systems were centered on this close relationship between land and water rights: those digging wells enjoyed priority use rights over them, and could regulate

access to them by outsiders. In so doing, livestock numbers on a given rangeland could be controlled. In the past, however, the creation of public water points has attracted increasing numbers of herders, and undermined the priority land and water use rights that local groups enjoyed under 'customary' resource management systems. This has fostered resource conflict and degradation.

6.3 Livestock Production Enhancement

Being predominantly pastoralists and agro pastoralists the livelihoods of the majority of the people in the region are directly associated with livestock production. In order to increase the livestock production for local people, the livestock conditions of the region must be improved and introduced modern technologies. Different level of governments and other concerned bodies must plan urgently a short term, medium term and long term developmental programs to improve the production of livestock in more technologically – oriented manner. The development of new technologies should integrate the :

- Improving urgently the water supply for animals by digging wells and constructing ponds in the remote grazing areas.
- Improve feed and forage availability for animals, especially in the area of natural grazing.
- Cultivate forage in the river areas and improve supplementary feeds from crop residues.
- More awareness & education through formal & extension services
- Create national and international dependable animal markets
- Increase and improve badly needed veterinary services in the area
- Introduce modern livestock husbandry practices
- Introduce genetically improved breeds of livestock

N.B: the later two more generally reflects the introduction of more genetically climate – resistant species.

6.4 Crop production Improvement

Huge part of Somali region is well known for their fertile soils with high potential for irrigated crop production. In recent years, for various reasons the crop production of the area has declined to the extent that now the household farmers can produce enough food for only

three months of the year. Although the perennial river of Wabi Shebelle traverses few districts, irrigation practices at community level are limited to very small-scale of individual farmers and recently initiated farmer cooperatives. Therefore, to increase the needed crop production of the region the following developmental factors must be improved:

- Increase water sources for crop production, through modern ways of rain water harvesting, and roof water harvesting.
- Encourage to use water pumps & repair the existence ones to irrigate more potential arable land near the springs.
- Improve & increase the availability of agricultural inputs, especially improved seed
- Introduce modern control of pests, diseases & dangerous wild animals.
- More awareness & education through formal & extension services
- Create dependable markets
- Introduce modern agricultural practices through extensive and mass exploration of agricultural extension services
- Reduce conflicts among the farmers
- Introduce genetically improved crop varieties

6.5 Rangeland Development

In general, the rangelands resource in the region are suffering a severe degradation caused by intensive collection of fuel wood and building materials as well as overgrazing in some areas, while the cropping activities and urban settlements are more and more advancing into the rangelands. As locals in some areas confirmed all most all natural vegetation near the permanent rivers and residential areas has been greatly influenced by different human activities within the last twenty years. Alongside the human overuse on the natural vegetation, the condition is aggravated by some natural source very frequent in the two surveyed districts, such as recurrent droughts, floods and widespread wind erosion in the dry seasons and water erosions in the rainy seasons. Often, huge areas of natural vegetation are destroyed purely so they can be owned although the land is not used for crops. Therefore, the conservation of natural vegetation must be given a number one priority to reduce the high risk of wind and water erosions, vegetation type and the loss of biodiversity.

To develop the potential production of rangelands of the region, the following solutions must be planned:

- Improve land use management which incorporates modern conservation strategies, including biological and physical soil and water conservation activities.
- A rangeland resources management programme must be initiated in the near future in order to protect and improve rangeland condition in the area.
- Local rangers (guardians) who work on food for work programmes and have the authority to protect communal rangelands, natural vegetation and wild animals of the region.
- More research is needed in the field of rangelands and rangeland management.
- Improve rangeland's condition and natural vegetation of the area.
- Develop the use and sourcing of alternative energy & building materials.
- Improve awareness & education through formal & extension services.
- Find or create a dependable market for produced incense & gum.

Natural Resource Management

Pastoralists have various traditional natural resource management strategies such as management of rangeland and livestock (identifying dry and wet season grazing, herd management, controlled soil burning, proper water management system, weed and pest management and others).To further strengthen the traditional system and support it with modern systems and technologies, the following appropriate interventions are recommended:

- Catchment treatment through land management, moisture and soil conservation and flood control methods;
- Implement soil and water conservation programs and projects that promote local community participation;
- Focus on rehabilitation and reclamation of degraded land, reforestation, conservation, management and protection of natural resources;
- Rehabilitate and manage dry season rangelands;
- Implement measures to control aggressive weeds and other invasive plants such as *Prosopis juliflora*, *Partenium*; and

- Implementation of planting multipurpose trees at house hold level in areas where water is available from irrigation structures.

Social services and infrastructure development

In the region only big urban centers like *Jijiga, Gode, Gabridahar, Dhagaxbuur, Wardheer* , etc. have a limited and poor quality of public and private social services, such as basic schools, general health, food supply and adequate markets. While the majority of pastoralists and agro pastoralists of the region do not have the necessary social services in their villages and pastoral areas. Thus, the concerned institutions of different levels need to carry out relevant actions to develop the social services in order to improve the quality of human lives. Mobile health and education services for both human and livestock would be beneficial in the context of pastoral and agro pastoral development programs funded by the regional governments and other concerned institutions. On the other hand, the concerned planners and developmental agencies must consider more how to improve the accessibility to the resources, social services and markets of the rural communities, constructing new rural roads and upgrading the existing ones. The short and long-term solutions of these problems are:

- Improve and increase basic health coverage through strengthening mobile health system.
- Improve & increase basic education services through strengthening alternative based education system and providing education materials.
- Mobile health and education services for both human and livestock.
- Create local & International dependable markets.
- Increase road networks & bridges, through community participation.
- Upgrade the existing rural roads on the basis of climate – resilient system.
- Improve awareness of available health and education services to wards climate issues.
- Increase the level of human capacity in terms of environmental knowledge.

