Candlelight for Health, Education & Environment

Report

The Impact of Climate Change on Pastoral Societies of Somaliland

November 2009

Authors:
Ingrid Hartmann, Ahmed J. Sugulle,
Editing Author
Ahmed Ibrahim Awale

Contributors:
Prof. Abokor Sh. Abdi Mohamed, Mohamed Heban Awale, Asha Mohamed Samale, Abshir Migane Khaire, Elmi Ibrahim Wais and Ahmed Ismail Farah.

This document has been produced with the financial assistance of the European Union and Heinrich Boll Foundation; the Contents of this document are the sole responsibility of Candlelight for Health, Education & Environment and can under no circumstances be regarded as reflecting the position of the EU and HBF.

Lists of Acronyms and Abbreviations

CDM	Clean Development Mechanism
CLHE	Candlelight for Health, Education & Environment
DDP	Dry lands Development Paradigm
EC	European Commission
HBF	Heinrich Boell Foundation
INGOs	International non-governmental organizations
LNGOs	Local non-governmental organizations
ITCZ	Inter Tropical Convergence Zone
IWMI	International Water Management Institute
LADA	Land Degradation Assessment in the drylands
LDCs	Least Developed Countries
LUCC	Land Use and Land Cover Change
LUCF	Land Use Change and Forestry
NDVI	Normalized Differenced Vegetation Index
NOAA	National Oceanic and Atmospheric Administration
PEI	United Nations Poverty Environment Initiative (UNPEI)
REDD	Reduced Emissions from Deforestation and Degradation
SWALIM	Somalia Water and Land Information Management
TOR	Terms of reference
UNCCD	UN Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change

ACKNOWLEDGEMENT

Candlelight for Health, Education & Environment would like to thank the many individuals that made their contributions to the assignment, in terms of data, information and thoughts. Special thanks goes to:

- Ahmed Jama Sugulle, Project Manager, CLHE/HBF/EC project;
- Dr. Ingrid Hartmann, who was attached to the University of Amoud during the time of the study;
- The following members from the Department of Agriculture and Environment, Amoud University, Somaliland, for their participation in all phases of the assignment (planning, data collection and analysis). These include: Prof. Abokor Sh. Abdi Mohamed, Mohamed Heban Awale, Asha Mohamed Samale, Abshir Migane Khaire, Elmi Ibrahim Wais and Ahmed Ismail Farah.
- The communities of Salaxley and Balli Gubadle districts, particularly the elders and women groups for their hospitality, and for providing information. Special thanks also go to:
    - Mr. Ali Awil, the Regional Governor of Balli Gubale,
    - Mr. Jama Hussein, Mayor of Balli Gubadle and,
    - Mr. Abdirashid Mo'allin, Mayor of Salahley
- The logistics and finance departments of Candlelight for their excellent and timely arrangement of transport and resources needed for the assignment.

- Lastly but not the least, the European Union (EU) and Heinrich Boell Foundation (HBF) for funding this case study

Ahmed Ibrahim Awale
Executive Director
Candlelight for Health, Education & Environment

1. EXECUTIVE SUMMARY

Pastoralism is a traditional land management and production system which mimics wildlife in its basic principles. Through its dynamic, flexible and complex structures it has proved to be mostly adapted to the erratic climate and non-equilibrium natural conditions of drylands by providing and conserving a large array of ecosystem services in semi-arid to arid areas. During the last decades it has been increasingly recognized that pastoralism is essential for the sustainable management and ecological health of drylands, but also highly sensitive to increasing environmental degradation and global warming. Instead, however, pastoralism is threatened by a lot of factors, mostly political ones like sedentarization policies, focus on intensive agriculture, and low social status of pastoralists among many others, exacerbated by ecological degradation itself in a positive feedback-loop. Moreover, pastoralism is a system which can be assumed to be mostly capable of dealing with climate change by making best use of patchy vegetation, erratic rainfalls and coping with increasing droughts, climate change itself affects pastoralism and all ecosystem services it provides. This ambiguity – pastoralism in its role to deal with climate change and climate change as a factor which has negative impact on pastoralism - will be the subject of the following report, which will analyse how climate change impacts all relevant ecosystem services pastoralists provide and make use of as well as the bundle of environmental strategies they employ including their incorporation into their social and economic systems like migration and reciprocal and redistribution patterns of their economies.

Global climate models predict changes over the longer term – increased temperatures, shifts in rainy seasons, intense rains over much of East Africa – which will result in a mosaic of changing climate conditions with serious implications on land use. According to Intergovernmental Panel for Climate Change (IPCC), Climate projections in the Horn of Africa for 2080-2090 predict medium projected temperature and precipitation of 3.2^0C and 7% rise respectively. This trend will be characterized by "successive poor rains, increase of drought-related shocks, and more unpredictable and sometimes heavier rainfall (which are) likely to continue over the medium term[1].

The combined effect of land degradation and extreme weather conditions has caused food insecurity among the pastoral communities in the study area. Livestock numbers were tremendously reduced in some areas. Although the mentioned numbers of animals owned in three different wealth categories – rich, medium, poor – remained more or less the same, the number of people impoverished and switched from rich or medium to poorer categories tremendously increased. Livelihoods have suffered very much from consecutive droughts and most people do not see any future in pastoralism. Many pastoralists switched to charcoal production to compensate for economic losses from pastoralism, but are aware that this will also not be sustainable in the long run.

As an alternative option, it remains doubtful if agriculture will be a viable alternative to pastoralism in the area due to many aspects since the area is only marginally suitable for agriculture, while opportunistic agriculture does not yield high returns.

[1] Helen Bushell, Pastoralism and Climate Change in East Africa: Enabling Adaptive Capacity, OGB

Climate change and the combined effects of soil erosion and reduced vegetation cover/deforestation is also leading to biodiversity loss with its longer consequences of loss of indigenous knowledge and information systems on pastoral production and natural resource management, ethno-veterinary knowledge, weather forecasting etc.

While adaptation and mitigation to climate change need high investments especially for soil conservation, water harvesting, reforestation and rangeland improvement, hardly any of the local institutions or international non-governmental organizations have concrete plans and actions towards climate change awareness and adaptation . Therefore, to avoid the spiral food insecurity and reduce communities' vulnerability, immediate actions orientated to facing these challenges are more economic on the long run.

2. INTRODUCTION

The geographic coverage of this study is the present day Somaliland (formerly North West Somalia). Situated in the Horn of Africa, its boundaries are defined by the Gulf of Aden in the north, Somalia in the east, the Federal Republic of Ethiopia in the south and the Republic of Djibouti in the west.

Somaliland was formerly known as the Somaliland Protectorate under the British rule from 1884 until June, 26th 1960 when Somaliland got its independence from Britain. This independence was short-lived as the new republic merged few days later (July 1 1960) with the former Italian Somalia to form the Somali Republic. The merger did not work according to the aspirations of the people, and the strain led to a civil war which dragged from 1980s to the demise of the Somali Republic. In 1991, representatives from the various clans of Somaliland held a congress in which it was decided to withdraw from the Union with Somalia and to reinstate its sovereignty. Since then, Somaliland has been peaceful, stable, with a functioning national government for over a decade, but the country remains unrecognized in the international arena.

The total area of the Republic of Somaliland is 137,600 km² with a coastline of 850 kilometers long. Climactically, Somaliland is semi-arid. The country has a warm climate. The average daily temperatures range from 25-35°C. The sun passes vertically overhead twice a year, on 22nd March and 23rd September. Somaliland consists of three main topographic zones, the coastal plains- (*Guban*) meaning burnt, the coastal range- (*Ogo*), and the plateau- (*Haud*)

The population of Somaliland is estimated at around 3.5 million (Somaliland Government estimate). The average population growth rate is 3.1%. Population density is estimated at approximately 25 persons per sq. kilometer. Fifty-five percent of the population is either nomadic or semi-nomadic, while 45% live in urban centers or rural towns. The average life expectancy for the male is 50 and for females it is 55[2].

Pastoralism is the principle mode of production in most parts of the country whereby inhabitants with their livestock (cattle, camels, sheep/goats) follow seasonal migration patterns, mainly north/south movement depending upon rainfall and pasture availability. However, since the last 30 years, there has been a dramatic changes in the socio-economy of the pastoral population which were triggered by the breakdown of wet and dry season grazing patterns, loss of the natural bio-diversity, recurring droughts, change of land use, which in turn had its negative implications on availability of fodder, and thus negatively affecting livestock production and health.

Climate change poses a serious threat to the life on our planet Earth. The impacts of climate change are already being experienced across the globe. However, while climate change will affect everyone, it is expected to have a disproportionate effect on those living in poverty in the developing countries. There is a lack of community awareness about climate change although people in the study area as well as the region are already experiencing its effects in the form of extreme weather conditions, increased temperatures, unexplained phenomena of plant mortality

[2] *http://www.somalilandgov.com/cprofile.htm*

in some of the vegetation zones in the country etc. In the absence of adequate knowledge and information about climate change and its impacts, minimizing its impacts through adaptation will not be easy.

This main purpose of this study is merely an attempt to document the impact of climate change on pastoral livelihoods in the two districts of Salaxley and Balli-Gubadle in Somaliland. The outcome of the study is expected to add up to the understanding the causes of the deepening marginalization and vulnerability of the pastoralists, which makes many people believe that this mode of production system has outlived its usefulness.

3. OBJECTIVES OF THE STUDY

The study will detail the impact of climate change on pastoral livelihoods in the two selected areas with particular emphasis on:

1. Natural biodiversity (vegetation , domestic and wild life) – past and present
2. Land use (contribution to land use conflicts)
3. Seasonal migration
4. Rainfall and temperature
5. Livestock productivity
6. Socio-economic impacts
7. Impact of climate change on traditional weather forecasting

4. METHODS AND MATERIALS

The team comprised of members from Candlelight and Amoud University and possessed the disciplines necessary to cover the demands given by the TORs such as veterinary sciences and veterinarian sociology, georeference and water supply management, livestock husbandry, agricultural extension, sociology and economics, soil science and biodiversity assessment. The team members had experience in pastoralism assessments, household economic analyses and PRAs, water supply assessments and ecological assessments as well as institutional analyses and analyses of social systems and trade.

The current study is a field study on a micro level. It will therefore rather deal with specific local particularities of monitoring of climate change and vulnerabilities of local people than viewing the area or the local people through the lens of the climate convention.

Key questions to be answered in this respect were: How do pastoralists perceive changes of climate and weather patterns and which are their major indicators? Which were the impacts on vegetation cover, biomass, biodiversity, soils, soil fertility and livestock? How does climate change affect supply and resilience of various goods and services produced by pastoralist ecosystem, esp. water, hydrological conditions, biodiversity and their interaction? What is the

role or the potential of institutions in adapting to climate change? Finally, what are the trends of the overall carbon balance of the pastoral system under the current conditions? Which would be appropriate adaptation and mitigation strategies to climate change for the country?

By far the largest information has been directly collected as primary data from pastoral communities within the study area via participatory rural appraisal tools (Observation, semi-structured meetings, and unstructured interview, cross checking, timeline/historical profile, focus group discussions, household economy assessment and so forth) while meetings have also been conducted with local officials from a various districts.

In summary, the study involved or passed through following stages:

1) A planning meeting bringing together all research team members
2) Designing and pre-testing of interview schedule and questionnaire
3) Field work with the aim of generating primary data from target members/households within the study area.
4) Data analysis
5) Report writing

As the UNFCCC National Reports[3] indicate that the impact of climate change became visible during the past 30 years and while such a report has not been completed for Somaliland, the team agreed on putting the same time frame for our analysis.

Rapid Participatory Assessments was the first tool to be applied to get information about general trends (compare Annex). Based on this, main indicators were developed to assess the impact of climate change in detail. With semi-structured and open interviews the trends of these indicators were analyzed. While receiving information from all representative groups within the pastoral societies were tried, special consideration was given to women to elaborate changes in their roles, especially in regard to decision making and labour distribution. Pastoral *Sahan* (scouts) are a major source of information on impacts of climate change, since they are periodically on move and sent out to search for better pasture and water for their animals, as they also play a pivotal role on decision making processes on migration patterns.

The research was supported by already available vegetation and soil maps and data from Somalia Water and Land Information Management (SWALIM) and by an evaluation of climate data over the last 30 years also available from SWALIM. The research was also inspired by the SWALIM Natural Resource Survey (FAOSWALIM 2007) and the frameworks of the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005) and the Dryland Development Paradigm (DDP), compare Reynolds (2007).

[3] www.unfccc.int

5. DESCRIPTION OF THE AREA

To avoid that the study will become too general, it was decided to conduct an intensive investigation in the selected areas which are semi-arid. Generally semi-arid ecological zones are known to be most vulnerable to climate change, more than arid zones themselves and areas with higher rainfalls.

The area is located in the *Haud* area South and Southwest of Hargeisa, the capital of Somaliland, starting from the hilly areas outside Hargeisa Airport till reaching the Ehio-Somali border at a distance of roughly 70 km south of Hargeisa.

The *Haud* south of Hargeisa has originally been covered mostly by semi-arid woodland of scattered trees, mainly acacias, underlain by grasses that include species especially favoured by livestock as forage. Vegetation patterns can be explained by the variation in texture of the soil parent materials. For instance *Acacia bussei - Chrysopogon aucheri* or *Acacia tortilis - Andropogon kelleri* communities were organized as vegetation stripes (tiger bush) along water lanes in the Western parts of the *Haud* in Somaliland. These stripes were created by wind and water erosion which restructured the soil texture patterns in a way that fine textured materials accumulated in existing bush lands, creating periodic vegetation patterns that shaped the landscape in a way that trees and shrubs dominate on fine-textured soils with higher water storage capacities and also accumulate or maintain fine-textured soil and thus lead to a two-way feedback loop between environment and vegetation – a positive influence where fine-textured soils are accumulated, and negative ones where coarse textured soils are blown away. (Barbier et al. 2007).

The mean annual rainfall in this zone is generally between 200-300mm and is characterized by mixed woodland of acacia type composed of *Acacia bussei, A. tortilis, A. Senegal.* However, much of the tree component was destroyed by indiscriminate utilization mainly by charcoal burners and for the establishment of enclosures. An extensive *bun* (treeless plain) known as Qool-Caday, which in the past used to have one of the best grazing grounds, is also lying within the area under investigation. Productivity in terms of edible and/or palatable forage for livestock has been greatly reduced by excessive grazing over the years. The reduction in the grass cover is very notable when comparisons are made between today's cover and that described by early travelers (Swayne 1895). For example, Drake-Brockman wrote in 1912 of millions of acres covered by *Chrysopogon aucheri.* However, this valuable grass and others, namely *Andropogen kelleri ('duur') and Sporobolus marginatus ('dixi')* has now been largely replaced by species which are less palatable and less productive. According to Hemming (1966) common *Daremo* grass (*Chrysopogon aucheri*) is remaining under bushes or in vegetation arcs. Many areas are now converted into bare ground due to de-vegetation processes, long period of drought and over-grazing where the strong turbulent dust storms during *Haggaa* season *(May-September)* cause the soil to be transported. These areas are represented by wind-scoured or blowout areas where the finer particles of the topsoil have blown away, sometimes leaving residual gravel, rock, or exposed roots on the soil surface[4].

[4] C.F. Hemming: The Vegetation of the Northern Region of the Somali Republic (1966)

The *Garodi* woodland just to the east of Qool-cadey plain, was well known in the past for its richness in Acacia *bussei ('galool'*) and *Sporobolus marginatus ('dixi'*).

The region also used to be well-endowed with wildlife. According to literature going back to the 19th century, Somaliland's was teeming with wide variety of wildlife. There is mention of elephants and rhinoceros around Mandera between Hargeisa and Berbera (Swayne, 1895). Large mammals, including endemic Somali Wild Ass, were concentrated on diverse habitats of the country. These included lions, elephants, Gazelles, *Dorcatragus Megalotis ('Beyrac')*, *Ammodorcus clarkie ('dib-tag'*), *Gazella soemmeringi ('Cawl')*, Oryx *(Oryx gazella)* and so forth. Traditionally, hunting the wildlife for subsistence and economic gain was an uncommon practice and indeed was regarded as the task of the inferiors.

