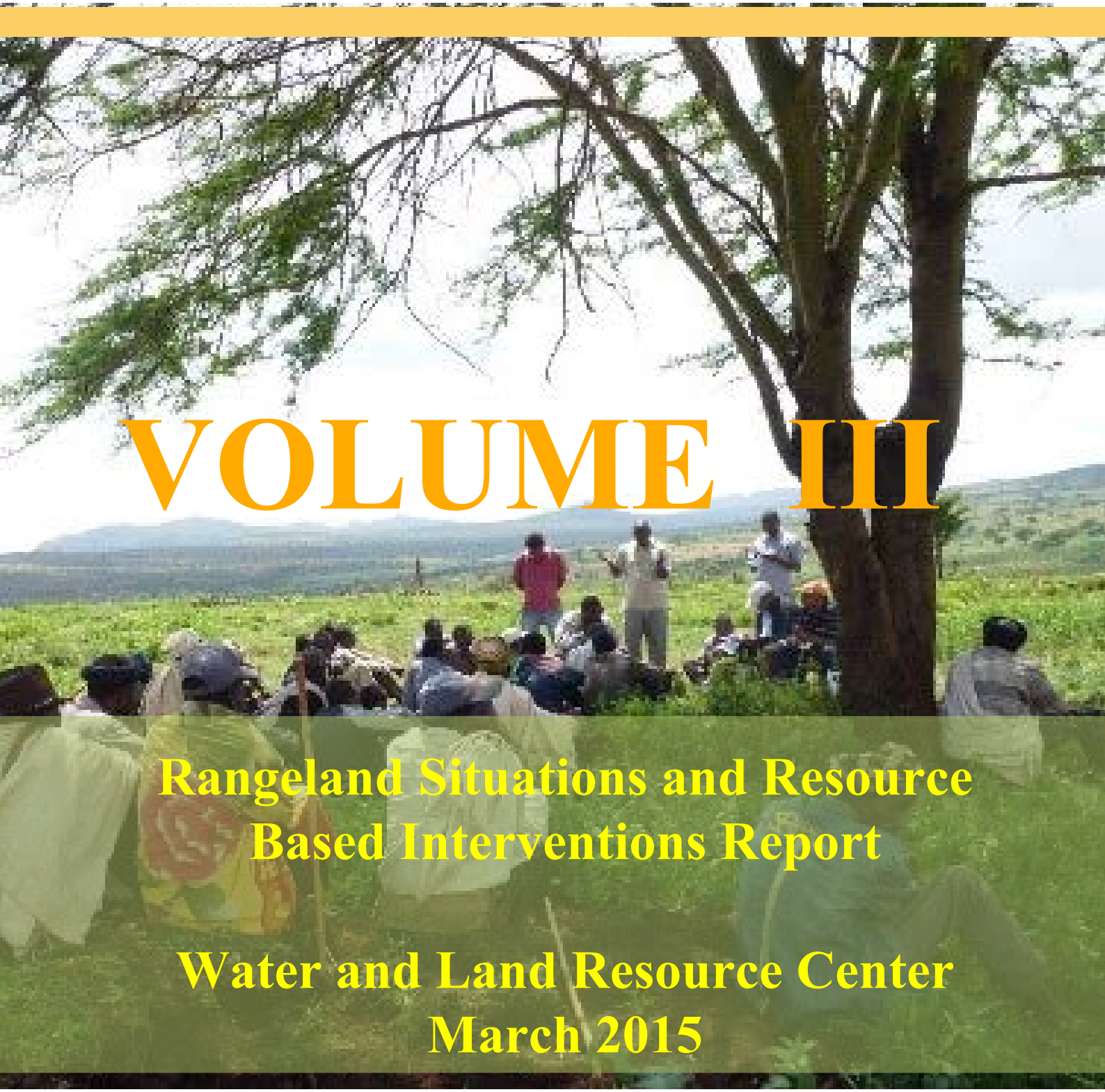
Water & Land Resource Centre

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Resource Availability Assessment Methodology for Land and Water Related Interventions in Wabi-Shebele and Genale-Dawa River Basins, Ethiopia