Community capacity building and awareness creation

For local adaptation strategies and external interventions bring about the intended outcomes, the limitations of the pastoralist societies in terms of capacity should be approached by local and international development actors and support the activities that pastoralists themselves

are already undertaking in order to deal with climate change. In the pastoral Somali societies, the capacity limitations are not specific to the community but also to the local government institutions, community leaders and experts. This necessitates the need to develop a capacity building plan aimed at addressing the capacity gaps at all levels

According to an assessment conducted in southern Ethiopia by Forum for Social Studies, lack of awareness in areas of population planning, girls' education, women empowerment, reproductive health, and impacts of harmful traditional practices complicate the impacts of climate change driven disasters (Aklilu Amsalu and Alebachew Adem, 2009). Projects aimed at bringing holistic and long term development impacts on the lives of the pastoralists should incorporate local capacity building component giving special emphasis to empowering economic, social and political say of women.

Another activity that can be done to further strengthen the adaptive capacities of the pastoralists is to strengthen early warning systems and make them user friendly and useful by incorporating indigenous knowledge systems. Therefore, the following are feasible interventions recommended in the capacity building component.

- Strengthening/enhancing drought and flood early warning systems at national and regional levels;
- Provision of training on preparation of early warning and disaster prevention plan;
- Capacitate the regional early warning systems to detect droughts, flood and other hazards;
- Prepare drought and flood contingency plan/funds at the regional level to ensure timely, appropriate, and adequate interventions aimed at mitigating the impact of drought-related crises;
- Establish kebele level early warning information system that links to the woreda level;
- Establish disaster risk management committees at woreda and kebele level and build their capacities to detect drought, flood and other hazards;

- Assure participation of the pastoralists in development initiatives including managing climate change and its impacts to a level which enable them to influence policy and implementation at the national level;
- Public training program on early warning system tools for climate change impacts in Somali; and
- Advocate for proper land use policy and resettlement options.

The identified appropriate response measures in each sector might not be appropriate at all times, for all communities and may not always be in line with the national policy and development strategies. As a result, it is of vital to devise evaluation criteria for the sake of prioritization. The most important criteria used by NAPA as proposed and endorsed by the National Climate Change Steering Committee members include, but not limited to:

- Impact on economic growth of the poor (poverty reduction potential);
- Complementarities with national and sectoral plans;
- Climate change risk (Losses avoided by poor People);
- Synergy with action plans under Multi-lateral Environmental Agreements (MEAs); and
- Cost Effectiveness.

Based on these and other relevant criteria, governmental and NGO interventions should select and prioritize response measures so as to create resilient Somali communities less vulnerable to impacts of climate change.

In addition to the above discussed appropriate development response measures, short term emergency interventions should be implemented when disasters occur and people are in a desperate situation. However, caution should be taken while implementing emergency interventions not to disrupt the ongoing development efforts and rather complement with each other. Provision of relief food and non food items, productive safety net, health care services, temporary shelter, evacuation facilities, livestock feed, water, sanitation services and school feeding are some of the appropriate emergency interventions to save lives of people and livestock and help fast recovery from the impacts of disasters.

Chapter VII

Portfolio of good practices and technologies required for the implementation of the identified of response measures

1. **More effective, efficient and participatory management & protection of available natural resources**:

1.1 Modification and increasing of rangeland management practices

A) Strengthening the traditional Natural Resource Management systems

Pastoralists in Somali region have various traditional natural resource management strategies such as i) Mobility as the basis for vegetation management and utilization**,** because pastoral production systems demand detailed knowledge of the environment: For efficient resource utilization, awareness of the climate and its spatial and temporal variability is essential. This awareness is based on generation of observation and adaptive management. There are many ways in which pastoralists and agro pastoralists in Somali region have adapted to the uncertainty of their environment. In the dry lands, low and unpredictable rainfall means that the only effective management system is an opportunistic one: to go where the resources are. This means spatial flexibility being mobile and temporal flexibility having variable herd sizes and risk management strategies. Pastoral mobility is both flexible and selective from one area to other area where better pasture and water are available ii) Herd diversity. Herd diversity is another adaptive management for better resource utilization and management. The livestock diversity in the pastoralists help to get a wide range of pasture and browse species and to optimize the herd's productivity and flexibility. Diversity also helps to ensure the optimum utilization of resources since the different domestic animals have different feed preference; for example camel and goat browse, while sheep and cattle graze, and this maximize the utilization of the available fodder. Also diversity helps against major disease outbreak, which may damage certain species but not the others. Goats and cattle are typically bred as dual purpose animals, with milk production having great significance, where as sheep are often marketable. In the more

arid areas, camel is also an economically important and highly adapted animal that produces both milk and meat and provides important means of transportation, in remote areas.