Predators (lions, leopard, cheetah, hyena etc) were controlled by bonfire, which was a common defense mechanism against them before the acquisition of the gun. Pastoralists burned large patches of forest or woodland in places ridden with predators in order to drive them out. However, long before the civil war, some major mammals such as elephants, giraffe etc disappeared whilst the lion, Oryx, *Alcelaphus buselaphus swaynei ('Siig')* and The Somali Wild Ass populations declined significantly and was no longer present in areas where they used to populate.

Among the most common wildlife remaining are the baboon (*Papio hamadryas*), warthog (*Phacochoerus aethiopicus)* which have been saved from hunting by the religious belief that consuming their meat is prohibited and impure. *Speke's gazelle* and Gerenuks can still be encountered in the area in few numbers, while Dik-dik *(Madoqua spp.)* are still numerous, thanks to their smaller body build which makes a difficult target for poachers using guns. Remaining carnivores include hyena, bat-eared fox, wild cat (*Felix lybica*).

6. SOCIO-ECONOMIC CONTEXT AND CURRENT TRENDS

Pastoralism is the principle mode of production system in the area, mainly herding a combination of camels, sheep and goats. It is estimated that 60-80% of food and income sources of the pastoral communities is derived from livestock and livestock products (milk and Ghee[5]). However, agro-pastoralism is practiced towards the southern fringes of the study area in where the topography is hilly and offers fertile depressions. Sorghum, maize and cow peas are the principle crops while *Qat (catha edulis)*[6], is becoming popular throughout the area as a cash crop due to its high demand in both urban and rural areas.

This part of the country used to be a wet season grazing area before the breakdown of seasonal grazing patterns. Pastoralists with their livestock used to sojourn in the area during the two rainy seasons (Gu' and Deyr). Rainwater filling natural depressions made possible the temporary stay of pastoralists and their animals in the area; but once these are exhausted they used to move back

[5] Clarified butter
[6] An evergreen shrub and a mild stimulant whose leaves are chewed mostly by men which cause euphoric effects

to their traditional water points in the Golis area and further north to the Guban coastal plains during Jilaal (winter) when the temperature is bearable.

According to Food Security and Nutritional Analysis Unit- Somalia (FSNAU)[7] reports and maps, the area is borderline-food insecure, and although this means that food security is continuously at the edge, the area is still a little bit better off than other pastoralist areas in the country. This is due to its proximity to Hargeisa, the largest urban centre in Somaliland, whereby the inhabitants have better access to markets and, moreover, getting a fairer share of humanitarian assistance compared to the remoter parts of the country. Nevertheless, communities have faced high losses of livestock over the years and particularly in 2009, following the failure of spring (Gu') rains.

Animal carcasses at Qool-caday plain

On the basis of the above, there is always an ever-present threat of herd losses from the change in climate patterns witnessed, particularly in the study area as well as other similar pastoral areas in the Country.

Bearing in mind that the collapse of herd size recorded can be inferred to suggest increasing threats to the traditional livelihood of the pastoral communities, this section attempts examine to what extent the reduction in herd sizes will affect the viability of pastoral production systems.

In doing so, to find baseline information that form the basis of analysis on whether the current livestock holding per family meets the necessary requirements/needs for the pastoral households within the study area, an attempt was made to identify whether there is an established livelihood normal threshold herd size for pastoral households at the community level as scientific information on this issue is not available.

[7] www.fsau.org

Drawing on the responses of the respondents in regard to what is seen as the normal wealth threshold herd size for a pastoral household of seven (7), the outcome is summarized in the following table:

Species	**'Normal" threshold herd size for family of 7 Persons**	
	Single species	**Mixed species**
Camel	40 Heads	25 camels/200 shoats or 30 cattle/200 shoats
Small ruminants	400 Heads	
Cattle	50 heads	
Burden animals	2 camels or 3 donkeys	2 camels or 3 donkeys

Table 1: Livelihood 'normal' threshold herd size (in accordance with the target groups)

From the above figures, it can be concluded that the number of animals that can shape a minimum livestock of normal holding per person in pastoral areas are 7 camels, 57 shoats and 8 cattle in the case of single species, whereas the numbers for mixed species holding are 3 camel, 28 shoats and 4 cattle.

Moreover, focus group discussions disclosed that the current livestock holding for over 80% of the pastoral households within the study area remain at least 40% below the figures indicated in the above table.
An increase in the person to herd ratio will mean fewer livestock numbers per a household and, therefore, this situation makes the pastoral family more vulnerable to destitution in times of droughts. In such difficult times, poor pastoral households are forced to sell animals of higher value such as pregnant and milk animals which they normally retain in normal times.

However, coupled with lack of diversity of livelihood options and access to resources, poor pastoralists believe that there is only a little opportunity for recovery, as the traditional coping mechanism in the form of social support has become over-stretched. Therefore, there is a great likelihood that those who have fallen into destitution will abandon pastoral life and settle in the urban centers as environmental internally displaced persons in major towns.

Apparently, one can draw from the foregoing that pastoral households in the study area are at most times deficient in subsistence level and are, therefore, depended on external assistance.

Another serious challenge which directly affects the recovery process and resilience of the long term pastoral livelihood is the low recovery capacity of the environment resources, mainly pasture material.

7. CLIMATE OF THE STUDY AREA

The climate of the study area follows the general climatic pattern of Somaliland. The climate is influenced by the northerly movement of the Inter Tropical Convergence Zone (ITCZ), which is responsible for the bi-modal rainfall pattern which the country experiences annually. The general climate is hyper-arid, arid and semi-arid. Records collected for over 40 years for Hargeysa indicate that there is the probability of rains during five months of the year but the actual amounts vary considerably. The rainy season has two peaks. The first occurs during April to June and is the more important of the two rainy seasons. This is locally known as the "*Gu*" and is of significant importance to the nomads and the agricultural communities. This rain is brought up by the south-west monsoon which blows during this period. Temperatures at this time of the year are somewhat above the yearly average of $21.7C^0$ with the highest temperature – around 40^oC – occurring in the last half of June.

This rainy season is followed by a short period with less rainfall but with, more significantly, dry strong winds. These winds reach their highest velocities in July. And they have a very serious desiccating effect on vegetation and the annual crops in the agricultural areas. They are most uncomfortable for the human population as well.

Deyr (Autumn), the second rainy season is most significant, not only for the recovery of crops that had been damaged by the strong and dry summer (*Hagaa*) winds, but also for the short time crops such as maize and dwarf sorghum. This period sees the cessation of the strong winds of the preceding period. During winter *(Jilaal)* both the mean monthly temperature and rainfall drop, though this is associated with tremendous variations as mentioned earlier.

The very few records of evaporation report values vary between about 1000-3000 mm/yr. In general, evaporation is much higher than precipitation across the country, only temporarily rainfall can be higher than evapotranspiration sometimes during the rainy seasons (compare Annex).

Generally, all Somali climate, weather and vegetation etc. is comprehensively monitored by the modern scientific systems of FAO, especially FAOSWALIM and FSAU. The major parameters which are monitored are temperature, precipitation, air humidity, wind speed and direction and overall climate dynamics. A comprehensive overview is given by Mucheri (2007). Additionally vegetation parameters are monitored, especially the NDVI, based on National Oceanic and Atmospheric Administration (NOAA) remote sensing systems.

General predictions on the future climate at the Horn of Africa are made by the IPCC climate models, which forecast an increase of temperature for the Horn of Africa of about 3.4° C for the future and an increase of rainfall variation between 30 – 40%, with rather higher quantities, which, however, would rather increase the amounts of off-seasonal rainfalls while seasonal rains would decrease (IPCC 2008). Earlier models predicted increasing temperatures with reducing rains (IPCC 2005).

8. CLIMATE CHANGE IMPACT

8.1. Community Perceptions of climate change

Concern is growing among community members over changes in earlier weather condition observed in the pastoral areas covered by this study. Comparisons made on the indigenous knowledge on weather conditions in the past and present, show there is a consensus among pastoral communities that change has occurred. The communities visited were unanimous about changes in temperature and rainfall levels. However, the predominant belief is that these changes are due to "God punishment" for the "sins and transgressions" of humankind. Generally, climate change is already happening with its impacts being felt by most of the people in the country, particularly pastoral communities, who are more vulnerable to its effect as they rely on livestock production that is highly weather sensitive. The observations made by the pastoral communities in the study also seem to confirm the scientific facts, which show that climate change is occurring and impacting livelihoods and ecosystems.

8.2. Impact on the indigenous knowledge related to weather forecasting

Traditional knowledge and information systems have a prominent role in rangeland and livestock management, and regarding the gaps in information from remote sensing, pastoralists would have been badly advised only to rely on modern systems. Traditional knowledge is sensitive and comprehensive and can be adapted also to changing conditions. Nevertheless, traditional knowledge has been developed under conditions, where climate and calendar were in harmony, where climate was mainly influenced by the positions of sun, moon and earth to each other and by the movement of trade-winds, undisturbed by atmospheric disruptions caused by increased emissions of greenhouse gases (GHGs). Another issue is, that traditional knowledge is also somewhat difficult to apply, like calendar setting, and modern calendars are nowadays also available to every pastoralists, who own mobile phones anyway and traditional knowledge is speedily eroded especially by the fast progress of urbanization, which is also accelerated by climatic change and its pressure on income generating opportunities in rural areas. In this sense traditional knowledge is one of the greatest victims of climate change.

Nevertheless, the preservation of vivid traditional knowledge is of paramount importance also for the restoration and conservation of a healthy environment for the following reasons:

a) Different from modern systems like remote sensing, traditional knowledge is applied directly where it is needed, it is therefore much more sensitive to immediate environmental changes and it is immediately available to the user.

b) Traditional knowledge might not tell the reasons for climate change as induced by GHGs, however, it still tells us how conditions would look like under healthy environmental conditions. Therefore, rather than a descriptive knowledge system, traditional knowledge could be taken as normative for the future, showing us, how conditions would look like if the world would still be in order.

c) Traditional knowledge reminds us about the roots of culture, in this case especially of Somali culture. Except to specialists, it is hardly known to everyone, how the calendar dates on a mobile phone relate to the stellar movements in the celestial sphere, how air humidity is related to the flowering behaviour of trees etc.. Therefore, traditional knowledge maintains awareness of the bigger cycles humans and environment are a part of.

Like many arid and semi-arid regions across regions of the World, pastoralists within the study area inhabit a fragile environment where living conditions are harsh and challenging, characterized by an extreme variability of rainfall between different years and between different places in the same year. Consequently, the seasonal variability of vegetation and vulnerability caused by recurrent droughts has been a common phenomenon, which local pastoralists witnessed regularly for centuries.

To reduce the devastating effects that often result from unpredictable and variable weather patterns, pastoralists have developed a culturally rich early warning system based on long-term observation and centuries old accumulated experience which was highly regarded as a source of inspiration, guidance and a tool for decision making. For example, rain forecasting has been a developed art among Somalis. This art was born from a synthesis of Persian and African astronomy. The Persian inheritage for instance can still be found in the *Nayruus*[8] ceremony, which is celebrated with ignition of fire (literally *Dab-shid*) and hanging a life branch/leaf (preferably aloes) at the entrances of houses, and is still a major starting point for traditional weather forecasting.

The northern Somali forecaster is called *Xidaar* (literally: someone warning against something ominous, such as drought, tribal conflict or heralds something good such as rain*)* or otherwise *Xiddigiye (*astronomer). This class of people were very much respected as their predictions generally used to be precise.[9]

Local astrologers predicted the probable course of events and on the basis of the information generated, pastoralists used to base their decision on issues related to their day to day life, whether climatic (rains, droughts) or social (migration, tribal warfare, marriage etc).

Given the importance of such traditional weather knowledge and the role it plays in coping with the significant threats from the climate change and variability phenomenon taking placing throughout the world, the study team organized a number of group discussion meetings with knowledgeable elders and traditional weather forecasters. The outcome of the discussions are grouped in the following chapters.

The following poem, narrated by a Somali pastoralist, generally alludes to the change in the weather and climatic conditions, particularly during the serious drought of *Daba-dheer* (literally long-tailed/long-lasting) which occurred in the northern regions of Somalia during 1974-75.

Ninka faalka Moorada Cirkiyo Dirirka maankiisa
Majiiraha Cirka seermaweydo iyo

[8] Compare to Norouz, the Persian New Year (Lewis 1955)
[9] Ahmed I. Awale, Climate Change Stole our Mist, (2007), Candlelight

Cawal mudduu muran ka taagnaaye
Mushkil baa ku dhacay Geydhe iyo Muhandistiisiiye
Laxaa marida loo eegi jireey, maalin haysimo e
Balse ninka sii miliilicayoo Mooshinkii haloowye.

Miiraalihii roob Gud-gude soo mirkici waaye
Halkuu waqalka soo marin jiruu dhigay mandheertiiye
Waayahanba miid lagama helin madaxyo weyntiiye
Masqal baa ku toolmaday maydal dheeraha e
Wixii caano laga maali jirey maato sabi-waaye.
Ragii Maahir dunida u lahaa, una madiixaayey
Inay webiga Maatada dhigeen uumiguu maqalye
Masruufna waxay ku qaataan galey maalin loo qado e
Majihiibaa kor loo eegayaa madaxii hooseeyo
Waxaan Muuqan jirin ayaa manta la hayaaye

This poem demonstrates the disturbance in the traditional weather forecasting to an extent that the predictions are not valid anymore and how the local communities argue in vain about the decrease in rainfall, animal products, particularly milk and meat.

On other hand, the poem mentioned how change in rainfall patterns, distribution and intensity, for example *Gud-gude* and *Miiraale* (both illustrating heavy night rains), are not as heavy as they used to be in the past. From the above also, a change in the traditional sheep calendar whereby pastoralists used to loose the ram into ewes for mating can be noticed. The poem had also made a clear indication on how change in rainfall pattern observed in the area immediately affected livestock production and their products (Milk, Ghee etc). The poet further laments the effects of the catastrophic effects of *Daba-Dheer* drought which triggered mass displacement of tens of thousands of pastoral households, mostly in the three eastern regions of Somaliland (Sanaag, Togdheer and Sool). Tens of thousands of the affected camel-herding households where transported to the riverine areas of Southern Somalia to start a new settled life based on agriculture and fishing. The poet describes the change in the lives of the former pastoralists as if "their heads were turned down to take the place of legs" and finally concludes his poem with **"what can be witnessed today (the change) is something never seen before"!**

8.2.1 Change in Sheep Mating Calendar

Usually, Somali pastoralists keep rams and ewes apart throughout the year, to control mating in a way that the ewes do not give birth to new born lambs in the dry season, when the feeding resources will not be enough for the next generation. *"Dambasame"* is the night, when Somali nomads let loose the rams with the ewes for mating, because it was about 150 days – the time the sheep are pregnant – until the beginning of the Gu rains. Dambasame night occurs exactly 120 days following the *Dabshid (Nouruz)* which marks the 1st night of the Somali year. It is the night when in the middle of autumn (November) the moon is in conjunction with the Urur/Pleiades on the 15th day of the lunar month or full moon. The Pleiades constellation is very important for Somali nomads and is also known as "*Urur"* or "*Laxo",* while "Laxo" means also sheep. So the

mating time is determined by using the Urur/Pleiades as a point of cue, and also as a precursor for tracking the time period left until the rains will begin in spring (Lewis 1955). In this way mating time is determined in a way that the lambs, which will be born about 150 days later, are delivered in a season of abundance in the middle of the Gu rains (spring) around April.15th. This is the time the Pleiades will start to set at about twilight described by the following proverb: **"***markey laxo dhacaan ayey laxo dhalaan*", "When the *laxo* star in the sky goes down, then the sheep bring birth**".** This also expresses the double meaning of "laxo" as a star and as a sheep.

The calculation of mating and delivery time of sheep in relation to the Dambasame night, as practiced until 1975, before the 'first' evidences of climate change was felt, is illustrated in figure. 1

Fig.1: The traditional Sheep Calendar prior 1975 (prepared by Ahmed Jama Sugulle)

While the night of "Dambasame" is still used to calculate the beginning of the Gu season, nowadays pastoralists are well aware of the changes of season and the unreliability of the onset of the Gu season, which is expected now to start about 30 days later than before (around May 15th earliest, sometimes even on June 15th). Therefore, from recent local experience, showing that Gu' rains shifted roughly around 30 days into the summer time, mating of the rams and ewes are not any more organized at Dambasame night, but 30 days later, meaning around December 15th. This shows the adaptive capacities of this traditional forecasting and decision making system.