VOLUME III

Rangeland Situations and Resource Based Interventions Report

Water and Land Resource Center
March 2015

Resources Availability Assessment Methodology for Land and Water Related Intervention in Wabi-Shebele and Genale-Dawa Basins

Volume III. Rangeland Situations and Resource Based Interventions Report

Water and Land Resource Centre
March 2015

This study was “financed by the Swiss Development Cooperation through the project “Resource Availability Assessment Methodology for Land & Water Related Interventions – Wabi Shebele & Genale Dawa Basins” (Contract no. 81019192)”

Lead thematic writer
Dr Ayana Angassa
Hawassa University, Hawassa

Contributions
Dr Tena Alamirew
Water and Land Resources Centre

Thematic contribution
Gete Zeleke
Zewdu Alebachew

Project Team
Prof. Woldeamlak Bewket
Dr Gete Zeleke
Dr Tena Alamirew
Dr Ayana Angassa
Dr Berhanu Belay
Dr Dawit Alemu
Mr Taye Alemayehu
Mr Zewdu Alebachew

Citation:- Water and Land Resource Centre (WLRC), 2015. Resource Availability Assessment Methodology for Land and Water Related Interventions in the Wabi-Shebele and Genale-Dawa River Basins, Ethiopia: Volume III - Rangeland Situations and Resource Based Interventions Report. WLRC Working Paper 3. Addis Ababa.

Declaimer:- The views and interpretations expressed n this report are entirely those of the authors and do not necessarily reflect the official view or position of the Swiss Development Cooperation

ABBREVIATIONS AND ACRONYMS

BHU	Broader Homogenous Unit
CADU	Chilalo Agricultural Development Unit
EIAR	Ethiopian Institute of Agricultural Research
FAO	Food and Agriculture Organization
FWSP	Filtu Water and Sanitation Program
GCM	Global Circulation Model
GD	Genale Dawa
GDRB	Genale Dawa River Basin
GNP	Growth National Income
ILCA	International Livestock Centre for Africa
JIRDU	Jijiga Rangeland Development Unit
MOA	Ministry of Agriculture
MoWR	Ministry of Water Resources
NERDU	North Eastern Rangeland Development Unit
OBLEP	Oromiya Bureau of Land and Environment Protection
OPADC	Oromiya Pastoral Area Development Commission
TLDP -	Third Livestock Development Project
RRC	Relief and Rehabilitation Commission
SDC	Swiss Agency for Development and Cooperation
SLM	Sustainable Land Management
SOPARI	Somali Pastoral and Agro-pastoral Research Institute
SORDU	Southern Rangeland Development Unit
SPU	Smaller Planning Unit
WLRC	Water and Land Resource Centre
WS	Wabi-Shebele
WSRB	Wabi-Shebelle River Basin

EXECUTIVE SUMMARY

The Ethiopian rangelands represent an important economic resource to the pastoral communities and the country at large. The arid and semi-arid conditions of pastoral areas and the erratic nature of rainfall have historically left rangelands to be considered as marginal in the national economic development policy making. Land degradation and conversion of rangelands from the original grassland state to bush dominated rangelands have increased the vulnerability of pastoral communities to the adverse impacts of climate variability and climate change. In the pastoral areas of Ethiopia, the rangelands are under severe pressure due to population growth and ecological degradation as evidenced by the proliferation of bush encroachment, internal pressures on the rangelands due to expansion of crop cultivation, recurrent droughts, resource use related conflicts and unplanned water resource development interventions. The problem is reflected by shrinkage of grazing resources, reduced livestock productivity and households' dependence on relief food. Loss of livestock due to recurrent drought and scarcity of pasture has forced pastoral communities to shift from pastoral ways of life to agro-pastoralists to rely partly on crop production. The objective of this study is to provide a comprehensive assessment of the rangeland resource base, existing challenges and opportunities for rangeland development in Wabi-Shebele and Genale-Dawa river basins. Wabi-Shebele and Genale-Dawa river basins are two of the 12 river basins in Ethiopia.