iii) Ecosystem knowledge as the basis for vegetation management. In-depth pastoral knowledge of complex rangeland agro-ecological dynamics is critical in detecting resource availability. This knowledge includes understanding erratic climatic patterns and familiarity with patchy range resources. Pastoralists have elaborates systems of ecological classification, such as the (*Degaan*) system, which enable them to practice postponed rotational management by moving livestock to seasonal pastures to optimize the use of the rangeland resources. The *Degaan* system divides grazing habitat in to four micro-categories based on plant cover and soil type. There are: (1) *Gabiib:* This land type is characterized by thick bush vegetation with clay soil and high water runoff during the rainy season, as it has little importance for crop production. People use this land type for incense production. (2) *Dhoobay*: This land type is characterized by thick bush vegetation with black soil and people use it for livestock production, in particular cattle husbandry during the rainy season. (3) *Dooy:* This land type is characterized by open bush and red soil with good water conservation and people use it for rain-fed crop production, especially for Sorghum cropping in shifting cultivation. (4) *Bay:* This land type is characterized by open bush mixed vegetation with grey red soil and people use it for extensive camel and goats production. iiii) Local institution: The Pastoralists in the region also have their own indigenous institutions led by a traditional leaders. The t rational leaders are the most powerful traditional system governing communal natural resources management and conservation. It enforces grazing controls, through informal policy; make final decisions concerning common grazing, such as the timing and location of movements, deferring grazing and granting permission to outsiders. It gives decisions to avoid areas already in use, keep at an appropriate distance from others and avoid areas just recently vacated by others. iiii) Fodder assessment and defined grazing as the basis for vegetation management: Llivestock sustainability mechanisms are taken into consideration in the pastoralist area. The vegetation composition in the rangeland is timed to safeguard plants during the production, so that seed banks are not mined, a typical outcome when mobility is restricted and defined grazing reserve is applied. The pastoral community conducts fodder assessment before moving to a new site. The assessment include, distance and condition of pasture and water, estimation on how long the fodder and water sustain a

given number of livestock, type of fodder and others. The elders will then make the final decision where to move to. The elders have a well developed local knowledge about the ecosystem and the browse and grass species most favored by their livestock. Based on plant cover and soil type in the area, they know how to use the resources including the number of stock and the duration of grazing. In this dry area grazing systems are characterized by their variability and uncertainty. Under such circumstances, management systems must have the capacity to respond quickly and intelligently to unforeseen challenges and opportunities. This management is in the sense of adaptive coping rather than optimization and control of the resource..iiii) Indigenous knowledge on species and their utilization: Knowledge of nutritive value of plants is vital for pastoral management of the rangeland. Knowledge of fodder species is well-developed, among pastoralists, such as fodder that promotes milk production or meat production, or provides dry or wet season fodder, and fodder for different stock of animals and ages. Pastoralists also have a well developed local knowledge about browse and grass species, most favored by their livestock and poisonous species. One of the ways that, pastoralists assess the palatability of the plants is by monitoring animal behavior when they are grazing or browsing. Animals tend to be selective on which plants to graze and browse. Also the pastoralists know the poisonous plants which they should keep away and the degree of the poisons in the certain plant. Pastoralists have long relied on an array of rangeland plants for food and medicines and they have developed a deep knowledge through their long and intimate association with their environment. The indigenous knowledge is based on experiential learning, evolving constantly, and shared through local communication processes according to the characteristics of pastoral production practices. But theses nomadic herders' indigenous knowledge has been often neglected by extension and research services. Only recently has it been recognized as a means to promote sustainable development.

B) Participatory Pilot Demonstrations

Pastoral RM faces multiple challenges caused by climate change, population growth, and other factors. Pilot demonstrations are to be conducted to identify feasible rehabilitation options – economically feasible, culturally acceptable, and environmentally friendly methods. Different technical approaches may be tested in different contexts and at different scales. RM

officers facilitate pilot demonstrations, rather than impose, and support demand-driven technical demonstrations that integrate pastoralists. Participatory pilot demonstrations require good indicators, data collection and monitoring forms to monitor efficiency of technical options, document rate of change, and assess impact on the environment. Thus, an area-wide rangeland resources inventory may be required to form the baseline information and an IEE (Initial Environmental examination) assessed to ensure that the technical options being investigated are environment-friendly. The team collaborates with key pastoralist informants and review secondary data, if these are available, to set out experimental designs – test plots, rehabilitation techniques, and follow-up methods. The level of demonstrations depends on technical approach pursued, willingness of local pastoralists, and availability of land. A key note from fieldwork is that experimental trials – data requirements, techniques, and objectives – should be harmonized with local conditions. A pilot demonstration may require up to two or more seasons. For example, more than two-seasons may be required to rehabilitate bare lands fully whilst thinning of invasive woody plants may be possible in a month.

2.1.3. Management and construction of water points

Water is not only a key resource, but a crucial resource management tool. There are different sources of water in pastoral lands – rivers, temporary ponds, wells. Surface water is mostly limited to the rivers and seasonal streams, which are temporary sources of water. Wells, ponds, and *birkas* are the major sources of water in the Somali region rangelands. In most pastoral lands, water points are managed together with forage resources. The management of water resources influences watershed potentials. Water development initiative may involve rehabilitation or constriction of water resources for human and livestock consumptions. This includes de-silting of seasonal ponds, construction of *birkas*, dry-season wells and pumps. It has supported customary systems whilst supporting contemporary options. For example, Pond construction/rehabilitation. facilitates effective pasture utilization in the wet season grazing areas facilitate and maintain indigenous rangeland management system- improves mobility to wet season grazing land areas improves ground water capacity of the dry-season wells by recharging traditional wells in the downstream – improves the availability and accessibility of quality water reduces the burden (long distance) on women to collect water by harvesting run off and making water available in the wet season areas Well rehabilitation:

- reduces the effort/manpower (from 12-15 to 3 -5 people) improves the time required to get water from the well to the watering trough improving the traditional watering trough made of mud to cemented structure improves the efficiency of watering livestock by increasing the number of animals watered at a time and reduce labor required to maintain the traditional trough encourage efficient utilization of dry season grazing land areas improves school attendance of pastoralist boys

2.1.4. Control and Utilization of *Prosopis juliflora*

Prosopis juliflora (mesquite) is an alien leguminous plant originated in *Latin America*. It was introduced to northern and south-eastern Ethiopia purposely and crossing borders: to help with soil and water conservation initiatives, in Somali, and crossing over the *Genale* river in *Liben*, *Dollo Ado*. Where it was wrongly introduced to the communal grazing lands where it was purposely introduced. In both cases, *prosopis* has turned to be a threat to pastoralist livelihoods by encroaching on grazing lands and affecting negatively livestock production, the key livelihood activity of Ethiopia's pastoralists. If addressing this dangerous plant is neglected, the livestock as well as livelihood support of rangelands where it invades will dramatically decline. Therefore, efforts have focused to manage mesquite with various management options and objectives. Including control and utilization methods of mesquite.