8.2.2 Mating Management Based on Wildlife Behaviour

While the rough calculations on the basis of Dambasame night are still in danger to become the victims of the unreliable beginnings of the Gu' season, there is another method for the determination of the proper mating time, which is said to be almost infallible: It is correlating the mating time of sheep with the mating time of the *Cawl.* The *'Cawl'* gazelle (*G. soemmeringii*) is the only gazelle species which mates outside the normal mating season, when all animals or gazelles are busy mating, which has the effect, whenever there is a drought because of Gu rain failures many of the newborn off springs of the other gazelle species suffer and die. However, the same is not true for the 'cawl' gazelle. There is a well known folklore which says that Cawl gazes at the stars before it mates and is said to be able to read the stars better than humans *"For you will never see a 'cawl' gazelle with new born off spring in times of failed spring rains, like you do with the other gazelle species"* (Somalilandtimes 2005). Also some modern researchers assume a relation of the mating behaviour of *Gazelle soemmeringii* related to a certain photoperiodism (Spinage 1973). According to Somalilandtimes (2005) some nomads used to go far in the middle of the night to keep a track on a nearby herd of 'cawl' gazelles, so that they know when to let their rams mate with the ewes, and all this depended on whether the 'cawl' stag gazelles had started to mate or not. Because, in the time period which 'cawl' gazelles give birth to new born offspring is about the same time as sheep give birth to their new born lambs (five months from the time of conception).

There are countless phrases, songs, proverbs and poems in Somali, which ascribe these skills to the 'cawl' gazelle and countless other wild animals. The poem of Cali Dhuux ascribes, these skills to the 'cawl'[10]:

Markuu cawlku cawlaa orgayn, waa u cibaaroone,
Cisaday ku uuraysatiyo, caadaduu garane,
Cashaday calool gelahayaan, cannugga beertiisu,
Curcurradiyo lawyada intuu, ku cuskaduu saaro,
Cirridiyo cagaar miday ku dhalan, caadka kor u eegye,
Hadba cirirka loo nuuriyuu, ku cimro-qaataaye

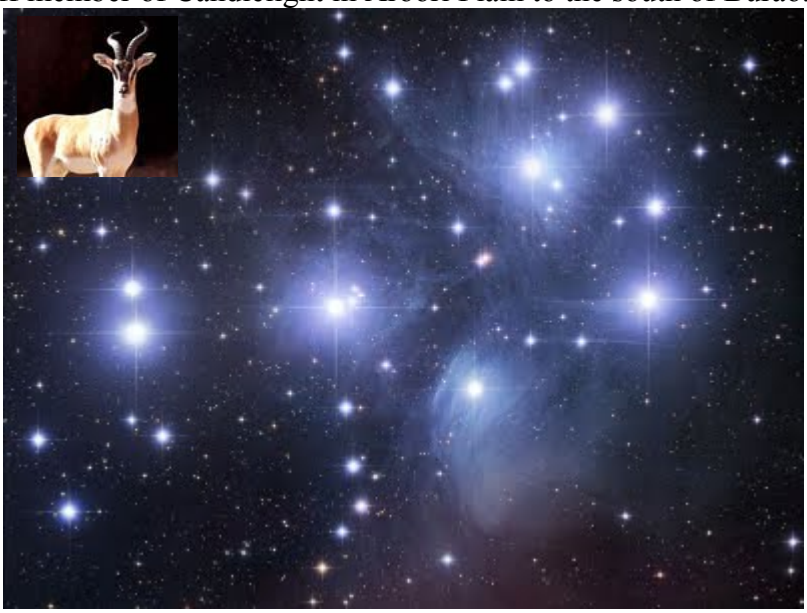
When the male 'Cawl' wishes to mate with his females,
He first makes astronomical calculations,
He knows their menstrual periods and the techniques of mating,
The day he wishes to cause propagation and off springs,
He, placing first his front knees on to the female's back,
Judges whether the young will be born in sun or green from the signs in the heavens,
His decision whether to continue mating or to descend is in accordance with his celestial inductions

The above story links indigenous knowledge, myth, and current changes. An ungulate "reading" the stars is fascinating. However, if we try to match this indigenous knowledge with the later scientific findings, it is true that some ungulate have the ability to delay the birth date for a

[10] www.somalilandtimes.net/somstars/forward.html

period of time if conditions are not suitable, thus ensuring the survival of the calf. Therefore, this means that 'Cawl' gazelle will always deliver its calves during a rainy season!

Unfortunately the *gazelle soemmeringii* is now rated as 'vulnerable' in the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species due to rangeland degradation and hunting. Therefore, its rarity and decline in number makes it inadequate as an indication for proper mating dates. A small herd of 'Cawl' gazelles, maybe some of the last herds in Somaliland, consisted of a stag and two females were recently (October 2009) sighted and photographed by a staff member of Candlelight in Aroori Plain to the south of Burao.



S. Gazelle (Caw)l gazing at Pleiades to decide its Mating Date

8.2.3 The Impact of Climate Change on Mating Time of Wildlife

Pastoralists pay high attention to wildlife, not only as an indicator, but also as a source of pleasant creatures in their environment and as potential food resources for hunting. The impact of climate change was an indirect one. Most wildlife had disappeared through habitat loss and wide scale hunting. Fox, warthog and Hyena are the main predators that are still prevalent in the study area.

Except the *Cawl,* which is able to fully integrate the whims of climate change into its mating behaviour, but hardly still exists, changing climate leads to greater confusion in mating behaviour to other wildlife. While there is, as the tradition goes, a position or hole in the sky, called **"***felak*" which distinguishes the date of mating time between livestock and wildlife, mating periods between wild and domestic animals gets more and more intermingled, since the distinction of *Gu* (spring) and *Jilaal* (winter) seasons is getting more and more dismantled, and wildlife and domestic animals are in rut at the same time, partly to the bewilderment of the domestic animals.

8.3 Climate change and droughts

A drought is defined as a period of months or sometimes years when an area or a region experiences a deficiency in its water supply due to consistently below average precipitation. Although a natural phenomenon, its effects can be worsened by anthropogenic factors. Usually droughts can persist for several years although even a short, intense drought can cause significant damage (IWMI 2007).

Likewise, the pastoral community defined drought as a degree of inadequacy of precipitation, in comparison to a normal or average amount and the duration of the dry period. In other words, it is defined as total or partial failure of two or more of the regular rainy seasons.

There are biophysical droughts caused by lack of precipitation and water availability, there are social and political droughts caused by failures of institutions to establish the necessary infrastructure for the required provision of water or due to increased water demand by growing populations and several others (IWMI 2007).The pastoralists' view on droughts is a complex, holistic and spatial one including all areas they usually migrate to and comprises all types of biophysical droughts, as the absence of rain in the Gu season, a decline of rainfall in the Deyr season, lack of water in berkads due to construction or maintenance failures, loss of run-off water due to erosion and decline of water storage capacities of soils.
Main indicators for experiencing a drought is related to livestock and livestock products, mainly in lack of off springs, skinniness and big bellies of sheep, who are most vulnerable to climatic stresses of any kind, and especially in a lack of camel milk, which indicates both previous and immediate scarceness of pastures.
Different from many other countries, where climate change impacts have roughly been reported for the last 30 years (see UNFCCC website), Somaliland pastoralists mainly describe a change of rainfall pattern for the last 10 years, in which only two good years appeared.
Informants described the development of weather patterns since 1980 as follows:

- 1980 drought "*Lafa'ad*" {white bones} – 90% of livestock, particular shoats died, and dead bodies were piled en masse.
- 1981 lots of rains
- 1982 normal rains
- 1983 farms and rains were prosperous
- 1984 less rain, 60% of livestock died
- 1985 good year, plenty of vegetation in the beginning, but then the rains stopped during the last two months and water trucks had to come from Hargeysa and many animals died
- 1986 no rain, they all went to Ethiopia where rainfall conditions were better
- 1987 alright
- 1988-1991 civil wars started. No drought. This is the time when almost all the inhabitants of Hargeysa as well as nearly all pastoralists in the project area fled to Ethiopia. They returned in 1991 and the vegetation then recovered and was rich, so they had some good time.
- 1992 poor rains
- 1993 normal rains
- 1994 drought

- 1997 droughts, water was delivered by trucks, the *Deyr* was exceptionally good and was named as *Biyo-badan* (plenty of water)
- 1998 normal rains,
- 1999 droughts, water was delivered by trucks[11]
- 2000 – 2002 droughts, water was delivered by trucks
- 2003 – poor rains
- 2004 – normal rains
- 2005 droughts, water trucking
- 2006 good rains
- 2007 drought
- 2008 drought
- 2009 drought, Gu' rains failed, lot of livestock deaths, but the Deyr rains were good

Drought conditions have always been a recurring feature in the long history of pastoral production in the region. Droughts have also their gradations and almost all severe droughts were marked with a name, for example, *Haraama-cuune* (1914) - a period of bad drought complicated by internecine warfare and looting of properties among tribes on one hand and the British campaigns against the warrior Mullah, Mohamed Abdulle Hassan on the other. Some of the major droughts of the last century were *Dooryaale* (1928), *Siiga-case* (1954), Gaadhi-gaadhi saar (1964-65) and *Daba-dheer* (1974-75). While it has been a common understanding among pastoralists, that droughts occur about every 10 years (see table 2 below) – other observed cycles are seven, thirty, fifty, or eighty years (*sideetan guuro*) and if one cycle fails, the next one becomes operative. However, it is important to note that the occurrences of those cyclic droughts during the past 30 years or so were becoming more frequent and more hard-hitting than ever before. Most people in the project area said that the only years with good rainfalls were between 2004 and 2006. In 2006 there were 80 nights of rainfall and camels got pregnant, which is – together with camel milk production, an important indicator for prosperous years. Before that there was not much rain, and after that the drought 2007/8 was one of the worst droughts continuing in most areas until present.

During the early part of the last century, there was an average of a ten year interval before the next severe drought strikes, against four year interval during the last few decades of the last century. Again it seems now that a drought condition is experienced once in every other year.

Increase in temperatures and reduction of precipitation has contributed to these drought scenarios which have caused the death of myriads of animals and exposing thousands of pastoral households to the ever present risk of asset depletion and ending in a state of destitution.

[11] Gaadhi-gaadhi-saar: as the name indicates, this was the first time trucking water on trucks started in Somaliland.

Table 2: Major droughts in the living memory occurred once in every decade

No	**Drought name**	**Year**
1.	Xaaraame –xune	1914
2.	Hawaara	1924
3.	Adhi-gaba	1934
4.	?	1944
5.	Siiga-case	1954
6.	Gaadhi-gaadhi saar	1964
7.	Dabadheer	1974
8.	Dhibi-jaale	1984
9.	Soor & Biyo-waa	1994

8.4. Climate change and wind movement

As local informants said changes of wind directions are the major cause and indication of changes of seasons and increasing droughts, since heavy dry winds would blow away the rain-laden winds blowing from the coast. This, however, does not only affect the rains, but also the fog. In earlier times there has been about **one month of fog** before the beginning of the Gu. Nowadays the wind reduces the fog and the mist: "*When there is much wind and Naaria and Maayu come together, then there is no fog or mist",* which hampers the early vegetation regrowth before the start of the rainy seasons (Ahmed Ibrahim 2008).

Wind speeds have been reported to have almost mercilessly increased, leading to dust and sand storms which reach up to Hargeisa, forming sand dunes or and blowing away or evaporating rains before they touch the ground. This might have both macroclimatic as well as microclimatic reasons, deforestation and decline of vegetation among the major ones.
Sand and dust storms are also triggers for the formation of sand dunes especially during the Xagga season as well as for causing droughts through increased evapotranspiration.

8.5. Climate change and desertification

Climate change has furthermore triggered desertification. There are huge amounts of literature about the correct use of the term desertification and its meaning. In the following desertification is referred to the process of soil degradation in the area, which is semi-arid to arid.

Desertification takes place in the following steps:

Litter production is reduced due to an overall decline of biomass production as a consequence of increased evapotranspiration rates and aseasonal rainfalls, which hamper the development of plants. Reduced litter production leads to a decrease of organic matter content of the soil, which reduces soil structure, increases soil compaction and reduces water storage capacity leading to almost unproductive, downright sterile soils in extreme conditions which increase surface runoff.

Reduced litter production – near Bali Gubadle

Increased runoff leads again to thinner soils and drier edaphic conditions and for the first time the area around Gumar near the Ethiopian border has experienced floods in 2008, whereby large number of animals drowned.

Reduced landscape rugosity from tree and shrub elimination (smoothed land surface) results in faster wind speeds at soil surface level and also in a higher albedo, hence increased potential evapotranspiration, increased water and wind erosion, and therefore drier microclimatic conditions because of the lack of windbreak and shading effects (Le Houerou 1991).

Sheet erosion by wind has removed almost all topsoil in the plains; in other areas wind and water have removed fine particles leaving gravels on the surface of regosols behind, all processes which are difficult to reverse.

Sand has been deposited through rains in almost all riverbeds and the surface of drainage channels and erosion rills which have been formed by water erosion are quickly filled with sand sediments

Erosion rills filled with sand near Bali Gubadle

Higher soil surface daily maximum temperatures and therefore elevated potential evapotranspiration due to the lack of shading leads to a decline of organic matter and an overall decline of growing seasons, leading to a change of species, which is partly responsible for the decline of grasses in the area like *Dareemo* (*Chrysopogen aucheri*). These processes create less favourable conditions for germination, and emergence and establishment of seedlings which is hampering the re-growth of natural vegetation. This reduces the recovery time of trees after clear-cuts for charcoal burning.

Wind erosion (creeping, saltation, reptation, suspension, corrosion) causes frequent and heavy sandstorms especially during the Xagga season, and sand dunes are forming within hours. Wind deposition of sand during these storms results in the formation of dunes, where trees do not act as windbreaks, creating new soil types in these areas - arenosols. Arenosols have been formed in certain areas during the last few years through the sudden emergence of sand dunes. According to the interviewed people the formation occurred very sudden during the last 5 years, however, it can be regarded as a result of long-term creeping processes of soil destabilization in other areas, in this case probably Southern areas of region 5, which had been overlooked for long. Sand dunes are mostly overspreading the remaining ground cover like *hiil* and *dixii*, which becomes unavailable as a feed for shoats. Sand also oversilt *berkads* (in ground cemented water cistern) in some areas and therefore negatively affect the availability of water.

Sand dune formation between Hargeysa and Salaxley (Photo: FSAU 2009)

Fertile soil particles are blown up to Europe, fertilizing the soils there, reducing nutrient contents of Somali soils to a further degree.

These processes have also expanded the spaces between the different tiger bush bands (Barbier et al 2007).

8.6. Reasons for degradation of Vegetation: Climate Change or Overgrazing?

Within the previous decades, biomass of the vegetation declined and also a lot of species were lost. Among the major grass species, like in other areas, *Chryosopogon aucheri* and S*poroborus variegates* are unavailable, leading also to the decline of livestock, the loss of underground cover like *hiil - Vernonia cinerascens* reduces mainly the fodder basis for sheep. Among the trees it is mainly the *galool – Acacia bussei*, which has become the major victim of charcoal burning.

A lot of discussion has been devoted to the question, if it is climate change or overgrazing, which causes the current reduction in species composition and diversity. The interviewed groups clearly indicated that it is consecutive droughts and aseasonal rains, leading to the following interactions:

Vegetation does not reach the flowering period or dries up during the flowering period therefore the sexual reproduction fails, the biomass of the whole plant is reduced and does not cover the ground properly, therefore exposes more soil and water erosion. Subsequent erosion either bares the roots, or covers upper parts of the plant by sand dunes, in both of which cases vegetative reproduction is hampered, so that the original vegetation decreases in quantity. This gives either room for an iterative feed-back-loop which leads to more and more thinning of native vegetation by more and more erosion, or it invites other more competitive plants to proliferate. This can lead in the best case to a selection invigoration of local trees, which are more resistant to erosion and water scarcity on the cost of grasses, shrubs and forbs which are more and more suppressed, in the worst case to the spreading of invasive species which are mostly unpalatable. A good example is the shrinking trend of *buns* (plains) from all sides as acacia species, *Acacia tortilis* and *Acacia nilotica* in particular, continually annex the more space in the plains. Overgrazing can have similar effects; however, latest research has proven that vegetation even after overgrazing can recover soon once there is enough rain. So it is both pastoralist's perception as well as the one of modern scientific research which sees the causes for decline of biomass and the invasion of new species in climatic reasons.