Rangelands in Wabi-Shebele and Genale-Dawa river basins are located in Borana Zone of Oromiya region and Somali region of Ethiopia, which is characterized by arid and semi-arid climate with highly diverse natural resources. The area has extensive borders with neighboring Somalia and Kenya. Border towns are important gateways that allow the trans-clan and trans-national trade network for the movement of goods and people in the region. The area is economically tied to a trade network linking the region to the Gulf States, where livestock are exported. The income from live animals is used by pastoralists to purchase manufactured goods and food commodities. The Wabi-Shebele and Genale-Dawa rivers traverse the area and flow to the Indian Ocean. The banks of the rivers form an agricultural belt used by agro-pastoralists. Outside this farming corridor, rangelands are used by pastoral groups practicing traditional livestock husbandry.

The specific case study sites visited include: (i) Delo-Mena, Arero and Dire in Borana Zone of Oromiya region; (ii) Bensa in Sidama zone of SNNPR; and (ii) Godie in Somali region. The study is based primarily on extensive review of available literature, and some primary data collected through fieldwork in selected case study sites in the two basins. These communal rangelands are mainly used by pastoral (90-95 percent) and agro-pastoral communities. The unique features of these rangelands are the diversity of fauna and flora, human-wildlife-livestock interactions, changing landscapes, and environmental consequences. The major developmental challenges in the basins are: shortage of water both for humans and livestock, health related problems, expansion of bush encroachment, land degradation, rainfall variability and drought, limited access to market, and lack of technical support.

Past rangeland interventions were not successful as they were based on the views of inappropriate policy approach, which did not consider the specific ecological conditions of arid and semi-arid rangelands in terms of technology transfer (Oba, 1998). It was believed that high livestock mortalities in the 1960s and 1970s were linked to livestock density instead of the interactions between climate and livestock through indirect influence of rainfall variability on forage productivity. Consequently, grazing exclusion and unplanned water developments altered customary land use patterns, created severe environmental degradation and feed scarcity for livestock, and contributed to the widespread food insecurity for pastoral households (Ellis and Swift, 1988; Tache and Oba, 2010). The past policies often excluded pastoral communities. Currently, the situations have changed both globally and nationally. Pastoralism has been recognized as one of the economic systems that requires development attention. Nationally, Ethiopia has now a better policy environment and more development opportunities than in the past. Some of the major opportunities in pastoral development are the following:

(1) The constitutional rights of pastoralists have already been defined
(2) The government of Ethiopia is committed to developing pastoral areas
(3) The Pastoral Federal Board has been established
(4) A rural development strategy has been developed
(5) There has been a decentralization and empowerment of local administrations
(6) New institutions supporting pastoral development are emerging. The Oromiya Pastoral Area Devel opment Commission (OPADC), the Somali Regional Pastoral Bureau and South Nations, Nationali ties and Peoples Region Bureau of Pastoral Affairs are the major ones.

Solutions to the dilemma of rangeland degradation and deterioration of pastoral livelihoods in the two basins should be based on appropriate water development, effective bush control methods and rangeland rehabilitation, design and implementation of appropriate land policy, integration of traditional and modern early warning systems, facilitation of mobility where resources are available, livelihood diversification, wild life management, improved access to market, efficient utilization of available resources, use of innovative options such as drought tolerant and/or early maturing crop cultivars (in agro-pastoral areas), and gum collection for income generation. Similarly, improved understanding of the ecology of pastoral areas, interactions between pastoral people and their environments and role of indigenous knowledge are important in any effort to improve the wellbeing of pastoral communities. Participation of pastoral communities in problem identification, prioritization, planning of interventions, implementation, and evaluations should constitute part of an appropriate methodology for rangeland related interventions in Wabi-Shebele and Genale-Dawa river basins.