Control

- Cutting the tree 15 to 20 cm below ground
- Uproot manually new growth
- Prohibiting livestock feeding on uncrushed pods
- Replacing land with other crops keeping only 20 to 30 plants pr thinned plots

Utilization

- Collect healthy pods from quality trees
- Dry pods – reduce temperature by 5% - oven dry to 54 degree centigrade
- Mill with stone mills of 10 mm screen to separate endocarps & mosocarps
- Mill mesocarps with 2 mm or finer screen size to produce flour for human food
- Mill endocarps with 2 mm screen – for livestock feed
- Crashed pods for livestock, and flour (from seed and mesoderm) for hum

2.1.5. Control of Invasion of Native Bush Encroachment

Bush encroachment is defined as the invasion and/or thickening of aggressive undesirable woody species resulting in an imbalance of the grass: bush ratio, a decrease in biodiversity, a decrease in carrying capacity, and causing severe economic losses (Smit, 1999). The phenomenon of bush encroachment in Somali region is to be seen as a process of desertification. Not all woody plants in the rangelands are invasive. Whilst some woody plants have a potential positive role such as N fixation when colonizing new sites, others, have negative effect on the growth of herbaceous plants. Invasive plants should be identified by working with local pastoralists, known for their knowledge of Rangeland Ecology. Plant species with the following characteristic features may be considered invasive:

- Inhibit underneath growth and development of herbaceous plants
- Suppress growth of useful plant populations and degrade biodiversity
- Deny access to grazing and/or browsing resources
- Unwanted/undesirable;
- Do not have sound ecological value; and household, medicinal etc benefits
- Have impact on the ecosystem that threats natural habitats

In Somali region the main encroaching bushes vary from zone to zone and from one site to another site in a region. Major encroaching bushes native woody species include *Acacia nilotica, Acacia drepanolobium, Acacia melifera* and *Acacia horrida*. There are no accurate data as to the area covered and amount of encroacher plants in the region. These native invasive woody species can be controlled through, thinning. Thinning improves watersheds by reducing encroachment of woody plants and amount of run-off. Opening up canopy, it gets enough light to under-story vegetation and allows adequate photosynthesis process allowing primary productivity of rangelands. It may also involve cutting – at different heights – of the invasive woody plants and uprooting short growing weeds. Thinning should be conducted by the end of dry seasons to cause maximum stress on the cut trunks. For example, *Acacia drepanolobium* can be killed if cut at knee height, 50 to 60 cm, by the end of long dry season. Thinning encourages primary productivity, growth of protective vegetative cover, and thus contributes to improved watershed potentials – improved ground water capacity and livestock productivity – of rangelands. All techniques should be monitored for their impact. Plots are seasonally monitored with data collection formats to measure efficiency of techniques using

key plant growth indicators; these may include level of grass recovery and number of sprout count on cut stems in each plot. Post-thinning initiatives – chopping and alternative land use plans – should follow thinning. Initial cutting of native woody plants should be followed by chopping new sprouts that may Participatory pilot demonstrations establish multidisciplinary technical field teams; train technical officers on: contemporary as and indigenous RM issues – systems and approaches, indicators, focus group discussions conduct area-wide rangeland resource survey, cluster sampling, develop after a season. Experimental plots are maintained for sometime to achieve the desired results although conditions may vary with experimental designs.

2.1.7. Area Enclosure

Scarce and poor quality of forage, results of land degradations and drought, inhibit livestock productivity. This is worsening as degradation is increasing. Enclosure development refers to deferring degraded, bare grazing lands for a year or so, to encourage re-seeding and re-growth of desirable, quality vegetation. Bare rangelands are enclosed to reduce soil erosion and run-off, and improve natural fodder output. Soil and water conservation, thinning/weeding practices may be incorporated with enclosures. This strategy has also effectively rehabilitated denuded lands in other pastoral and agro-pastoral areas of Ethiopia. Area enclosure may be followed by other activities such as hay making, a traditional role of pastoralist women –collecting hay to feed calves. Quality of hay is determined by time of collection. Whilst hay made from grass collected at the right stage of grass growth is nutritionally rich, hay from grass collected at late stages growth is low in nutrition. Areas may be enclosed for communal use to benefit calves, lactating and weak animals.

2.1.8. Drought reserves

Drought is not a surprising event for pastoralists, in the arid and semi-arid rangelands, whom have been managing rangelands for centuries. Customary institutions have not only managed drought risks through drought reserves, but they have maintained healthy rangelands. Because movement of herd to areas reserved for drought during scarcity allows grazing lands to rest leaving them in good conditions. Customary RM institutions have reserved areas for drought as part of the reciprocal NRM system – seasonal land use. The arid and semi-arid rangelands are characterized by unstable climatic conditions, which make drought unpredictable; droughts may result from the disruption of rainfall pattern or extended dry

season. The level of stress varies with the drought conditions. For example, in some pastoral lands failure of both short and long rainy seasons affects severely forage growth and livestock productivity. Key to managing rangelands water is the joint management of water and forage resources. In areas with scarce water resources forage cannot be utilized. Extended time and distance to watering points and lack of forage induce increases livestock mortality, which is followed scarcity of food for the human population. Access to drought reserves is regulated by watering regimes of cattle. Also, seasonal herd mobility plays key ecological role reducing land degradation, improving availability of rangeland resources, and increasing local drought coping.