This is supported by findings of Schwennesen (2008) who states that:

"Grazing, like other uses, may cause a change in the species composition of rangelands, but if rangeland degradation is defined as a long-lasting or permanent reduction in livestock production, the evidence of widespread rangeland degradation under pastoral grazing is shaky. Contemporary ecological research shows that dry savannas follow a different logic from wetter grasslands: In dry areas vegetation growth is mainly determined by the rainfall that year, but not by the grazing pressure of the previous year, as standard range management theory and practice suggest. Where rainfall is highly variable from year to year, vegetation production will vary also. In such situations and especially where annual grasses dominate the sward, the definition of a precise carry capacity becomes impossible. Grazing pressure is a less important determinant of species composition and biomass production than the amount of rain and available soil moisture."

Schwennesen (2008) also points out that the rangeland management of pastoralists is not very

much different from browsing and reproduction behaviour of non-domestic wildlife:

"Accounts of the vast herds of nondomestic ungulates on the African savannas or the North American prairies, where the physical grazing effect is comparable, enthuse over the prodigious health and productivity of these landscapes, with animal numbers far beyond the "permissible" ones imposed today by policy makers."
and
"From the plant perspective, there is little practical distinction between on grazing entity (wild, domestic, mechanical, or other) grazing a plant ten times, or ten grazing entities grazing a plant once - except in terms of the recovery time the plant is allowed to reconstitute itself within its growing season."

Nevertheless, while climate change also reduces the carrying capacity of rangeland, overgrazing, defined as the removal of tissue from a living plant, to the extent that the tissue removed exceeds the ability of the plant to replace it, within a growing season**,** overgrazing has become a secondary effect of climate change and other drivers like land enclosures, however is not originated in the rangeland management system itself. For the future, therefore Schwennesen recommends:

"There is nothing more significant in resource management, than correctly understanding what grazing and therefore overgrazing, actually are. The oldest known cultures on Earth have subsisted and thrived on an intuitive and relentlessly tested understanding of how animals use plants. A variety of events in recent history (technology, droughts, political changes, loss of ancient knowledge, shifts in economic pathways and "scientific policy") have led understanding away from the intuitive and towards the administrative, leading these to some cultures to the brink of extinction. The predicament that pastoralists face worldwide today is graver than anything they have ever experienced."

8.7. Climate change and extreme weather conditions

Extreme weather conditions in the form of stormy and sometimes icy rains and flash floods have been experienced in many parts of the country during the past ten years or so. In 2007, heavy rains laden with speedy winds had destroyed hundreds of *Aqals* (traditional collapsible nomadic houses) in Balli Abbane settlements in the Balli Gubadle district and made hundreds of pastoral families homeless. The extreme weather also caused the uprooting of thousands of acacia trees, particularly the all important *Acacia bussei* species whose lateral roots spread out just below the surface of the ground and Mature Umbrella Thorn Acacia (*Acacia tortilis)*. The selective harvesting of mature trees for charcoal production increases open batches in the wooded areas, thus making the remaining trees susceptible to the uprooting effects of the winds.

Comparison to other areas of Somaliland

Near Berbera high mortality rates could be observed both of *balanites* and *Acacia tortilis*. The frequency of extreme weather conditions such as storms, dust storms and floods has also tremendously increased, and icy rains occurred for the first time in the country (Yufle in Sanag and Baki in Awdal in 2007). Umbrella acacias (*Acacia tortilis)* were uprooted due to increasing winds as a result of secondary effects of climate change due to deforestation. Declining precipitation and droughts affected the growth of many plant species like *Boswellia*. Biodiversity of rangeland is negatively affected both by climate change and resulting changes of grazing patterns altogether, in a way that palatable species like *Chrysopogon aucheri* and *Sporoborus variegatus* declined in favour of unpalatable ones (Ahmed Awale 2008).

Increased temperature levels, either caused by changes in land use as a result of the continuing denudation of vegetation from the ground, or by the global effects of climate change, has also been experienced in the study area and the country in general. The seemingly declining use of some Somali terms expressing cold weathers is another indicator of climate change. Words like "*gabadano, gawre and juube*" which were used to denote severe cold weather conditions is rare to hear nowadays.

8.8. Plant and animal stress

As a direct result of changes on spatial and temporal patterns of precipitation, temperature, solar radiation and on population dynamics of plant pests and disease, plant stress is likely to increase. There are already signs indicating these changes that can be experienced in the different vegetation zones of the country. For example, the deterioration of the Junipers forests (*Juniperus procera)* in Gacan Libaah and some other higher altitude areas in the country is attributed to the decrease in mist levels in higher altitude eco-zones in the country (Awale, 2007). Also, a very worrying trend of the massive drying and dying of *Acacia tortilis {'Qudhac'}* and *Balanites orbicularis {'Kulan'}* in the coastal (Guban) areas is yet to be investigated.

The prolonged droughts, increased wind speeds and temperatures are some of the most prominent stress agents that impact plant dynamics. The respondents mentioned the new phenomenon of a quick shriveling up of grass due to increase of temperature levels compared to earlier periods. The common Somali term *Sirir* (literally: wilted) translates a negative and abnormal condition in plant growth which herald its death probably caused by inadequate precipitation coupled with higher temperature, pests or diseases.

Respondents mentioned that there is an average increase in temperatures resulting in heat stress on animals. The possible results of heat stress include less feed intake, which may lead to less milk production and less body weight. Different animals also have different tolerance levels to heat, cold weather and rain. For example, goats are less tolerant to cold weather and rain than sheep possibly due to their scanty hair, but the later are less comfortable with heat stress. *Haraaryo* (literally: panting for breath) is very common for sheep and is characterized by rapid shallow open mouth breaths and is caused by heat stress usually when the sun is at the zenith. In such a condition, sheep stops grazing and in the absence of a shade, particularly in *Bans* (open

treeless plains) each and every animal lowers its head and drives it under the standing body of another sheep to seek shelter against the heat of the sun.

8.9. Bio-diversity loss and climate change

Globally, the survival and succession of many plant and animal species are under the threat of climate change impact. The rate of species extinction in the recent times is unprecedented in the long history of Plant Earth. Current extinction rates are at least 100 to 1,000 times higher than natural rates found in the fossil record[12].

In a semi-arid environment, such as the study area, overgrazing and deforestation contributes to reduction of ground cover. Climate change also accelerates erosion processes. The resulting food insecurity compels resource users to extract the maximum benefit out of the fragile environment. Moreover, over-population, over-stretched carrying capacities, disruption of traditional pastoral movements, overhunting of wildlife which drove many species to extinction are all visible in the area.

Over the past thirty years, there is more than a dozen wild food species, mostly edible succulents and fruit bearing shrubs, which elderly members of the visited communities passionately relate to "the good old days" and "times of plenitude" are either pushed to extinction or are in a very short supply. These include *Glossonema Hispidum* (*'Sobkax'), Caralluma sp? ('Gacayro'), Edithcolea sordid ('Xamakow'), Digera alternifolia ('Carab-lo'aad'), Grewia tenax ('Dhafaruur'), Grewia erythraea ('Midhcaanyo')* and others.

One could be very fortunate enough to come across a remnant plant from the above category in an enclosure, as a result of the controlled grazing and the existence of shrub layers to protect shy plants from trampling – the greatest immediate threat posed by animals and humans. Moreover, many of the smaller shrubs, grasses and forbs were also victims of the coverage by sand dunes due to increased sand storms.

8.10. Bush Encroachment and Invasive species

The disappearance of rangeland species gave room to bush encroachment and invasive species. Invasive species in their ecological functions are seen as invasive when they lead to a decline of biodiversity in an area and in their economic impacts when they do not contribute to land user's incomes. As most significant invasive species in the Hawd have been mentioned - as in most other places of Somaliland and the Horn of Africa, *Prosopis juliflora* (Garanwe), *Parthenium hysterophorus* (Keliginoole),) and *Opuntia ficus indica* (Cactus) while on the one hand the change of vegetation in Somalia can prominently be seen as a shift to more drought-resistant species and hence a secondary consequence of climate change, the mentioned species are rather better adapted to degrading land and thus a tertiary consequence of climate change: invasion

[12] http://www.msnbc.msn.com/id/6502368/

after decline of vegetation regrowth due to aseasonal rainfalls and subsequent soil erosion triggered by decrease of soil cover

8.11. Impact on Water Sources

Water shortage is already a problem in many parts of the Greater Horn, particularly the Somali inhabited areas which is characterized by very high spatial and temporal variability. Large changes in land cover/land use and water management practices have taken place during the past 50 years or so and became prone to disturbances during the last two decades. The human induced changes in land use such as deforestation, clearing of woodlands for agriculture have accelerated desertification processes and reduced water retention capacity of soil and moisture regime. This situation is unlikely to be reduced and may be exacerbated by climate change as projected precipitation increases are small, and temperatures and evaporation are projected to rise.

Consecutive droughts have led to chronic water scarcity across the area, leading to acute water crises. This means all areas, which are normally dependent on *berkads,* are getting exposed to water shortage in the years where the seasonal rainfalls performs poorly and fail to recharge the *Berkads* fully.

For centuries, the study area has been a wet season grazing rangelands whereby pastoralists and their animals used to sojourn during the rainy season. Water harvesting structures were introduced in the 1950's. *Berkads* and *Ballehs* became increasingly important as a source of water. The Berkads are purely private owned, as anybody who can afford to construct their own in their clan territory can construct it. The owner of the *Berkad* has full control over the use of the water. *Ballehs* are mostly communal and have been either dug by the Government and/or development agencies, but most by clan members and often carry the name of a distant grand-father. Depending on the impermeability of the soil, shallow wells are dug around some Ballehs and percolated water is extracted after the water in the Balleh is exhausted.

Higher temperatures mean higher evaporation levels and higher water demand by humans and animals. Moreover, the ongoing desertification process causes fine soil particles carried into water sources, thus accelerating siltation processes and ultimately reducing their water storage capacities. Some of the plant species most suited for shading Berkads viz. *Vernonia cinerascens ('Hiil")* and *Andropogon Kelleri ('Duur'*) aimed at reducing evaporation and heat induced cracks of Berkad walls are now very rare to get, as mentioned above.. Therefore, other than structural defects, this may also contribute to the existence of high number (nearly 50%) of non-functioning Berkads in the study area.

8.12. Impact on Water Demand

Apparently there is a change in water demand both for human and animals. The increased demand in water consumption can be attributed both to increase of temperature levels and wind speeds on one hand and the changing lifestyles of pastoralists and animal management. Before the introduction of water harvesting facilities, particularly Berkads and Ballehs, in the Haud waterless area, people and their livestock used to trek longer distances to permanent water points,

for they were far apart. Camels, known for its endurance to thirst, used to go for long periods (in extreme cases over 25 days) without water. But how long does a ruminant can remain without water varies and depends on a number of factors, such as the succulence of the feed, air temperature and the amount of work being performed. Camel herders used to drive their herds for distances ranging between 40 and 60 km to permanent water points during dry seasons and the period between two *Kal* (watering sessions) ranged between 20 and 25 days. However, recent estimates on periods between two *kals* is 10 days for camels and 4-7 days for sheep and goats (Nele Foech, 2003, Caritas Swiss Report). It can be argued that both men and their animals were better adapted to those harsh conditions in the past compared to today when water points of different types mainly *Berkads* (cemented in ground water tanks), *Ballehs* (man-made surface water reservoirs) are heavily dotted in many parts of the study area.

8.13. Impact on traditional Institutions

Pastoralism requires types of institutions which can flexibly react to adapt quickly to the ever changing conditions.
The two major types are *Xeer* agreements and *Degaan* ownership:

• Degaan ownership: According to the perception of land as a "smooth" space, in traditional Somaliland society, private ownership of pastureland did not exist, and water sources could only be owned privately to a limited scale. Until today, access to natural recourses is based on communal ownership and cooperation with other groups. Generally, the concept of *Degaan* describes the traditional claim for land ownership by a certain clan-group.

• Xeer agreements: Affairs are regulated by contracts between clan groups. These contracts define rules for the management of land and other issues, and set up sanctions for the case that agreements are broken by one of the parties. *Xeer* agreements between groups need to be continuously renegotiated and redefined according to the needs to move towards new water and grazing resources.

The responsibility over these institutions was held by the clan authorities: Clan elders regulate clan affairs on behalf of their people especially in regard to access to natural resources land conflicts. (APD 2008). However, changes in land use patterns also eroded these institutions. Many elders reported that they lost their authority, and, while traditional institutions lose their significance, modern institutions are not yet ready. This is especially relevant in regard to land grabbing for the establishment of enclosure or for appropriation of communal land for charcoal burning, where traditional land use agreement lost almost completely control of.

In this sense, climate change does not only lead to an erosion of traditional institutions but to an overall disorientation of environmental governance, leading to increasing conflicts, especially about land and further environmental degradation, since degradation of communal land can mainly be seen as the consequence of the collapse of traditional institutions.

In the case of Somaliland, institutions for rangeland management broke down several times within the dynamic history of the country.

In the past government policies on land tenure regarded rangelands as communal and open to all pastoralists and from 1978 - 1990 many projects applied rotational grazing system on rangelands, where parts of the pastoral lands were kept closed from grazing and utilized only certain times of the year to enable the recovery of the other lands which also reduced the impacts of droughts.
Since the collapse of the central government there have been minimal range management projects, only few NGO projects reintroduced rotational grazing (Candlelight 2004), and land conflicts exacerbated the situation and the establishment of enclosures plays another negative or ambivalent role (APD 2008).

8.14. Climate change and conflicts

Although it is complex to link, there is growing evidence that scarcity of resources and most importantly biodiversity loss can increase internal communal conflicts. There is already a rush for land grabbing, establishment of enclosures and breakdown of common user rights. The proliferation of enclosures has become one of the most serious problems in recent years in the study area. Enclosures obstruct free access to permanent water sources and to the main grazing plains and valleys and became a recipe for insecurity and conflicts which are usually on the rise during the dry periods. Drought cycles often result in pastoralists trespassing the enclosed area and thus sparking tensions.

Charcoal production, another contested issue in the study area, has become an important coping mechanisms for poor pastoral households, whose livelihoods may have been affected by the effects of recurring droughts and vegetation loss. As competition for resources increase, equally conflicts arise between among herders, charcoal producers and wildlife.

Climate change has also exacerbated human-animal conflicts. While most of the wild animals have been decimated in the past by poaching and habitat loss, Baboons and Warthogs have somehow increased in number. This fact can be attributed to the profanity of their meat on one hand, and the destruction of lion and tiger populations which used to kill both species as a favorite meat.

The scarcity of wild foods and pasture is driving these animals to adopt aggressive grazing and food collection habits which bring them into conflict with humans. There are even cases reported by the community in the study area where baboons become very aggressive and violent than ever before, attacking human habitation in search of food and water. Monkeys eating small ruminants and attacking children were also reported. Monkeys are omnivores, though the majority of their diet is plant matter. They are not adverse to eating meat, but don't normally go out and hunt it.

8.15. Impact on Gender

Somali women play a significant role in Somali society; the division of labour is clearly defined and heavily weighted towards women. Traditionally, the nomadic woman milks the animals, processes the milk, feeds the family, and cares for and watches the livestock. She also collects firewood, cooks, feeds the children, cleans the house and washes the clothes and the utensils. In addition to that, women have the responsibility of "building and dismantling the nomadic *aqal* (home)" as they move from place to place in search of grass and water for their livestock, while men were to "move, arrange additional transport from other families" and looking after the camels (Rhoda 1991). In all villages of the study area many women are involved into smaller petty trade such running small shops, selling tea, *Qat* etc but also few are engaged in livestock trade and charcoal business as wholesalers while men produce it as illustrated above.