Developing resource availability assessment methodology for rangeland related interventions in Wabi-Shebele and Genale-Dawa river basins was conducted based on literature review, field visits to selected sites and discussions with different stakeholders in the two basins. In addition to an extensive literature review, primary data were collected through group discussions, individual case studies and field observations at four sites in each of the basins (Delo-Mena, Arero, Dire and Bensa in Genale-Dawa river basin and Adele, Kombolcha, Jigjiga and Godie in Wabi-Shebele river basin). The field work was conducted between 28 April and 07 May 2014. Group discussions with community representatives, local authorities and experts were used to assess development challenges, identify community priorities and possible sustainable interventions to tackle the identified challenges with a view to improving livelihoods of local communities. Field observations were used to obtain firsthand information on the status of environmental resources as well as living conditions of the local communities. The identified possible development interventions are then assessed in terms of potential adverse environmental and social impacts along with ratings of scale and probability of impacts occurring and possible risk mitigation strategies (Annex 1).

Based on field visits, communities' views, and a large body of literature review, the study concludes that there is substantial potential for range-livestock development in the two basins. Indigenous cattle breed conservation and improvement, conservation of biodiversity and natural resource management based carbon sequestration and climate change mitigation are also potential intervention options for livelihood diversification and income generation. Creation of income generating activities such as livestock fattening, gum collection, hay making and handicraft are alternative options for the resource poor households in the rangelands of the two basins.

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

1.1 General

Rangelands are defined as uncultivated lands that supply a grazing or browsing resource to domestic and wild animals. Rangelands are globally important ecosystems of great significance to human welfare and economies (Sankaran et al., 2005). Livestock grazing is one of the primary uses of rangelands. They also supply a number of other products, including water, firewood, wildlife, ecotourism, environmental services, recreation, mining, and so on. Rangelands cover about 41 percent of the earth's land surface (FAO, 2002; Washington-Allenet al., 2008). In Africa, rangelands, which contain both grasses and woody plants, cover approximately 2.1x109 ha and Africa's huge livestock populations extract about 80 percent of their nutrition from these vast rangelands (Allen Diaz, 1996). In addition, Africa's rangelands support a vibrant tourist industry that, in many countries, is the leading contributor to gross national products (GNP). Due to the rapid growth of Africa's population, the rangelands have recently become an arena for intense human and animal conflict, leading to serious reduction in the spatial distribution and diversity of species (Angassa et al. 2012). This reduction is likely to be exacerbated by the consequences of the projected climate change. Rangelands are noted for high climatic variability and high frequency of drought events, as well as long history of human use (Oba et al., 2000a). The combination of climate variability and inappropriate human land use make rangeland ecosystems highly susceptible to rapid degeneration of ecosystem properties (Angassa and Oba, 2008).

Rangelands in the Horn of Africa pastoral systems represent a unique geographical region, comprising a great diversity of ecosystems, cultures and human-environment interactions (Sankaran et al., 2005). With respect to natural resources, the huge diversity of biota and rangeland ecosystems provide unique opportunities to improve understanding of fundamental ecological processes, and management and conservation of biodiversity (Ellis and Swift, 1988). Unique ecological aspects of East African rangelands include spatially extensive grazing ecosystems with high diversity of mammalian fauna, changing landscapes, unique human-wildlife-livestock interactions, and environmental consequences (Sinclair and Fryxell, 1995). East African rangelands are under threat from population pressure and unregulated systems of land use (Angassa et al., 2012). The apparent effects of these threats include loss of biodiversity, rapid deterioration in rangeland cover and depletion of water availability due to destruction of catchments and aquifers. Changes in the climate will interact with these underlying changes in the environment, adding further stress to the deteriorating situation of the rangelands (Angassa and Oba, 2008). A sustained increase in mean ambient temperatures beyond 1°C would cause significant changes in rangeland cover, species distribution and composition, and migration patterns. Many organisms in the drylands are already near their thermal tolerance limits and some may not be able to adapt further under hotter conditions. Arid and semi-arid rangelands are under threat and highly vulnerable to the negative impacts of climate change (Megersa et al., 2014). In areas where rainfall is likely to increase as projected by some general circulation models (GCMs) in the highlands and river basins, marginal lands would become more productive than they are now. These effects are likely to be negated by population pressure on marginal rangelands. Adaptation options include control of bush encroachment, improved rangeland management, expansion of protected areas, designing appropriate intervention options for the development of watersheds and river basins and sustainable management of pasture and water resources.