2.2. Integrated SWC Activities

Soil and water harvesting can be applied either at macro level (i.e. runoff from large catchments) or micro level catchments adjacent to cropped area) at macro level, runoff water can be collected and stored in small reservoirs to be used for irrigation during dry periods, or allowed to seep into the soil to recharge aquifer. At micro level, runoff water is trapped and channeled to be stored in the soil profile directly supporting the growth of grasses and trees. Water harvesting increases and stabilizes yields. It also reduces erosion, lees run off, less soil carried away and fewer gullies formed. Appropriate water harvesting techniques suitable for the site selected like pitting involves the creation of small basins to catch and hold precipitation through the use of mechanical devices). Forage shrubs will be planted around water-harvesting structures furrowing for slope less than 10% (small ditches or water channels constructed along the contour to divert the flow of water from its normal course) water spreading (these are spreading structures that, consist of dams and dykes to intercept surface run-off and convey it out of natural drainage areas at low gradient across the land surface where it can be conserved), terraces (earth embankments constructed to obstruct water flow along the contour in steep areas vulnerable to erosion and accordingly it is suitable for watershed areas) will be practiced as deemed necessary. Frequent droughts and consistently low soil moisture levels make it hard to maintain rangelands, has developed integrated water harvesting techniques that improve rainwater use efficiency as well as soil moisture levels, providing better conditions for plants to grow. These techniques are now being tested and promoted through pilot projects in several countries

2.3. Treatment of upper watershed areas to protect flood hazards

In the guideline of community based participatory watershed development (2005) defined watershed as "any surface area from which runoff resulting from rainfall is collected and drained through a common confluence point". A watershed is made up of the natural resources in a basin, especially water, soil, and vegetative factors. At the socio-economic level a watershed includes people, their farming system (including livestock) and interaction with land resources, coping strategies, social and economic activities and cultural aspects. Although the community have the above-indicated vision; taking the existing limitation in to account, they want the following issues to be addressed:

- Flood hazard protection
- Water supply for domestic and animal
- Land productivity
- Soil erosion and gully formation
- Fire and construction woods supply
- Animal feed
- Food self-sufficiency

The in order to manage watershed that are degraded & contributes the existing flood hazards affecting human, animal & other physical resources, different physical conservation parameters will be applied to protect floods – through strengthening pastoralists' participation in integrated watershed management & flood protection techniques particularly, the watershed which is severely affected by moisture stress, low yield from crops and livestock, gullies emanating from soil erosion. SWC measures as land development and rehabilitation, water harvesting (household water harvest (hemispherical), spate diversion using local material or Gabion) Road and Footpath development, etc are all elements of integrated participatory dry land water shed management.

2.5. Gully control & rehabilitation

Severe land degradation is seen in many parts of the region, and hence it's to be addressed immediately. Using different techniques: such as Small earth dams constructed across medium size gullies for

- Sediment trapping
- Water collection
- Diversion & overflow of excess runoff

The space behind these structures is rapidly converted into fertile and productive fields. Important means to convert unproductive lands such as gullies into fertile fields have a beneficial influence in regulating water regimes and protecting downstream areas from excess runoff

Increasing feed level for livestock production

Use of alternative feed resources or improving the utilization of available feed resources (e.g. treatment of crop residues, supplementation strategies using available feed)

Options for Managing Seasonal Shortages: Quantity of Fodder Seasonal shortages are often caused by long dry seasons and/or by drought. Drought is a risk which needs to be managed by all livestock producers. The extent of the risk and the amount of effort that can be made and which is sensible for managing drought varies with location. The process is essentially one of risk management. Some risks are more certain than others for instance, in a seasonal climate, livestock keepers can be 100% certain that a dry season will occur. The length of the dry season is less well known but can be accessed on the basis of previous experience, whilst the risk of periodic drought is less certain still. Options available to livestock producers for hedging against the risk of drought include

Feeding grain. Feeding grain to maintain breeding stock through a drought.

Moving breeding stock to areas not affected by drought to maintain breeding stock through a drought.

Growing drought fodder banks. This includes establishing blocks of fodder trees and shrubs, perhaps as shelter belts or erosion control plantings, which can be selectively harvested during a drought. Fodder from any one tree and shrub species in isolation is unlikely to contain sufficient energy, protein and nutrients to meet the maintenance needs of

livestock. A mixture of fodder trees and shrubs is more likely to provide an effective drought bank.

Feed Conservation and Storage using seasonal surplus for livestock during periods of feed scarcity in rain feed areas

Seasonal shortages are often caused by long dry seasons and/or by drought. Drought is a risk which needs to be managed by all livestock producers. The extent of the risk and the amount of effort that can be made and which is sensible for managing drought varies with location. The process is essentially one of risk management. Some risks are more certain than others - for instance, in a seasonal climate, livestock keepers can be 100% certain that a dry season will occur. The length of the dry season is less well known but can be accessed on the basis of previous experience, whilst the risk of periodic drought is less certain still. Options available to livestock producers for hedging against the risk of drought include: In most areas, of the region there are times when feed supply exceeds thee requirements for livestock, but these times are counterbalanced by times of feed scarcity later in the year when prolonged dry periods limit the amount of fresh forage available By conserving and storing some of the feeds available during periods of surplus, livestock keepers can ensure that they have sufficient feed to offer their livestock throughout the year. In addition, when crops are harvested, there are usually residues and by-products that can be fed to livestock.