8.15.1. Labour division

A typical working calendar for women like the one in Ina Igare village is shown below.

Typical traditional women's working calendar (Location: Ina-igare)

05.30: Praying, preparation of *loxox* (Somali bread), milking sheep, preparation of tea (milking camels is usually done by men, although sometimes women can do)
06.30: Preparation of breakfast for children
07.30: Washing dishes and other domestic work
08.30: Looking after animals
12.00: Preparation of lunch, mostly rice or pasta
12.30: Praying
13.00: Taking a nap
13:30: Taking water
14.00: Cleaning of animal stable
14.30: Looking after animals
15.30: Preparation of firewood
16.30: Praying
17.30: Returning to animals and bringing them home
18.00: Putting animals inside the fence
18.30: Praying
19.00: Preparing dinner
19.30: Praying

NB.: Prayer times is conveniently inserted in this table. In the real sense, in a male dominated pastoral society, women play an essentially passive role in religious life and are essentially are not expected to be as devout as men are. A wife may always make water for ablution and the prayer rug ready for her husband but at the same time may not perform her daily obligatory prayers.

Climate change and the resulting loss of livestock, water and vegetation has changed this traditional workload. Currently the preparation of firewood and the collection of water can take

longer time than it has been before, the preparation of food can be more tedious since ingredients are getting scarce, especially ghee and sugar. Many women, where livestock is lost, have to replace the care for animals by other domestic or income generation activities. The preparation of ropes from plastic bags (instead of Acacia fibre) for household use is one that has been recently adopted, others are engaged in preparing coverings/shelter material for their *aqals,* higher involvement into the cash economy by selling tea, boiled rice or pasta, are other strategies.

8.15.2. Livelihoods

As has been said above, climate change along with other social and environmental factors has changed pastoral livelihoods in various directions, which also has affected women's livelihoods, their coping strategies and their social position.

a) Increasing poverty and disruption of families

Among the poorest groups of pastoral families, further increase of poverty due to the decline of the natural resource base induced by climate change can lead to a disruption of families, in a way that men migrate to towns to look for jobs, while women are left behind to take care for the children and the remaining livestock. Usually this situation is desperate for the women and children, not having more than a few goats left behind, living in a small *aqal* frequently in an environment they are not used to. One woman in Salaxley said, when she married 7 years ago, she and her husband were moving around with 400 shoats looking for grazing areas. Now, due to consecutive droughts only fourteen remained, and she settled down in Salaxley with her five children without being familiar with the people living there.

Other women, when the family lost all their livestock, moved back home to their parent's families, helping in the general every-day work. Usually these women felt less desperate, more food secure and better protected than the women living on their own.

b) Increased mobility

Generally in normal times men are more involved into far-distance movements with their herds, while some family members, especially women and children, are left behind with the more vulnerable parts of the herds, like lactating animals etc. However, some pastoralists react to the decline of natural resources with an increased mobility. In this case, women are left behind more frequently, but on a temporary base. This is actually the better case, since also the income base for the family is better, and in general families who can employ this type of response strategies have higher livestock numbers and better incomes.

c) Decreased mobility

Decreased mobility is the more frequent response to react on declining resource base, mostly because most livestock is lost, sometimes caused by the proliferation of water sources and settlements in an area, which does not require much movements, but most frequently caused by an attitude of resignation. The resulting loss of income is compensated by coping strategies

which exacerbate the detriment to the natural and social environment, especially an intensive involvement into the charcoal and the chat economy, which is especially common for enclosure owners. Nevertheless, all women reported and also men agreed, that almost all the income from charcoal will not be used for the benefits of the families, but is used for *Qat* consumption instead, which on the other hand helps men to overcome the psychological depression they are exposed to due to the desperate future of pastoralism they are prospecting. It is especially these groups of families, where women are mostly required to earn the income for the family, especially through petty trade. Many women are organized in milk selling cooperatives through the support of some NGOs. However, while milk production and milk sales are negatively affected by the declining resource base anyway, women especially complain that the clearing of vegetation for charcoal trade has also adversely affected their income from milk sales. In summary, it is to a lesser degree the direct impact of climate change which affects the women's economy, but the response strategies to climate change of the male economy which impacts the female economy.

d) Marriage and Reproduction

The declining number of livestock during droughts also affects the number of marriages, some livestock is needed for as a dowry. It was said, during the current long drought, almost no marriages took place. Traditionally, marriages and festivities were conducted during the rainy season. On the other hand, since the loss of livestock requires less labour, the spared time is used for increased reproduction activities. As a consequence, while the unmarried women stay unmarried longer, the married women get more children.

9. ADAPTATION/COPING STRATEGIES AND TRADE OFFS

As a result of climate change, pastoralists' way of life is undergoing great transformation and the trend is moving towards higher vulnerability, loss of solidarity mechanisms for coping with droughts, destitution and dropping off from pastoral life. Pastoral production system depends on the availability of natural resources which are sensitive to climate change. What complicates their situation is that pastoralists do not have a diversified pool of resources to draw from, which makes them more susceptible to outsidee pressures such as climate change.

The prevailing vulnerable situation of pastoralists as well as future uncertainties looming over the whole spectrum of pastoral production, many households have opted for some sort of diversification in order to fill existing economic gaps caused by climate change. While some of animal products such as ghee (clarified butter), hides and skins and gums have had a longer history of trade, more recent additions are milk. With the decline of milk, ghee is now also rare to get. Gums, particularly *Acacia senegal ("Cadaadda")* which has been an important activity during the turn of last century is not a viable income generating option anymore due to environmental degradation.

9.1. Milk sales

Selling milk in the past was uncommon and a lowly business to an extent that any person or family involved in selling milk was dubbed as *"caano-dhiiq"* (literally milk-seller). Surplus milk was always kept for and freely given to guest and wayfarers. In a pastoral encampment, consisting of a number of families, it was the responsibility of women to contribute, collect milk and store into one gourd which is then kept under a tree with the intention of satiating the hunger and thirst of a weary traveler. Nowadays, selling milk is a well organized business with well established network of collection. The commercialization of milk in the pastoral areas on one hand and their increasing demand in the urban areas causes to drain milk from far and wide, with its resulting negative impact on nutrition, particularly for children and the elderly. Nevertheless, milk sale is an important contributor to pastoral household income. More attention among pastoralists is now on higher milk yielding animals rather than emphasis on body weight.

9.2 Charcoal production

Charcoal burning from wood has been a new strategy to cope with economic losses from climate change and other external factors like the ban of livestock sales to Arabian countries during the years between 1999 and 2007. As table 3 (below) shows, a substantial number of the pastoralists East and South of Salaxley have based their income now on charcoal burning, and the economic returns realized from charcoal production are competing nowadays as the ones from livestock.

Charcoal production became a fallback option for poor pastoralists who are unable to carry on with their traditional way of life. Charcoal making, as a non-livestock income generating activity, is widely practiced in the study area and from discussions with the community it remains the most important option for generating alternative income with regards to the number of people involved, coverage, market opportunity and low investment required to kick start this sort of business as well as the free access to tree resources to produce charcoal.

Hence, in the study area, charcoal making is the major income source for more than 70% of poor and middle households, contributed around 75 % of their total income per month ($ 60 per month in average) varying from household to household or area to area.

Discussing with local elders about the history of charcoal production activities in the area, they mentioned that licensed cooperatives were the only producer groups before the year 2000. However, the heavy involvement of pastoral households in charcoal production started soon afterwards. The main driving force was the restrictions on livestock imports to Saudi Arabia and other Gulf countries due to the alleged Rift Valley Fever said to have affected livestock in the Horn of Africa as early as 1999. The widening and increasing consumption of Qat chewing among pastoral youth and the deteriorating livestock herd sizes makes them resort to charcoal production.

Table 3: Charcoal producing households

Village	Number of households engaged in charcoal production
Laan-qayrta Celiyo	110
Laan-qayrta qool-dhuxulaale	60
Qool-buullale	300
Libaax qawdhama	70
Balli mataan	300
Balli kaliil	133
Qori-jabley	300
Qool-caday	20
Raydabka	18
Aden Abokor	15
Balli ciise	30
Ina igare	46

To gauge the extent this coping mechanism contributes to mitigating adverse impacts on pastoral livelihoods, one can argue that it is an effective strategy since it provides contingent income needed by poor households as a distress coping strategy. However, it is important to highlight its negative impact on environment and the permanent loss of livelihoods which could result from charcoal production. The regeneration of acacia species is very slow and it usually takes at least thirty years for a tree to mature and produce a minimum of 50kg of charcoal.

9.3. Out-migration

An increasing number of pastoralists who lost their animals are leaving livestock production altogether, making their way to major urban centers, particularly Hargeisa town. The combination of increased climatic shocks, practices which hinder mobile pastoralism (enclosures) and a lack of other viable livelihood options is pushing more and more pastoralists out of the system, many of them ending up in urban areas as environmental internally displaced persons. Their remaining herds are left behind under the care of elderly family members and children. In a way, this is some sort of coping strategy whereby family members who succeed in getting employment in the urban areas support their families in the rural areas. On the negative aspect, the trend leads to turning these rural families dependant on the support of extended families members in the cities on one hand, and the pastoral mode of living to deteriorate on the other.

9.4. Enclosures

Huge amounts of literature focuses on movement and migration of pastoralists as an ecologically preferred and appreciated coping strategy to deal with erratic rains, patchy vegetation and droughts. Nevertheless, more and more individuals fence communal land for their own exclusive use to ensure themselves continuous access to grazing land.

APD describes four major types of enclosures:

1. Enclosures around *guri* degaans, to demarcate ownership around homeland, sometimes misused for land grabbing to get control large areas of land
2. Pure farming enclosures: relatively small, to protect cultivation sites, are not created to grab land and no source for conflict. Mostly contain berkads (inground cemented cistern)
3. Comprehensive enclosures: consist of plots for farming, grazing resources and grown-up trees for charcoal production. Banned by law and also disliked by communities. The average size of comprehensive enclosures is 0,250 km² (500m wide) to 1 km² (1000m wide). This is the most common type of enclosures around Bali Gubadle which extend frequently up to 1500 linear meters of thorn fences.
4. Grazing enclosures: to sell grass or occasionally charcoal. Also officially forbidden.

Enclosures have a socio-economic and a biophysical aspect. The socio-economic part is much contested, since enclosures act simultaneously as enclosures denying other members of the community access to formerly shared grazing land, which poses a challenge to cultural norms and values of the Somaliland society, especially comprehensive and grazing enclosures. Also trekking routes to water points and markets are blocked. The increasing commitment to a sedentary way of life has greatly disadvantaged pastoral communities in Balli-gubadle, while owners of comprehensive enclosures became strikingly wealthy. Hence enclosure and land grabbing tendencies effectively reduce the amount of freely accessible grazing areas and lead to increased livestock pressure and overgrazing on the remaining open rangeland, increase income differences among and within communities, and exacerbating conflict potentials in this way.

Nevertheless the common view among the population in Balli-gubadle is that enclosures are already highly integrated into their livelihoods and can therefore not be removed easily.
In addition, considering the investment costs that people have put into their enclosures, it is clear that they are not ready to dismantle them without receiving any benefits in return. According to an APD (2008) study many enclosure owners explained that without alternative income opportunities, such as agricultural extension programmes in which at least farming tools and trainings are provided, the dismantling of grazing and comprehensive enclosures would be impossible. Accordingly, by providing support to farmers, the shift from pastoralism to cultivation could be promoted, leading to a reduction of grazing and comprehensive enclosures.
While privatization has been frequently promoted as a “rational” response to the “tragedy of the commons”, private enclosures are sometimes assumed to cause a “tragedy of privatization”, where pastoral people are impoverished because land holdings are too small to support their livelihoods in dry grazing lands.

9.5 Agriculture

In the past, pure pastoralism was the principal mode of living in the project area. They used to follow seasonal migration patterns, mainly north/south movement depending upon rainfall and pasture availability. However as pastoralism is becoming more intricate than ever before, those herders who are losing their grip on this age-old system are increasing year after year. The pattern of land use is undergoing a great transformation, particularly in the hilly areas towards south of Hargeysa. More and more ex-pastoral households are settled and establishing rain-fed farms. The principle crops are sorghum, maize, cowpeas as well as fodder production. They also rear smaller number of livestock and usually keep the milking animals, mainly camels and goats, for the purpose of selling milk to the market and for household consumption. However, once the milk production capacity of these animals dries out they are sent to an extended purely pastoral family to take care of the animals for a season or two until they can produce milk again.

Since increasing cycles of drought reduced the already shrinking natural resources, traditional coping mechanisms which mitigated the effects of these factors do not function as they used to be in the past.. Consequently the crisis in the livestock mode of production is causing a great deal of suffering and destitution among the rural population. Many herders who have lost all their livestock see themselves forced to start alternative economic activities to deal with dwindling resources and asset basis (APD 2008) among which farming, charcoal production or trading are the dominant ones. Others move to the urban centres where they try to make their daily living.

In recent times, almost every pastoralist in the district has started opportunistic farming activities, although only very few of them can live from cultivation alone – while the majority still rely on livestock. People mainly grow maize and sorghum, and sometimes also tomatoes, papaya, and salad. They may also grow *Qat,* although its quality is poor and it can only be sold at a low price in the local market compared to the type that comes from Ethiopia.

According to APD, products of small rain-fed farms become the main source of living in years with normal rainfall, while during the rainy season their livelihood depends mainly on the products of their livestock (milk, meat, selling of animals). Some farmers practice opportunistic farming to produce maize or millet production in their enclosures mostly to feed their animals. Most pastoralists if asked individually said, if they had enough money, they would build a *berkad* to harvest rainwater and start farming to ensure continuous production and water supply in the face of changing environment. This, however, was opposed by most elders who emphasized the need of sharing land and water resources for pastoralism.

The conducted survey was not detailed or long enough to compare land and water productivity between agriculture and pastoralism in the face of changing climate or predict their future chances on the long run. However, after two consecutive drought years there was not much evidence that agriculture would be a viable risk reduction strategy or production alternative to pastoralism.

According to FAO: "*Drylands pose great constraints to crop production. Yields vary enormously from year to year, and crops frequently fail. Soil fertility, weed infestation and pest incidence fluctuate from place to place.. Locusts and armyworms are common crop pests. For the farmers*

it is extremely difficult to plan ahead, and cropping is very risky. Crops can be grown under rainfed conditions, different traditional forms of water harvesting and flood irrigation, as well as modern irrigation techniques. The risks of environmental damage are generally larger under crop farming than under pastoral conditions. The biomass is low, which lowers the applicability of practices such as mulching and composting. On an average, a successful crop is harvested once in every five years."

In fact, agricultural yields have been zero during the previous years due to consecutive droughts and degraded land. FSAU statistics show the same for almost all of Somalia except for some riverine areas (FSAU 2009). Also the land use suitability studies of FAOSWALIM do not even give any major evidence, that the country is suitable for agriculture with the exception of some certain areas around Borama (Awdal region).

Farmers' skills, the availability of labour, and access to resources outside the farm are other factors that determine farmers' ability to adapt their farming practices to the new degraded dry land conditions of higher temperatures and increasing aseasonality of rainfalls.

Since there was hardly any agriculture practiced in previous Somali history, Somali pastoralists of the North can hardly build up on rich traditional agricultural knowledge with few exceptions.

In regard to climate change mitigation, pasture and rangeland have a 100% higher potential on an average to store organic carbon compared to agricultural crops. Moreover livestock production makes use of virtual water and biological resources which could not be used by humans without the intermediation of animals. Also economic terms of trades are in favour of meat prices also in drought years, especially before the Eid festivities (FSAU 2009). It also seems to be contradictory to replace a system which is highly adapted to erratic rainfall and patchy vegetation by a system which is less adapted to these conditions when rainfalls become more variable. On the other hand livestock production is only 10% as water and energy efficient as crop production, and also nutrient cycling is more and more inhibited through livestock production with increasing aridity due to the decline of mesodetritivores by livestock (Safriel 2003) and agriculture is a way to compensate for the loss of vegetation on the rangelands by better land management practices.