The biggest challenges facing the Ethiopian rangelands are substantial changes in terms of development policy since the 1960s (Angassa ; Oba et al., 2000b; and Oba, 2008; Tache and Oba, 2010). Millions of dollars were invested to rehabilitate the Ethiopian rangelands and improve range-livestock production following the droughts of the 1960s and 1970s (Oba et al., 2000a). Despite the large investments to improve the local economies of

pastoral communities in Ethiopia, rangeland development projects during the past five decades have been less successful (Angassa and Oba, 2008). Instead, the equilibrium based interventions have weakened indigenous pastoral production systems and their effectiveness in mitigating the adverse effects of climate variability.

Past rangeland development projects were not successful as they were based on the views of unsuitable land policy approach, which did not consider the specific ecological conditions of arid and semi-arid rangelands in terms of technology transfer (Ellis and Swift, 1988). It was assumed that (i) changes in grazing systems and patterns of pastoral land use will improve rangeland conditions; (ii) if grazing is rotated by developing water points in specific areas within the rangelands, then degradation will be reversed; (iii) long-term livestock exclusion from the rangelands will reverse rangeland degradation; (iv) pastoral communities in arid and semi-arid rangelands conventionally maintained higher livestock number than can be supported by rangelands (Breman and de Wit, 1983). The high livestock mortalities during the 1960s and 1970s were linked to livestock density instead of the interactions between climate and livestock through the influence of erratic rainfall on forage productivity. As a result, grazing exclusion and unplanned water developments altered customary land use patterns, created severe environmental degradation and feed scarcity for livestock, and consequently contributed to the widespread food insecurity for pastoral households (Ellis and Swift, 1988; Tache and Oba, 2010).

The assumptions about past rangeland approach arise from the pre-dominant equilibrium views of rangeland management policy, which was exclusively developed for more stable environments. The equilibrium school of thought suggests that if rangelands are stocked at greater than their carrying capacities (i.e. if the number of livestock exceeds the available forage) then grazing induced rangeland degradation will occur (Milton et al., 1994). Eventually, those unsuccessful development approaches created land degradation and economic decline in the rangelands of Ethiopia. Poverty, associated with frequent drought, land degradation and livestock feed scarcity, is persistent in the rangelands of Ethiopia (Angassa and Oba, 2008; Little et al., 2008).

In contrast to the equilibrium concepts of grazing programs, pastoralists' customary land use is more appropriate to the unique ecological potentials of arid rangelands. Ethiopian pastoral systems of land use involve a high degree of opportunism to cope with the unpredictable nature of rainfall and drought events and the highly fluctuating forage distribution in space and time (Oba et al., 2000a). Livestock mobility relieves areas of high livestock concentration and allows pastoral herds to make use of grazing resources that are unevenly distributed in time and space. Pastoralists' strategies of managing multiple livestock species (both grazers and browsers) allow optimal use of the highly variable grazing resources. Pastoralists' land use strategies are aimed at exploiting multiple vegetation patches across landscapes. Hence, pastoralists' systems of land use are similar to those recommended by the non-equilibrium school of grazing models (Ellis and Swift, 1988; Oba et al., 2000a). According to the non-equilibrium ecological model, plant production dynamics in arid and semi-arid rangelands is influenced largely by rainfall variability than the impact of livestock grazing (Angassa and Oba, 2007). This is mainly factual in arid and semi-arid rangelands of Ethiopia where both plants and animals are strictly controlled by rainfall fluctuations.