The suitability of different conserved feeds and by-products for different classes of livestock depends on the nature of the feed. Potential range grass lands in the region will be identified, local communities will be organized in a Feed Conservation and Storage using seasonal surplus for livestock during periods of feed scarcity cooperatives and trained them how to prepare the hay making and conservation and stories will be established in those identified areas. The conserved and stored feeds during the surplus time will be purchased from the local community and distributed during periods of feed scarcity

C) Large scale nursery establishment and Large scale tree plantation

At least one nursery will be established at all selected woredas, with that will target more than 100,000 multi-purpose fast growing tree species seedlings both indigenous and exotic for all four selected *woredas*. The produced seedlings will be planted during the rainy season

to compensate the exhaustive use of the indigenous trees. Benefits to be obtained from greater access to forest products by local people and reduced pressure from the natural vegetation, with planning, that takes into account the opportunity costs of the land, land tenure problems, availability and accessibility and so on; tree planting can be an appropriate response to fuel wood shortages.

Chapter VIII

Impact assessment of response measures in order to address possible mal-adaptations

In countries like Ethiopia, climate change adaptation interventions cannot be separated from other poverty reduction and sustainable development efforts because climate change acts upon existing vulnerabilities. In other words, in Ethiopia vulnerability to climate change is largely contextual, and hence adaptation partly simply requires emphasis on baseline or business-as-usual development activities. Evidently, improved social, economic and human development is synergistic with adaptation to climate change. Thus climate change represents an important additional stress on those pastoral areas already affected by increasing resource demands, unsustainable management practices and environmental degradation. These stresses interact in different ways across themselves and reduce the ability of the pastoral production system to provide, on a sustained basis, key goods and services needed for successful economic and social development, including adequate food and feed, good health, water and energy supplies, employment opportunities and social advancement.

In the Somali region, vulnerable households and affected pastoral and agro-pastoral communities employ a range of measures to cope with the impacts of climate variability and climate change-induced disasters. The most commonly practiced household and community measures in the area of resource (herd and range) management include hay making (grass and straw collection), off-season and opportunistic cultivation, slaughtering of calves, looping and feeding animals on acacia leaves, settlement around water points, herd diversification and splitting, area enclosure, negotiation with other ethnic groups for scares resource utilization, , use of traditional medicine for humans and livestock. In the case of flooding hazards, the Somali employ traditional practices including maintenance of broken riversides, planting trees and protecting vegetation covers on hilly areas, constructing soil and water conservation structures, temporary displacement from flood-prone areas, flood diversion, etc.

Current coping strategies

Communities who are hit the hardest are already undertaking activities to cope with drought and other climate-related hazards (i.e. conflicts, disease and pest outbreaks, bush encroachment, and land degradation). An assessment of current local coping strategies, as well as their effectiveness and sustainability, can give us an insight on local adaptive capacity. Current coping strategies are given in the table below.

It is important to note that not all current local strategies to cope with hazards are efficient or appropriate for long term adaptation. Some strategies, based on short-term considerations, survival needs, lack of information or imperfect foresight, can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options (Eriksen, 2001). The sustainability of different coping strategies also depends on the intensity, duration and frequency of hazards. For example, traditional coping strategies such as charcoal and firewood selling, food rationing, and traditional asset redistribution mechanisms, might be efficient coping strategies when there is a major drought every 6-8 years, as there used to be. However, if there is a major drought almost every year, charcoal and firewood selling leads to massive deforestation, making this strategy obsolete in the long run, and leading to intensification of climate change impacts; continuous food rationing leads to malnutrition, decreased disease resistance and human capabilities, and sometimes even death; and traditional asset redistribution mechanisms become obsolete strategies if there are too many losses and too many people in need every year. The unsustainability of many traditional coping strategies in the face of current climate change is already visible, and has been seen In those communities are the most hit by the adverse impacts of climate change.

In addition, vulnerable households employ a diverse portfolio of economic and social strategies to cope with climate change-induced disasters. Petty trading, resource sharing like lending milking cows to poor households, consumption adjustments, minimizing non-food expenditure, seasonal migration, traditional knowledge of medicine and treatment of illness, firewood and charcoal selling, minimizing ceremonial expenses and saving money, purchasing of food commodities with credit, inter- mirage with other ethnic groups, etc. However, the capacity of most of the traditional household and community coping strategies

are too weak or limited to help them adequately cope with current climate variability and predicted climate change impacts. Also, it is important to note that not all current local strategies to cope with hazards are efficient or appropriate for long term adaptation. Some strategies that rely on short-term considerations can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options. For example, traditional coping strategies such as charcoal and firewood selling leads to massive deforestation, making this strategy obsolete in the long run, and leading to intensification of climate change impacts. Similarly, traditional resource sharing and asset redistribution mechanisms become obsolete strategies if there are too many losses and too many people in need every year.

It is important to note that not all current local strategies to cope with hazards are efficient or appropriate for long term adaptation. Some strategies, based on short-term considerations, survival needs, lack of information or imperfect foresight, can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options. The sustainability of different coping strategies also depends on the intensity, duration and frequency of hazards. For example, traditional coping strategies such as charcoal and firewood selling, food rationing, and traditional asset redistribution mechanisms, might be efficient when viewed from the perspective of daily survival and short-term coping. However, if there is frequent drought, charcoal and firewood selling leads to massive deforestation, making this strategy obsolete in the long run, and leading to intensification of climate change impacts; continuous food rationing leads to malnutrition, decreased disease resistance and human capabilities, and sometimes even death; and traditional asset redistribution mechanisms become obsolete strategies if there are too many losses and too many people in need every year. The unsustainability of many traditional coping strategies in the face of current climate change is already visible, and has been widely documented.