Therefore in many other countries land users decided to switch from pastoral production to agriculture when pastures and rangeland productivity irreversibly declined. Hence also in the investigated areas agricultural activities should not totally be discouraged but very well planned after implementing a careful trade-off analysis between pastoralism and agriculture:

Firstly it has to be remembered, that it might be difficult or take some decades to restore rangeland after agricultural crops have been established, therefore in general, rangeland should not be sacrificed to agriculture, and clear-cuts for charcoal burning should not be used as an excuse to practice agriculture in the future, as it is presently done. This is already provided by the law, which prohibits establishing agricultural land on grazing land (APD). Secondly, since rainfed farming potentials will be more limited than irrigation farming, a competition about water resources between farming and pastoralism should be avoided. One hectare of irrigated farmland could use the water sources of many hectares of pastoral land. It is therefore

recommended to use as irrigation waters for agricultural plots only or mainly surface run-off water from degraded lands, where restoration of vegetation will be difficult anyway. This will also need a detailed assessment of water flows. Finally, the question is: might the future land uses focus on agriculture or rangeland? in any case it will need high investments to restore the degraded lands.

10. MITIGATION

Mitigation in the context of climate change refers to human interventions to reduce the sources or enhance the sinks of greenhouse gases. Examples or mitigation measures might include switching to solar energy or wind power, expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere (UNFCCC 2010).
While global warming is predominantly caused by emissions from industrialized countries, the UNFCCC has installed some payment schemes, following mostly a cap and trade structure, to award developing countries, as there are for instance Join Implementation (JI), Clean Development Mechanism (CDM) or Sustainable Development Mechanism (SDM) schemes, which pay compensation for capturing carbon through carbon sequestration, sustainable or non-use of forests in developing countries etc.. These mechanisms are still controversially discussed, both technically, if they are efficient in emission reductions at all and economically, if they would not hamper development options of developing countries by driving them into a low carbon economy. Another contested issue is moreover, if also developing countries should contribute and / or pay for mitigation as well, and if so, how much, since it is the position of some developed countries, that emissions are caused in developing countries especially by Reduced Emissions from Deforestation and Degradation (REDD) related processes through deforestation and land degradation.

- Promoting carbon sequestration through reforestation and land restoration

While Somaliland is not directly affected by these discussions and currently cannot benefit from related payment schemes, it might nevertheless be recommendable also to develop an internal mitigation scheme, since land degradation and removal of vegetation also partly affect the microclimate of the Somaliland landscape through reduction of evapotranspiration and increase of albedo. While the switch to solar energy and other energy alternatives might be options for the future, restoring degraded land and forest stands are most important measures, which also could be mainstreamed into the respective adaptation measures in pastoralism and agriculture. Also carbon sequestration projects could create synergies with soil and water conservation activities and will increase water and nutrient storage of soils and therefore the productivity of pastoral and agricultural land.

- Cooperating with international donors to ensure funding for mitigation measures

Since Somaliland does not have access to international payment schemes, international organizations and donors should take the lead in ensuring funds to compensate Somaliland for mitigation activities.

11.0. CONCLUSION AND RECOMMENDATIONS

11.1. Conclusion

Global warming has changed the quality of droughts and created a situation of a permanent stress which destructed the regenerative capacities of the human-environmental system. In many cases, vegetation does not reach anymore the stages of reproduction, since rainfall distribution is too erratic, too short during the growing season or too low in quantity, while vegetative parts like roots of plants are eaten by animals, since hardly anything else is left. The reproductive capacities of livestock is also impacted, since the scarcity of vegetation leads to lower reproduction rates of livestock and high losses of animals due to lack of feeding resources. Many animals are lost during the longer distances of movements. While the adaptation capacities of vegetation and livestock are exhausted, humans have to find new mechanisms to react to the new situation.
The current trends are all in favour of a more sedentary lifestyle, either by uncontrolled out-migration to towns, decline of mobility due to herd size reduction or switching to opportunistic agriculture, which leads to new types of livelihoods and land management systems, but on a much lower level of living quality and productivity than before, if no supporting measures are taken. Climate change can therefore be considered as a trigger for sedentarization.

In this trend of overall change, also pastoral institutions like *Xeer* (customary law) and *Xiddigiye (astrology)* have lost their importance, so that the original high capacities of traditional institutions have been eroded or completely lost. Interestingly in this respect is that climate change, which has been triggered by Western lifestyles, is also enforcing these types of lifestyles on pastoralists, but on a level that is almost endangering survival.

Current coping strategies in the way they are practiced can only be considered as a means to cover short-term needs for cash, or exacerbate social and environmental injustice like the establishment of enclosures and are in no respect capable of mitigating or adapting to the conditions of climate change in the long run. The long-term carbon balance – although not quantified – is unanimously negative. Unfortunately, due to the specific political situation of the country, it is also not yet part of international adaptation schemes, therefore cannot benefit from prospective financial agreements on carbon sequestration, CDM schemes etc., although there will certainly be a potential. Key areas for future adaptation strategies can certainly been seen in carbon sequestration through improved understanding and management of the interactions of grazing and vegetation recovery, as pointed out by Schwennesen (2008), and in assessing the true potential of water harvesting for agricultural purposes without negatively impacting pastoralism. Finally new social mechanisms for adaptations could be identified, as for instance insurance systems, as a support to the currently overstretched traditional solidarity systems, which would also help to avoid overstocking and hence overgrazing. .

11.2. Recommendations on Policy Options and Strategies towards Climate Change

Somaliland is not internationally recognized as a nation and therefore not represented in the UNFCCC either as a party or as an observer state. This is one of the reasons why the country is not involved into any international efforts of mitigation or adaptation to climate change, despite its attachment to a very comprehensive environmental and socio-economic monitoring programme of FAOSWALIM and FNSAU.
While, nevertheless the country is highly vulnerable to climate change and – regarding the discouraging outcomes of Conference of the Parties (COP 15) in December 2009 at Copenhagen - is likely to be even more negatively affected in future, it seems to be inevitable to develop strategies to deal with the threats of global warming in any capacity despite its political isolation.

The suggested policy options would consist of the following strategies:

1. a) Development of an internal adaptation and mitigation strategy
   b) Developing an international advocacy strategy
2. Mainstreaming climate change policies and capacity building on all levels.

Adaptation according to the UNFCCC definition is the "*adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities"*. In this sense adaptation means long-term strategies to adjust ecosystem management to the changing environmental conditions in a way that it continues to ensure the provision of the full array of ecosystem services for the population. In this way adaptation policies are different from coping strategies, which are put in place to reduce current vulnerabilities and are mostly short-term measures.

Even though the country is not a party, for the design of establishment of adaptation policies it might be recommendable to build up on the recommendations and lessons learnt by the UNFCCC, which has established a comprehensive compilation of experiences, strategies, and guidelines.

- Writing an internal NAPA (National Action Plan for Adaptation) for Somaliland

Like for party members of the UNFCCC, it would be helpful to write a full NAPA to climate change for the country. The comprehensive data base by FNSAU and FAOSWALIM evaluated through the lens of climate change would be a major step in this effort. In the following, a few critical points and possible strategies for adaptation will be highlighted.

- Taking an Ecosystem Approach

As an overall goal, adaptation policies have to be designed in a way that at least the basic food and water needs of the rural population can be sustainably met also under a changing climate. In the case of Somaliland, which has already been affected to a high extent by climate change, adaptation means first, to reverse the damages by climate change, and either restore old system and improve them in a way that they are resilient to changing climate or to develop new systems.

As the study has shown, the country is at a bifurcation point to decide in which proportions these needs should be met in future by agriculture or by pastoralism. This means to increase the carrying capacity of the land resources for the Somali population. As a first overall guideline to make decisions on this question it is advisable to take the ecosystem approach.

The ecosystem approach – although not explicitly part of the climate change convention but of the biodiversity convention – is based on 12 principles which recommend to consider the use of land, vegetation and water on a larger ecosystem scales like watersheds, while taking full advantages of the economic potential provided by all ecosystem services and at the same time fully acknowledging the natural limits set in an ecosystem and to find under this umbrella an agreement on appropriate land use systems among all stakeholders involved and on all levels..
www.cbd.int/ecosystem/sourcebook/: Ecosystem Approach Sourcebook. Visited on January 15th, 2010

Water Management and Flood Reduction

- Increasing water use efficiency and productivity

Since more and more water resources are lost due to run-off on the progressively denuded land, appropriate water management will have the highest potential to restore and increase productivity both of pastoral and of agricultural land.
Entry points will be diminishing run-off water in rangeland for instance through road water harvesting, increase of water infiltration through recovery of rangeland vegetation for grazing land. In agriculture more efficient use of green water[13] through restoration of soil organic matter, selection of seeds with highest water use efficiency and water saving systems for blue water like drip irrigation etc. would increase productivity.
In general it is agreed upon that optimized use of green and blue water[14] can extend these resources. Further information can taken from the International Assessment on Water Use in Agriculture (IWMI 2005).

- Avoiding and mediating trade-offs in water use between pastoralism and agriculture

1 ha of irrigated land could destroy the water resources of 10 ha of pastoral land. Trade-offs in water use between pastoral and agricultural land will therefore have to be carefully assessed and discussed and mediated among all affected stakeholders to avoid conflicts and losses of productivity

- targeting the specific needs of pastoralists and pastoralism in water supply by designing aid programmes in a way that they give incentives to pursue pastoralism and appropriate resource management rather than discouraging it

[13] Green Water: is the water infiltrated into the soil, taken up by roots, used in photosynthesis and transpired by the crop.
[14] Blue Water is made up from run-off to rivers and deep percolation to aquifers that finds its way to rivers indirectly. Moreover, White Water is the water intercepted and directly evaporated by the crop canopy and the ground surface.

Also an oversupply of water source in certain areas has to be avoided. As chapter 8.11 has shown, the proliferation of *Berkads* has led to a reduction of mobility and to overgrazing around water sources. Mainstreaming climate change considerations into water, sanitation and hygiene (WASH) programmes by coherent management plans for the proper location of water points would help to avoid these problems in future.

Soil Conservation and Flood Reduction

Soil conservation is of paramount importance both for water management as well as for the maintenance of vegetation on pasture and arable land. Making better use of rain (e.g. forms of rainwater harvesting) as well as improving and maintaining soil porosity and water-holding capacity of soils themselves, following soil improvement with organic matter should be further assessed. To quantify the potentials would be a first decisive step towards developing strategies to reduce susceptibility and increase resilience;

Restoration of the vegetation is the most important measure, accompanying measure such as the gully restoration, wind breaks, earth and stone dams and bunds, are of paramount importance.

All measures that conserve soil increase soil infiltration rates and will reduce the risk of floods.

Sand dune stabilization is of special concern to protect open water resources – berkads – pasture and agricultural land. Pastoralists in some parts of Togdheer region, for instance, stabilize sand dunes by *Commiphora* cuttings, which reproduce themselves even without the presence of water and organic matter.

Sustaining Pastoralism

- ensuring that governmental and donor policies clearly acknowledge the value of pastoralism for environmental conservation

Pastoralism is still the backbone of the present Somali economy and will be in future. It also shapes the cultural, social and political system of Somaliland, and, in respect to climate change, pastoralism is optimally adapted to the erratic nature of precipitation and vegetation growth. Future monetary returns for pastoral products will also be promising, especially since markets reopened after the termination of the Arab meat ban.

Maintaining and strengthening pastoralism in Somaliland is therefore of paramount importance. To adapt present pastoralism to climate change conditions will need to restore and improve the current grazing land, the livestock management system and to adjust mobility patterns to meet the needs of people and environment.

- Improving grazing base rather than destocking

The practice of opportunistic grazing in traditional pastoral systems has frequently been criticized because of alleged overstocking which is supposed to lead to a sub-optimal livestock / vegetation ratios. However, while under changing climate the present livestock number in relation to the declining resource base is too high, it is too low to meet the family's needs. While there is frequently the advise to optimize the meat production per animal instead of the meat production per land area, comparisons between opportunistic (pastoralist) or conservative strategies (ranching) of livestock have shown, that opportunity costs of understocking occur in years of high productivity and reduced stocking rates might reduce the capacity to support

people. Although there is of course an interaction between weather, vegetation base and livestock, the focus of management efforts should therefore preferably be put in an improvement of the grazing base, while for livestock there might be many other technical opportunities – introduction of heat resistant species, vaccination programmes etc. which could be complementary. Rather than reducing livestock numbers it might be better targeting the necessary threshold number of livestock as a minimum requirement, which, however, should be subject to further and intensive research.

- Replacing social services provided by livestock if necessary

Livestock does not only provide milk, hide and meat, it is also an insurance, bride price, and a prestige object. If numbers of livestock have been reduced, either due to voluntary destocking or through droughts, these services have to be replaced by other mechanisms, for instance by international insurance systems as currently tested in Ethiopia, finding new forms of social respect and marriage ceremonies.

- Adapting mobility patterns the whole array of services provided through nomadic lifestyes

Advocacy groups for pastoralists usually argue vigorously against any sedentarisation policies for nomads in recent times. While Somalis can cross quite freely borders to Ethiopia or Kenya, progressing trends towards higher sedentarization can not be overlooked, but it is rather climate change itself that is dictating the movements of pastoralists more than governments, and the proliferation of *berkads* and *ballehs* in an unorganized way has done its own.
Before giving a general judgement on mobility of pastoralists, it might be worth to have a closer look to the services which are provided by mobility, which are besides a flexible response to the fluctuations of an erratic vegetation base also transport, information and trade services. While nomadism is frequently romanticized by urban population, it also cannot be overlooked that nomadic livelihoods at least for poorer wealth groups are frequently marginalized and characterized by hard labour, hardships and deprivation from earliest childhood on. Therefore, instead of generally recommending fully mobile nomadism, it might be worth to consider alternatives of a "soft" nomadism, where traditional mobility of clans following the grass, might be replaced by certain agreements of labour distribution, moving of herds is done by trucks, as it is already now done by the wealthier pastoralists, information services by mobile phone – also a development which has been established recently and trade is done by specialized trade people.

Agriculture

- Exploring the chances of mixed farming

There are few irrigated farms which are prosperous, and most pastoralists try to practice opportunistic rainfed farming. Agriculture is closely linked to higher sedentarism, to the establishment of enclosures, *berkads* and *ballehs* as well as to a loss of biodiversity, frequently also to charcoal production and complete clearance of vegetation, all very contested issues. Nevertheless, with lesser returns from pastoralism agriculture is more and more preferred not only by the people in the study areas, but in drylands worldwide. However, agriculture is still

more in its experimental phase and it is doubtful if agriculture under the climate conditions of the study area will be a viable option on larger scale, however, there might be some opportunities, which will have to be carefully explored.
Agricultural policies should therefore focus on research and extension services, especially support rural people in the identification of proper land for agriculture and give training on crop cultivation, irrigation, fertilization and pest management, furthermore provide seeds, tools and other input materials.
But even if agricultural returns will remain low, the switch to a new sector might also be the ground to other land independent economic activities like handcraft, energy sector etc..

Research and Knowledge Management

- Preserving traditional knowledge by "translating" and mainstreaming it into education programmes.

Somali pastoralists have developed their own rich knowledge system of biology, mathematics, astronomy and rangeland management. For Somalis the whole environment is a huge indicator system, which they learnt to decode in order to predict and explain natural events.
All this knowledge has also been diverted into Somali poetry, which mainly shapes the culture, even the political and especially the land tenure systems of Somalis and can easily be lost by rapid environmental change and progressing urbanization. It is therefore suggested to mainstream this knowledge into education programmes and teaching materials, which would most likely make disciplines of mathematics, biology and astronomy easier accessible to students and stabilize society by strengthening cultural identity.

- Development of a hybrid knowledge system for environmental and socio-economic monitoring

The same should be applied for monitoring programmes. While Somaliland is covered by high resolution monitoring programmes of FNSAU, FAOSWALIM in Nairobi and even participating in the Land Degradation Assement in drylands (LADA), this is hardly accessible to common land users, who almost completely rely on traditional systems. To share the benefits of both knowledge systems, it is advisable to mainstream traditional knowledge, especially indicator systems, into modern monitoring programmes and make modern monitoring systems more accessible and user friendly.