The Ethiopian rangelands comprise 61 percent of the national land area (Coppock, 1994). Geographyically, the rangelands of the country occur below 1500 m above sea level sourronding the massive highland areas of the country with arid, semi-arid and sub-humed climates. The rangelands of Ethiopia are also home to 12 percent of the human population (Oba, 1998). The rangelands suport 26 percent of the livestock population and contribute to more than 90 percent of the legal export of live animals. The ranagelands of Ethiopia are important sources of livestock supply to the nation by providing milk, meat, animals for the mixed farming systems and employment opportunities for the local communities. The rangelands of Wabi-Shebele and Genale Dawa river basins of Ethiopia in particular were the major focus for the range-livestock development projects

in the past because of (i) the ecological potential of the rangelands in the basins; (ii) the quality of livestock from the rangelands of the basins; and (iii) their proximity to the national and international markets, as well as the relatively well develoed infrastructure at that time (Coppock, 1994). The rangelands of the country are also rich in biodiversity (flora, fauna, wildlife parks and sanctuaries), mineral resources and cultural components (well developed traditional institutions). Among others, the well developed and roubost traditional range management practices, seasonal based land use patterns and mobility due to seasonality and inter- and intra-annual variability of rainfall are some of the salient featues of the rangelands of Ethiopia. Mobility as an ecological rationality in arid and semi-arid lands is a response by pastoralists to variable range production and livestock nutritional needs. Mobility relies on pastoralists' knowledge and local institutions for making decisions (Angassa and Oba, 2008). However, the rangelands of Ethiopia received minimal development policy attention. Major environmental and social problems in the rangelands of Ethiopia include climate variability, recurrent drought, expansion of bush encroachment, encroachment of crop cultivation, shrinkage of the formerly vast rangelands, increased human population pressure, loss of biodiversity, marginalization, and vulnerability of pastoral communities.

Future rangeland management and development policy formulation should consider the unique ecological conditions in terms of the influence of rainfall variability on primary productivity and consequently on livestock production in the two basins. The important role of climate-plant and herbivore as interacting ecological processes in the region need due policy and development attention to maintain rangeland ecosystems for multiple purposes. In contrast to the equilibrium view, the interacting ecological processes among climate, plants and animals predict that the exclusion of both domestic and wild herbivores did not improve the condition of arid rangelands (Oba et al., 2000a). Evidences (Angassa and Oba, 2008; Oba et al., 2000a and b) have shown that an extended lack of grazing may result in the accumulation of "old vegetation", a decline in new growth, loss of species diversity and reduced plant production. This indicates that some plants in arid and semi-arid rangelands need the presence of grazing and fire to reproduce. Under arid conditions, plants that are grazed constantly may have lower residual biomass and ground cover, but they may also have higher production and better survival than ungrazed plants (Angassa and Oba, 2008). In pastoral areas of the country, strengthening drought resilience and reducing livestock losses through proper management of rangeland resources will help to increase food availability and boost economic growth.

Objectives of the study

This study forms part of a larger research project that aims at developing a methodological framework for a systematic assessment of natural resources and identification of sustainable resource-based development interventions by using Wabi-Shebele and Genale-Dawa river basins of Ethiopia as case study sites. It focuses on rangeland resources. The major objective is hence to provide a comprehensive assessment of the range-land resource base, existing challenges, and opportunities for rangeland development in the two basins. The specific objectives include:

i. To assess situation of rangeland resources in the Genale-Dawa and Wabi-Shebele river Basins
ii. To understand major challenges and opportunities for rangeland related development interventions in the two basins, and
iii. To contribute to the development of the methodological framework for assessment of available re sources and sustainable development options

2. METHODOLOGY

The study is based primarily on extensive review of available literature and some primary data collected through fieldwork in selected case study sites in the two basins.