On the other hand, decentralization, expanding infrastructure, improved coverage of primary health care and education (particularly for girls) are enabling conditions which support community adaptation and build the adaptive capability of individuals and households. The support of state and non-state actors, in rebuilding assets damaged by disasters, rehabilitating degraded environments, diversifying rural incomes, and building human capacity through

various development programs is another most important opportunity in building ecological and human resilience to the unavoidable impacts of climate change.

Experiences so far show that there is a potential for interventions to have unintended short and long term beneficial as well as harmful impacts on the lives of the beneficiaries and physical environment. The challenge for external institutional interventions in pastoral areas has so far been in the use of local indigenous adaptation mechanisms in the planning, implementation and evaluation of such development interventions. A brief description of the unintended impacts of some of the response measures discussed in the previous sections is given here under.

Emergency interventions

Institutional emergency interventions in the form of the transfer of food and cash aid, school feeding, safety-net and others may affect the long-term sustainability of the pastoral production system and may even create dependency syndrome. Lack of sufficient information and comprehensive and responsive early warning system on the possibility of occurrence of a hazard has been one possible cause for the poor timing of emergency aids. Moreover, inadequacy of emergency resources and poor targeting of beneficiaries, in some cases, contributed to the less inadequacy and ineffectiveness of such interventions in addressing immediate needs of pastoralists at risk.

Development interventions

In the last two decades, the federal government and the Somali Regional state government have implemented various development interventions in the form of livelihood diversification, asset protection, range rehabilitation, soil and water harvesting and management, irrigation infrastructural development, and bush clearing. Despite the limitations of financial resources, institutional capacity and logistics, these interventions have contributed to improved living conditions and building local resilience.

The government of Ethiopia has adopted policies, strategies and action programmes aimed at poverty reduction, environmental protection and sustainable development. The various national policy initiatives and sectoral programs in place also address climate change, directly and indirectly. In the pastoral areas, the government executes different programs from emergency aid and productive Safety net programs, disaster prevention and management, asset protection and livelihood diversification, to conflict management and resolution. However, 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.

Though livelihood diversification interventions such as expansion of opportunistic and irrigated farming agriculture have been proven to enhance food security of households and resilience to impacts of drought hazards, if ill planned can have negative impacts as well. The expansion of areas for agriculture may induce shrinkage in rangeland areas and hence affect mobility and recovery in the pastoral system. In addition, poor planning and management of irrigation projects can have unanticipated negative environmental impacts such as salinity of farmlands, incidence of malaria outbreak, siltation of irrigation infrastructures and farms etc. Moreover, government, NGOs and other development actors should consider environmental sustainability, technological adaptability and socio-cultural acceptability factors when designing and implementing any intervention which involves water development and use and management of communal natural resources to avert possible conflicts among resource user groups.

Furthermore, any technological interventions such as construction of water supply points, irrigation schemes and others should be cost effective and easy for local management and maintenance. While suggesting a specific intervention, it is also important to consider the workload placed on women: as they take up new activities, they still have to fulfill their usual tasks of childcare, food preparation, collection of firewood and fetching water, which, given

the multi-faceted impacts of climate variability and change, has become more time-consuming.

In general, though it is difficult to determine the best interventions and timing of an intervention, long term development activities that are environmentally sustainable, cost effective, and socially acceptable can contribute to ecological restoration and the development of local resilience and adaptive capacity.

Whilst development activities have adaptation benefits, it is also necessary to give explicit attention to climate-justified adaptation measures which may be beyond baseline poverty reduction and development interventions. For example, land use planning related measures will be necessary to mitigate flood damages in flood-prone areas, or to take advantage of changed climates (e.g. increased temperatures) to produce certain types of crops. Besides, in some cases business-as-usual development can lead to mal-adaptation, increasing exposure and vulnerability to climate change. An example for such type of development could be resettlement of people in areas that are likely to become unsuitable for human habitation due to risks from climate change such as increased floods or droughts, heat stress, exposure to infectious diseases, etc.

Chapter X

Suggested Strategies for Adopting to Climate Change

If future climate change scenarios of decreasing rainfall and increasing temperatures were to occur next year, the following suggested interventions should have to be incorporated both in terms of the short term (immediate intervention) and the long term. The following **short-term adaptation strategies**:

1. **Provision of more human & livestock drinking water points:** it's argued that the majority of the region's land is dry and besides increasing temperature leads to a greater shortage of water for both human and livestock drinking. Hence the need to develop more watering points for both species is to be considered.

2. **Introducing hand dug wells in the most hit areas.**

3. **Intensification of small scale irrigation system:** given the region's potential for irrigation, it's an imperative condition to develop more irrigation schemes, particularly small scale irrigation, so that food security is achieved and the adverse impacts reduced.

4. **Modification and increasing of rangeland management practices**: scaling up pasture enclosures to feed weak animals, lactating cows and calves during dry seasons. These includes strengthening traditional wet and dry season grazing lands, bush clearing/thinning and adopt new methods to control bush encroachment.
5. **Increasing feed level for livestock production**: this is to increase livestock value chain both in terms of productivity and growth.
6. **Introducing alternative energy sources**: to decrease the level of forest degradation, it's important to develop new methods, particularly indigenous, of energy usage. This means the likes of solar energy, wind turbine, bio – fuel, etc.
7. **R&D for new technologies of animal feed and rangeland management practices**: given the existing climate conditions and higher temperature standards, the current level of animal feed production will be no longer sufficient, and hence, therefore, the need for new species that are more drought – tolerant a d less – water consuming ones are to be discovered with help of research and development.