- Exploring new ways of adapting to changing environmental conditions through research programmes:

To adapt to the new environmental conditions, it will, however, beside monitoring and traditional knowledge, need further research. While traditional knowledge has sustained the land use systems over centuries, these have been impacted by many factors among which climate change is only one of many, therefore not in any case is still viable under changing environmental conditions and land tenure systems. And although the country is scrutinized by modern monitoring, it will need some further research, preferably on the following topics:

- Development of scenarios of vegetation succession dynamics in rangelands for dry and wet years and successive droughts
- Development of different scenarios on rangeland biomass productivity under different succession patterns
- Development of different scenarios for dry and wet years on agricultural productivity
- Valuation of ecosystem services under different scenarios
- Comparison of land, water and energy productivity and monetary returns between pastoralism of agriculture on geographical scales of high resolution
- Comparison of calorie intake available for human consumption through pastoralism and agriculture taking into account the energy losses throughout the food chain
- Multi-Criteria assessments and cost benefit analyses of the most preferable solutions

Presently the Agricultural Ministry is conducting assessments on the successes of farming in the area and lessons learnt, which can be built upon.

- Promotion of agro-forestry and beekeeping as synergistic measures

Agroforestry will be a system to be newly introduced, and if done properly can represent a compromise between agriculture and pastoralism, which also needs trees as a feed esp. for camels. Agroforestry has also high capacities to build up organic matter in soils and retain water, and therefore means contribution to adaptation to climate change through these features. A first feasibility study on agroforestry around Hargeisa has already been conducted by Dr. Ensermo from Addis Ababa University, Biology Department, on an initiative by the Horn of Africa Environmental Network., which can be built upon.

Beekeeping does not only create income through honey and wax production, but also increases the productivity of agriculture and forestry through pollination services, which are estimated to be about 200 times higher in their value than direct incomes from honey and wax.

- Promotion of land independent economic diversification

To generate income without putting additional pressure on land, land independent economic diversification will be advisable. Recommendations usually given are related to the establishment of new economic sectors – like handcraft production, solar energy etc.., however – it should be realistically surveyed, if these new alternatives are really feasible and preferable to the reestablishment, improvement or partial change of a system which is proven and well-known as it is pastoralism.

Cross-Cutting Issues

Equity and Justice

- Deescalating, mitigating and rationalizing discussions and conflicts around enclosures and charcoal burning in a way that these activities are managed in a way that they do least harm to the environment and society for instance through forest management activities to reforest areas which have been cleared for charcoal burning and establishing social contracts with enclosure owners that benefit all sides like compensation payments or redistribution schemes etc;

As Chapter… has shown, there are certain advantages and disadvantages for the establishment of enclosures. The disadvantages affect mostly the more vulnerable parts of the society which are excluded from using the land inside of the enclosures, while the stronger parts take advantage both of their enclosed land as well as from communal land. This is the reason why enclosures are mostly strictly condemned by everybody who is advocating for equity and justice. However, it cannot be overlooked, that the enclosing of land is a trend which is taken over already by the majority of pastoralists. Since it is very difficult, if not impossible, to implement land policies against the will and the practice of the majority, dialogues should be created between enclosure owners and full pastoralists, to negotiate an equitable cost and benefit sharing regime, opening or widening corridors, compensation for mutual services, introduction of land taxes etc.

Currently there are informal water payment schemes among berkad owners and other users, frequently berkad owners also give free access to others, especially clan members. Currently there are no major conflicts around water, if water becomes scarcer, however, it might be advisable to work out equitable water payment schemes.

Gender

- Support of womens' organizations and milk trade, since this will create positive synergies between family livelihoods and environmental conservation

As chapter has shown, it is mostly women's income which sustains the families, while man's income, though larger, is mostly diverted into chat consumption. Moreover, women's economy is environmentally sustainable, since it depends mainly on livestock production and not on clear cutting. Strengthening women's economy will therefore both benefit families and environment.

- Giving special support to single-headed households

Since commonly not found that men are left alone in an area far from their homestead with a couple of goats to take care for a number of children it is mainly women, who will have to be targeted by special programmes, which support them by supplementary food or livestock or some support in labour, in case the community solidarity systems will not work.

- *Psychology*

While climate change can not be blamed for all this development, the continuous decline of returns from livestock and related decrease of incomes have left especially the male parts of the communities in frustration and even despair, channelled into an overconsumption of chat, which leads almost to a complete readiness to sell out the whole environment as a cash resource for chat – which is especially conspicuous in the charcoal economy as shown in chapter and leads into another vicious cycle of inertia towards the environment and poverty. Therefore, as a recommendation which normally is not found in other efforts to adapt to climate change, it seems to be highly recommendable to employ highly experienced psychologists and community drug experts etc. to tackle this problem, which extends almost over the whole society, and especially also affects the female economy, therefore women and children.

Capacity Building and Mainstreaming Climate Change Adaptation Policies into all Levels and Relevant Sectors

Somali institutions have been shaped by pastoralism since ancient times, in a way that they were able to adapt flexibly and dynamically to the vagaries and fluctuations of nature. Colonization, wars and globalization required rapid changes of these institutions, which hardly could follow, leaving them in a kind of transitional change that no more fulfils the needs of the environment and not yet fully meets the requirements of modern environmental governance. Climate change represents again a new challenge institutions have to respond to. It needs therefore careful enabling of traditional and modern institutions to react properly and creatively to the recent trends of environmental change and mainstreaming of climate change adaptation policies on all levels and into all relevant sectors.

As a suggestion for instance, ministries and NGOs concerned with environment, agriculture, water and meteorology and other relevant sectors should employ at least one full-time or part-time expert to design special programmes on climate change in all their technical, socio-economic, financial and legal aspects, who have be well trained on all climate related issues including funding mechanisms. These persons would also be responsible for mainstreaming climate change considerations into all types of projects and programmes from environmental projects to educational sectors on all levels from communities to ministries.

Development of an International Advocacy and Financing Strategy for Climate Change Adaptation and Mitigation

Political Advocacy

- Linking civil society and governmental organizations with the political instruments of the UNFCCC and other forums of international advocacy work on climate change

As initially mentioned, due to its specific political situation currently no Somaliland organization is represented at the UNFCCC, not even as an observer, which makes it difficult to advocate for its own interest on international level. Since the government can not present itself at the

UNFCCC, international NGOs and UN organizations should inform civil society and governmental organizations about their rights and opportunities to link up with UNFCCC organs and activities to represent themselves there, building bridges and make linkages.

- Linking in the same with the UNCCD and CBD activities

Due to the high synergies of climate change adaptation and mitigation activities with the targets of other conventions, international organizations should also support Somali organizations to link up with the UNCCD and CBD in the same way.

- Ensuring that international organizations and donors mainstream Somali climate change policies in their own programmes and support them in their own through their own advocacy work within the country

Since Somaliland after the destruction of civil war is still highly dependent on donors and aid agencies, these organizations should integrate Somali climate change policies into their own programmes and do international advocacy work for these policies on international levels, where Somalis due to their political isolations do not yet have access to.

In emergency response policies this will for instance mean to introduce climate change adaptation into the concept of "crisis as an opportunity", as it is for instance mentioned in the FAO Phase Classification, and it will involve the introduction of risk und vulnerability reduction programmes towards droughts and natural disasters into these policies.
For the numerous organizations it will mean to include the right to food into their work and to acknowledge its intimate linkages to environmental justice and sovereignty as a human and democratic right.

Provision of Financial Mechanisms for Adaptation and Mitigation of Climate Change and other Ecosystem Services

- Cooperating with international donors to develop a viable financing strategy that rewards pastoralists and farmers for adaptation and mitigation and other environmental services.

Since Somaliland does not have access to international payment schemes, international organizations and donors should take the lead in ensuring funds to compensate Somaliland for mitigation and adaptation activities. This might be by creating links to international funding schemes such as United Nations Poverty Environment Initiative (PEI), UNFCCC, International Climate Fund for the least developed countries (LDCs) or others for reforestation or carbon sequestration programmes or others.

Supplementary, other funding mechanisms should be employed to compensate pastoralists and farmers for the environmental services they provide by mainstreaming with programmes which mainstream poverty with environmental issues which are provided by UNPEI or UNEP.

- *Embedding funding mechanisms for climate change adaptation and environmental services into traditional systems of solidarity and poverty alleviation*

Mutual support and reward for environemtal services is not unknown in Somali societies, which is built upon old-aged traditions of solidarity and reciprocity. These are mostly based on the exchange of productive assets rather than on welfare, for instance by lending each other milch or transport animals or giving mutual access to grazing land and water resources. It is advisable, that programmes for poverty alleviation or risk reduction would mimick these traditional systems, because they are easier adopted and preserved from disruption. As an example this could mean, providing social welfare support to pastoralist communities in the form of cash payments in place of food aid to enable the members of pastoralist communities meet their basic needs

This could also imply putting different frame on conventional food aid strategies.

Currently, soil and water conservation measures are almost exclusively financed by food for work programmes. Acknowledging their significance as a contribution to globally relevant ecosystem services like carbon sequestration, reduction of aerosols and dusts, protection of habitats, will open new financing opportunities for these activities and moreover strengthening the dignity of the ones involved into these activities and the appreciation of their work.

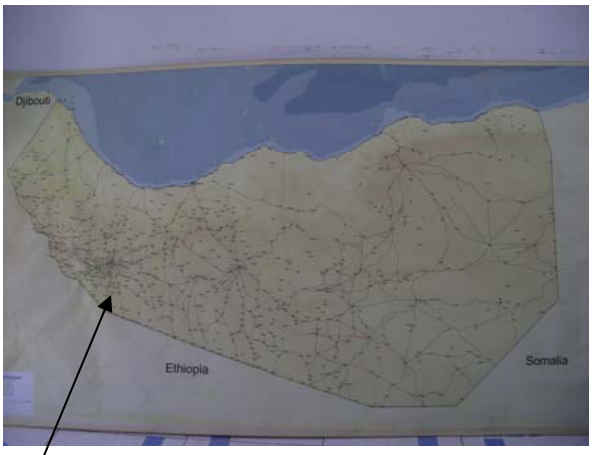
12. BIBLOGRAPHY

1. Ahmed Ibrahim Awale (2007): Climate Change Stole our Mist. Candlelight Hargeisa
2. APD (Academy for Peace and Development, 2008): Land-Based Conflict Project. Somaliland Report. No more "Grass Grown by the Spear". Adressing Land Based Conflicts in Somaliland. Hargeisa 2008
3. Barbier, N., P. Couteroni, R. Lefever, V. Deblauwe, O. Lejeune (2008): Decoupling of Facilitation and Competition at the Origin of Gapped Vegetation Patterns.
4. Ecology 2008, vol. 89, no6, pp. 1521-1531
5. Blench, Roger (2001): "You Can't Go Home Again." Pastoralism in the New Millennium. ODI Paper, London 2001
6. Bushell, H. (2009): Pastoralism and Climate Change in East Africa: Enabling Adaptive Capacity, Oxfam Great Britain. Paper prepared for presentation at the World Conference of Humanitarian Studies Groningen, The Netherlands, 4- 7 February 2009FAOSWALIM (2007): Field Survey Manual.
7. http://www.faoswalim.org/ftp/Land_Reports/Cleared/L-01%20Field%20Survey%20Manual.pdf
8. FAOSWALIM (2007) Soil Report
9. FAOSWALIM (2007) Land Cover Report
10. Foech, N. (2003): Caritas Wash Berkad Report. Caritas Switzerland
11. Hemming, C.F. (1966): The vegetation of the northern region of the Somali Republic.
12. Proceedings of the Linnean Society of London. Vol. 177, No. 2, Pg. 173 – 250. DOI: 10.1111/j.1095-8312.1966.tb00958
13. IPCC 4th Assessment (2007) : Working Group I: The Physical Science Base.
14. http://www.ipcc.ch/ipccreports/ar4-wg1.htm
15. IWMI (2007): Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. Ed. D. Molden, Earthscan, London and International Water Management Colombo Institute, 2007, http://www.iwmi.cgiar.org/assessment/Publications/books.htmMillennium Ecosystem Assessment (2003): A Framework for Assessment. www.maweb.org
16. Mucheri P.W. (2007), Climate of Somalia. Technical Report No W-01, FAO-SWALIM
17. Lewis, I.M. (1955): People of the Horn of Africa. International African Institute.
18. Reynolds, J.F. (2007): Global Desertification. Building a Science for Dryland Development Science 316, 847 (2007); http://www.biology.duke.edu/aridnet/pdfs/Science-en_sp/2007-Reynolds_Science_en.pdf
19. Rhoda Ibrahim (1991) "The changing lives of Somali women", "Changing perceptions: writings on Gender and Development", ed. Tina Wallace with Candida March, Oxfam publications, Oxford, 1991
20. Schwennesen, E. Overgrazing: The Crux of the Pastoralist Controversy. http://*www.drylands-group.org/noop/file.php?id=667*
21. Swayne, H.G.C, 1895, Seventeen trips through Somaliland, London: Rowland Ward.

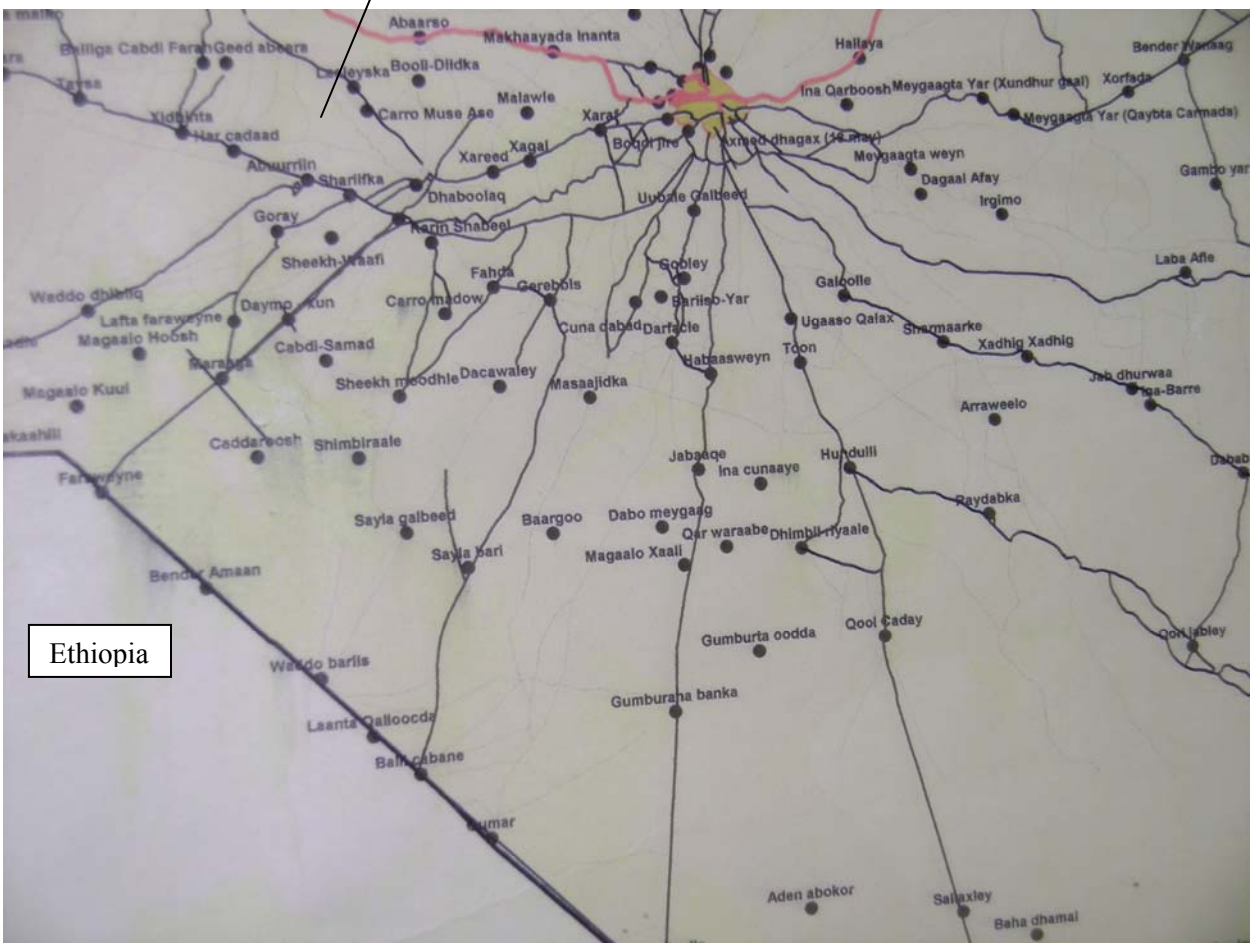
ANNEX

Contents

Map of Research Area:



Map of Somaliland



2. Periods of positive and negative rainfall and vegetation indices (summarized from FSAU data compared to long-term average)

Deviations of Rainfall (RFE) and Vegetation Index (NDVI) from long-term medium in months (compiled from FSAU data, FSAU 2009)

RFE positive	***Total***	***Gu***	***Deyr***	***Dry Season***
Nov 97 – May 98	7	2	1	4
May 98 – July 99	15	2	8	5
Oct 03 – July 04	10	3	2	5
Jan 07 - June 07	6	3		3
Σ	**38**	**8**	**11**	**17**
RFE negative				
Sept 96 – March 97	7	0	2	5
August 99 – May 00	10	2	2	6
Oct 00 – sept 03	36	9	6	21
Mar 05 – May 05	3	2		1
Σ	**56**	**13**	**10**	**33**
NDVI positive				
Oct 06-Nov 07	14	3	4	7
Σ	**14**	**3**	**4**	**7**
NDVI negative				
June 00 – June 02	25	7	4	14
Oct 02 – May 05	31	8	6	17
Sept 05 – Nov 06	14			
March 08				1
Σ	**70**	**15**	**10**	**32**

3. Seasonal Calendars (prepared by Abshir)

Bali Gubadle 2007

	Apr	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*
Precipitation												
Water												
Food.												
Fodder												
Human Disease	Diarrhoea Respiratory									Malnutrition Diarrhoea		
Animal Disease			tick borne						Anthrax Black Quarter		Tick borne	
Income												
Expense												

Bali Gubadle 2008

	Apr	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*
Precipitation												
Water												
Food avail.												
Fodder												
Human Disease	Diarrhoea Respiratory									Malnutrition Diarrhoea		
Animal Disease			Tick Borne						Anthrax Black Quarter		Tick borne	
Income		-										
Expense												

Salaxley 2007

	Apr	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*
Precipitation												
Water												
Food.												
Fodder												
Human Disease	Diarrhoea Respiratory									Malnutrition Diarrhoea		
Animal Disease			tick borne						Anthrax Black Quarter			
Income		-										
Expense												

Salaxley 2008

	Apr	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*
Precipitation	■	■			■							
Water	■	■			■	■						
Food avail.		■	■	■	■	■	■	■				
Fodder	■	■	■	■			■					
Human Disease	Diarrhoea Respiratory									Malnutrition Diarrhoea		
Animal Disease		Three days	Tick Borne						Anthrax Black Quarter		Tick borne	
Income			■	■	■	■	■	■	■			
Expense	■	■	■	■								

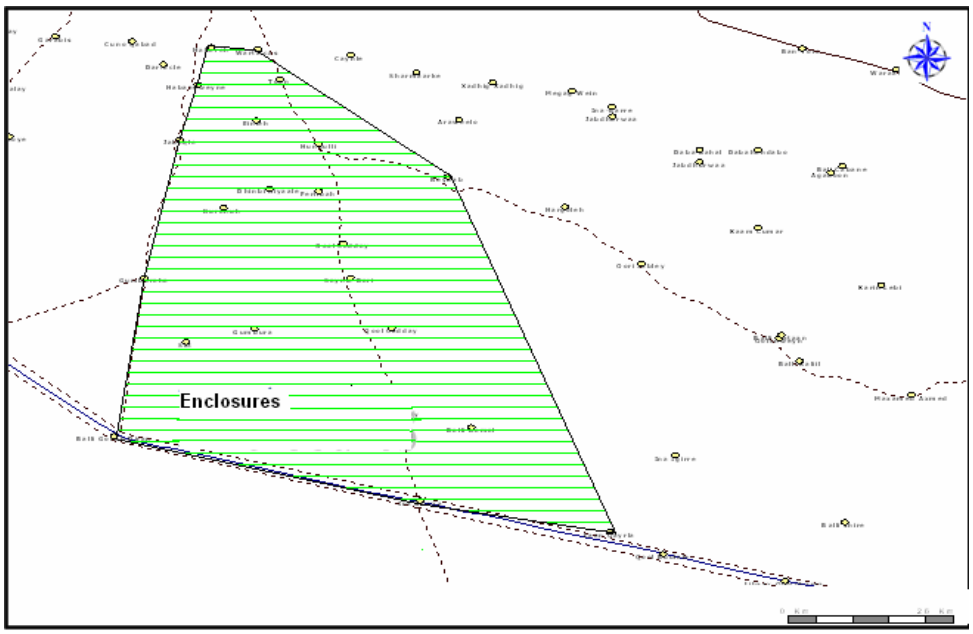
4. Village Transect Salaxley (prepared by Abshir)

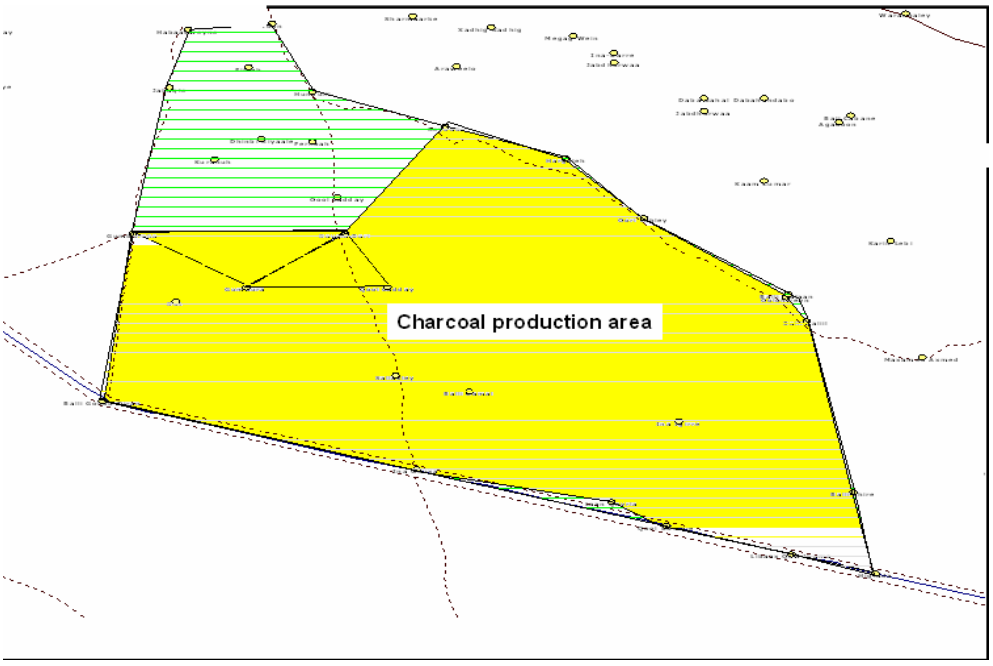
2 km West to East, Town Center to open land

West → East
Town Center Outskirts Open Land

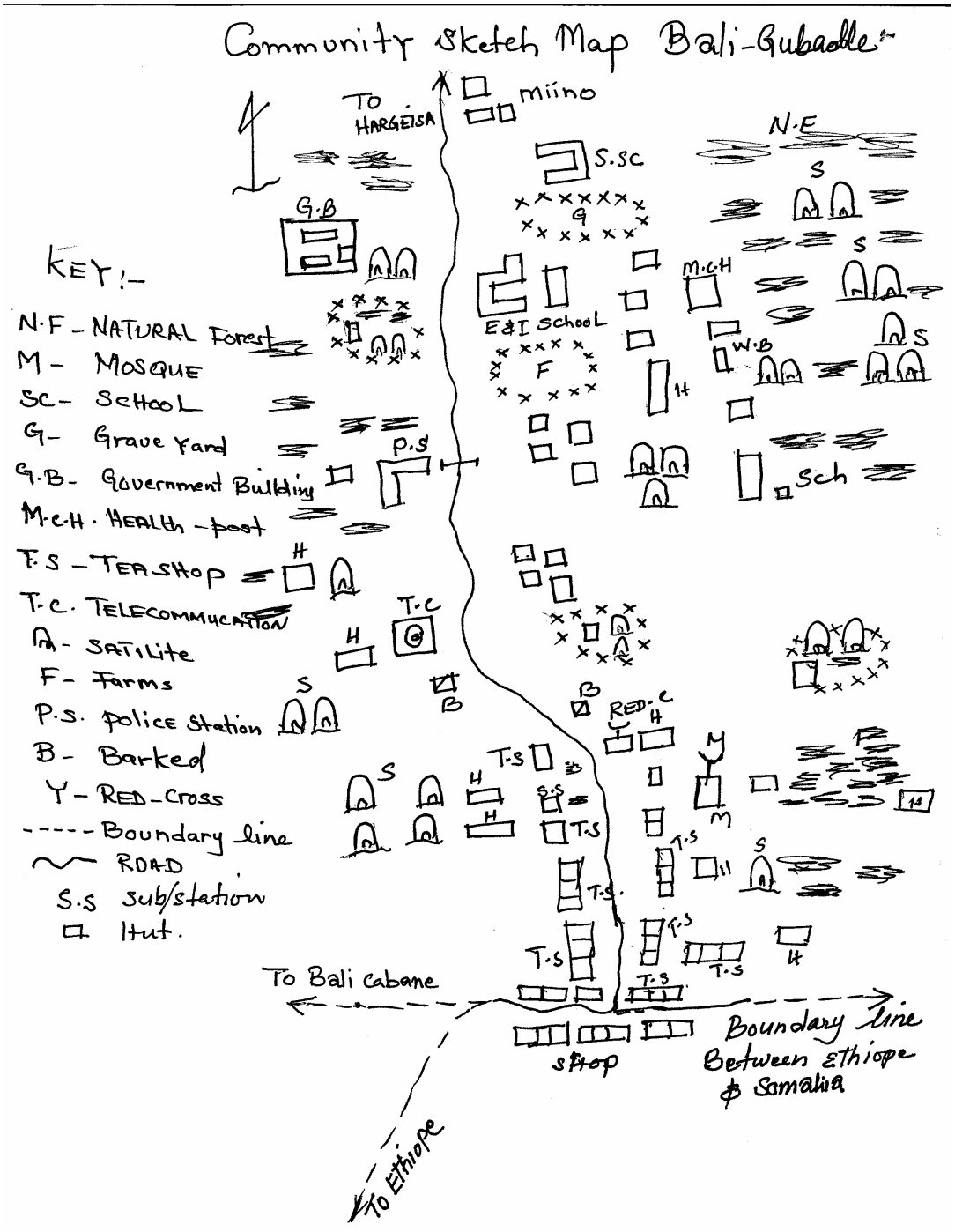
Parameters	**Zone 1**	**Zone 2**	**Zone 3**
Soil Type	Sandy loams with gravel, sandy clay	Sandy – with clay and gravel	Sandy clay
Crops	Maize, sorghum, cowpea	Cowpea, vegetable, maize	Tomatoes, Maize
Water	Berkads, balley	Balley, Berkad	Berkad, Balley
Socio-Economic Infrastructure	Hut, grass-thatched. Most unemployed men + women	Teashops and small stores, specially run by women	Nomadic Huts, Water Reservoirs
Erosion	Sheet erosion	Small gully erosion	Sheet Erosion Small Gully Erosion
Vegetation	Cadaad, Qudac, Maraar, Galool, Bilcan, Small Shrubs	Meygaag, Cadaad, Qansaax, Small Shrubs	Small Scattered Shrubs

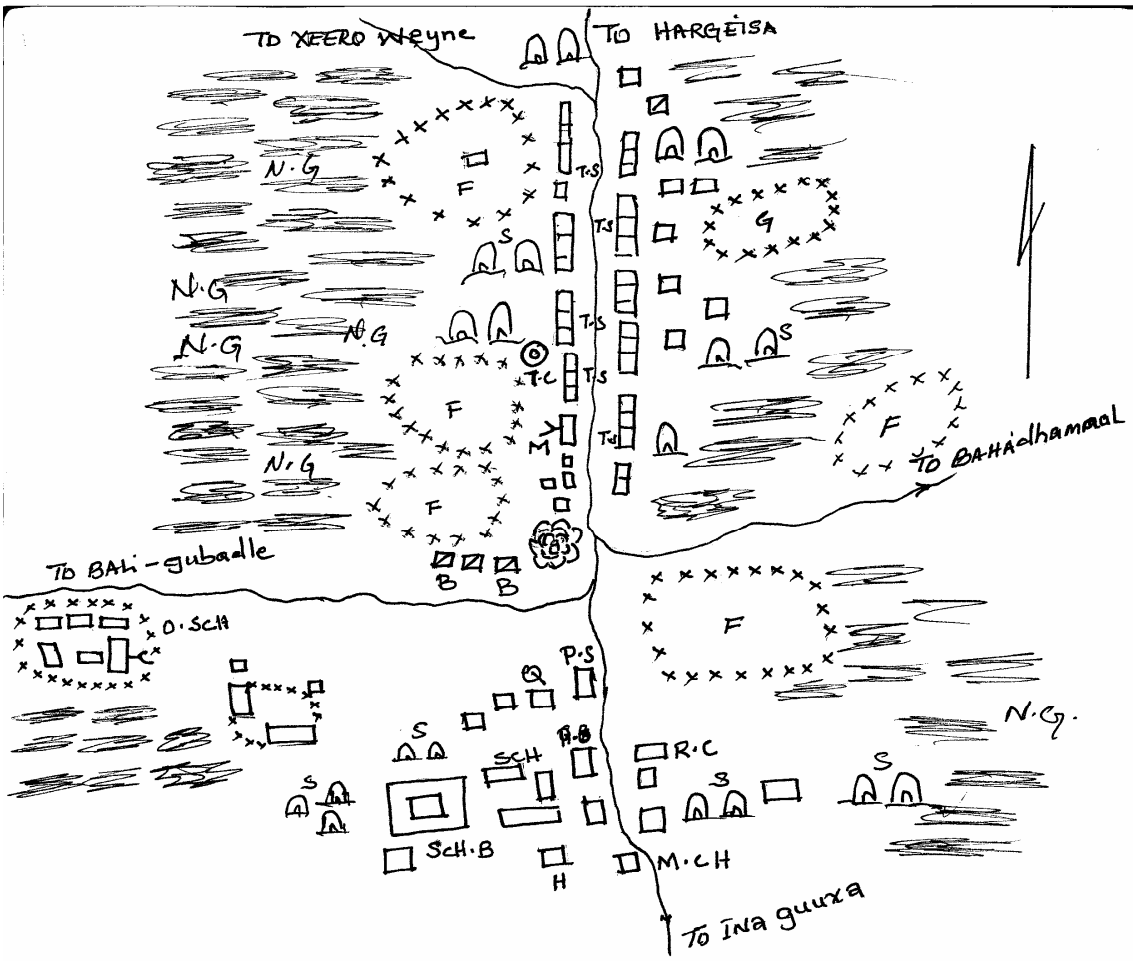
5. Areas of Enclosures and Charcoal Production (Sugulle)





6. Community Sketch Maps (prepared by Abshir)





Community sketch Map SALAHLAY:-

KEY:-

N.F – NATURAL FOREST
M – MOSQUE
B – WATER-RESERVIOR
SCh – SCHOOL
G – GRAVE YARD
G.B – GOVERNMENT Build.
M.C.H – HEALTH post
T.S – TEA-SHOP
O.SCH – ORPHAN-SCHOOL
B.SCH – Boarding school
T.C – TELECOMMUNICATION
SATILITE
Quranic-School
F – FARMS
P.S – POLICE STATION
R.C – RED – CROSS
ROAD
HUT.