Review of literature: available and accessible documents, both published and unpublished, were collected from various sources and reviewed systematically. In addition, background biophysical and socio-economic data were collected from relevant offices in each case study site.

Primary data collection: primary data were collected through focus group discussions. Participants of the group discussions were drawn from the local administration and agricultural offices as well as from communities and they included various community members such as elders, women, men and youth in mixed group settings; they are from dominant livelihood systems such as agro-pastoralists and pure pastoralists. The focus group discussions were convenient platforms to collect unbiased and non-exaggerated information from participants as group members would be checked on each other. Checklists were developed and used to orderly guide the discussion sessions.

Selection of fieldwork sites: The selection of the specific fieldwork sites followed a systematic procedure, which has been reported in full in the synthesis report (WLRC, 2014). To briefly mention, the first step involved delineation of broad homogenous units (BHUs) using farming systems as criteria. The BHUs were subsequently sub-divided into small planning units (SPUs) using selected criteria. The fieldwork then covered a total of four sites from each basin. Although some of the key findings and recommendations are based on the data generated from the case study sites, we believe that the general conclusions are valid to similar areas and in particular the methodology is replicable to other sites.

2.1. Study area description

2.1.1. Genale-Dawa River Basin

Genale-Dawa river basin has an area of 172,889 km2, covering parts of Oromiya and Somali National Regional States and the Southern Nations, Nationalities and Peoples' Region (SNNPR). It is situated between 3°30' N and 7°20' N latitude and 37°05' E and 43°20' E longitude. The basin covers seven administrative zones including Bale, Guji and Borana Zones of Oromiya Region, Sidama and Gedeo Zones of SNNPR, and Afder and Liben Zones of Somali Region (Fig. 1). It is the third largest river basin, after Wabi-Shebelle and Abay river basins (Oromia Bureau of Land and Environmental Protection (OBLEP, 2010)). The Genale-Dawa river basin has the lowest elevation of 171 m and the highest elevation of 4385 m above sea level (masl). The total mean annual flow from the river basin is estimated at about 5.8 Billion Metric Cube (BMC) (OBLEP, 2010). The basin falls mainly in the arid and semi-arid zones and is generally drought-prone with erratic rainfall. According to OBLEP, 2010), about 85 irrigation potential sites have been identified in the basin, out of which, 18 sites have potential for small-scale irrigation, 28 sites are medium-scale, and 39 sites are large-scale. The basin has an estimated total area of 1,074,720 hectares of irrigable land. Out of these potentials, 1805 hectares have been identified for small-scale, 28,415 hectares for medium-scale and 1,044,500 hectares for large-scale irrigation development (OBLEP, 2010). Agro-pastoralists constitute about 10 percent of the total inhabitants of the Genale-Dawa Basin, while the majority (more than 88 percent) of the inhabitants are still practicing pastoral mode of production (Filtu Water and Sanitation Program-FWSP, 2009).

The Dawa basin alone encompasses 1,740,370 ha of land, which covers the Borana zone of Oromiya Regional State (OBLEP, 2010). The Dawa basin includes the districts of Arero (86.04 percent), Bule-Hora (69.6 percent), Dirre (28.8 percent), Dugda-Dawa (91.3 percent) and Yabello (76.12 percent) in Borana zone. In terms of climate, 85.6 percent of the Dawa basin falls within hot to warm sub-moist rangelands, while 12.3 percent falls within warm to cool sub-moist mid highlands. The remaining areas of the Dawa basin are in the range of either warm to cool humid mid highlands, hot to warm moist lowlands, warm to cool moist mid-highlands, hot to warm semi-arid rangelands, and warm to cool sub-humid mid-highlands (OBLEP, 2010).