8. **More effective, efficient and participatory management & protection of available natural resources**: harvesting and storing as much water as possible, in the forms of roof water harvesting, rain water harvesting, runoff water harvesting and the like, and using it effectively. Since the availability of pasture land is declining, diversifying livestock and shifting to animals that consume shrubs (i.e. camels and goats.) is important. Natural resources are presently exclusively controlled by elders, prompting young men to mention that giving younger people more control and decision-making rights over natural resources would give them a sense of ownership and responsibility' and therefore to encourage young men to participate in resource management. Besides, the need to implement different methods of biological and physical soil and water conservation activities to protect severe land degradation is very crucial. This includes, among others, integrated dry land watershed management, etc.
9. **Gully control & rehabilitation:** severe land degradation is seen in many parts of the region, and hence it's to be addressed immediately.
10. **Large scale tree plantation**: this strategy includes establishment of big – holding capacity nurseries and running of large scale tree plantations because it's one of the factors that reflects to be the changing climate is deforestation.
11. **Facilitation of markets for early selling of weak and old animals:** This is meant of developing marketing opportunities for livestock trading while livestock prices are still good.
12. **Strengthening of animal health centres and animal health professional:** this is meant to be the provision of veterinary equipment to animal health posts and clinics and also conducting CAHWs training in different times of the year.
13. **Improving the existing mobile human health and education systems:** this is in the form of building the capacity of mobile health and education workers to address the climate change issues.
14. **Raising community awareness on climate change issues and impacts in the areas of health, education, gender, etc:** this includes projections and potential adaptation strategies so that communities can prepare as much as possible in the future.

To prepare for the possible future scenarios the **longer-term adaptation strategies** includes:

1. **Encouraging migration & mobility:** This includes migration of livestock to better pasture lands in times of drought; moving livestock to higher grounds during heavy precipitation events; shifting human settlements to higher grounds; migration of young men to nearby towns and across borders to find employment; and temporary migration of young men to mines during difficult times. A part from this, mobility of pastoralists is seen to have a positive environment on their role of balancing the ecosystem through their indigenous management of vegetative cover.

2. **Water infrastructure works:** Rehabilitating/repairing ponds after heavy precipitation events via community mobilization. In addition, diverting runoff water from traditional wells, digging of deeper water wells in the remote areas, and the likes are very important.

3. **Modifying livestock diversity, composition and numbers:** increasing livestock diversity and adjusting herd composition towards fewer grazers (cattle and sheep) and more browsers and drought-tolerant species (such as camels and goats). For example, households who have started rearing camels have been getting more milk during dry seasons and droughts than those households who have not started rearing camels. In addition to, reducing the number of livestock to simplify management during times of drought, and converting some of the livestock into fixed assets (e.g. selling animals to build/buy houses in town to rent or investing in other income generating activities like petty trade and small enterprises) is necessary. Introducing a new policy promoting more equal/balanced livestock holdings among households, as some have 200-300 heads of livestock, while others only have 2-3 is very crucial.

4. **Diversifying livelihood activities**: It's suggested that pure pastoral communities should engage in farming activities and planting early maturing crops to diversify income and food sources. It's also suggested that starting some large scale irrigation agriculture if the government is able to piped water from highland areas or dig boreholes to near by - highland centers like Shinile and Jigjiga Zones . In addition to this, it's necessary to start growing and selling horticultural plants to generate income. Communities in all pastoral areas and villages suggested engaging in different kinds of income generating activities such as petty trade, wage labour, starting businesses, building houses, producing and

trading honey, selling camel milk, brokerage activities, and selling firewood and charcoal are necessary. All these points are to be addressed with the help of appropriate policies strategies.

5. **Hay making, collection and preservation** to prepare for adverse conditions or drought periods when there no pasture is available. For example, haymaking and pasture enclosure activities. However, this activity would require irrigation.

6. **Modification of farming practices**: shifting to crop species and varieties that grow within a shorter period of time and with less rainfall, like teff and beans and also more effective and efficient use of crop residues (e.g. storing residues for livestock feed during dry periods).

7. **Maintenance, rehabilitation and construction of water infrastructure**: constructing a big cistern for the women's group. Community participation in the construction of various water points like boreholes, ponds, cisterns, etc is very crucial. The rehabilitation of traditional wells and other water sources regularly should be addressed. Its also a very important phenomena to develop huffier dams in the most severely hit areas.

8. **Education**: Improving children's education so that young man & women can engage in different income generating activities and support their parents in the future. There should be formalized education in order to sustain the future of pastoralists. In addition to this, the need improve the existing alternative based education system and developed new systems to allow pastoralists to more modern and formal education system.

9. **Establishing savings and credit activities**: it's suggested the promotion and further development of savings and credit activities. It's also required to introduce/educate pastoralists and farmers how to save money in bank accounts in order to manage risks

related to drought. Besides, it should also be encouraged the social norms of obtaining credit from relatives living in other areas and not as severely affected by climatic conditions.

10. **Establishing community groups**: it's necessary to the establishment of youth associations for undertaking diverse social and economic activities to overcome the negative impacts of drought.

11. **Reducing conflicts over available resources**: strengthening existing conflict resolution mechanisms to enhance resource access and building the capacity of the communities to handle conflicts and conflict resolution mechanisms.

ANNEXES

Annexe 1: List of selected Woredas for program implementation

Criteria for selection;

- ✓ Accessibility
- ✓ Security
- ✓ Vulnerability

1. Jigjiga
2. K/Bayah
3. Awbarre
4. Gursum
5. Babile
6. Harshin
7. Gashamo
8. Dh/Bur
9. Shinnile
10. Denbal
11. Erer
12. Ayshi'a
13. Afdem
14. K/dahar
15. Godey
16. Kelafo

Annexe 2: Annual Program of Action Plan

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