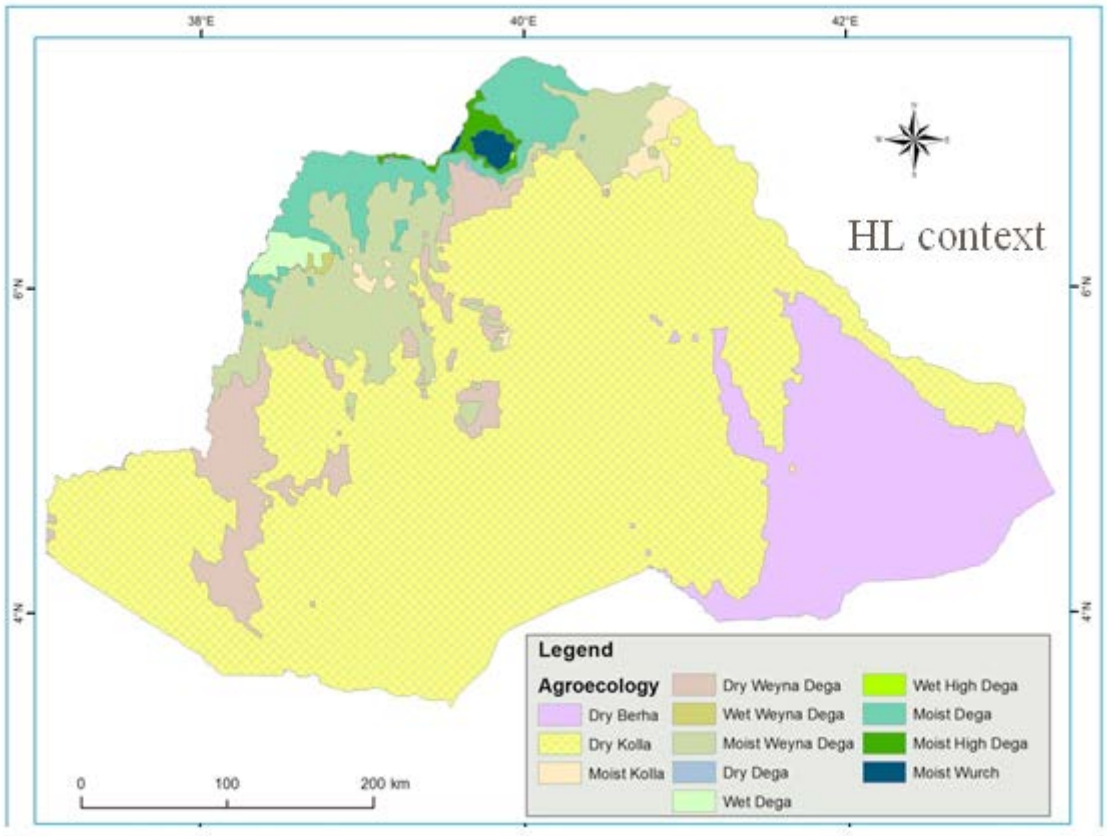


Figure 1. Agro-Ecology Map of the Genale/Dawa basin

According to OBLEP (2010), the major soil types of the Dawa Basin are Vertisols (4.19 percent), Luvisols (23.5 percent), Cambisols (4.19 percent), Andosols (0.28 percent), Fluvisols (3.89 percent), Calcisols (5.45 percent), Nitisols (11.34 percent) and Leptosols (10.17 percent). Most of the soils identified by the OBLEP are generally suitable for small scale irrigation where water is available. Some of the limitations related to soils in the Dawa basin are drainage in the Vertisols group, limited soil depth in Leptosols and deficiency of some elements and erosion hazards in the steep slope soils.

Categories of the main land use cover of the Dawa sub-basin include cultivated land (0.085 percent), bare land (4.291 percent), forest land (0.483 percent), grass land (0.911 percent), riverine forest (13.214 percent), shrub land (78.209 percent), water body (0.002 percent), wetland (0.019), and woodland (2.729). The sub-basin pasture resources have been declining severely in terms of quantity and quality because of the invasion of bush encroachment. The Dawa sub-basin shows considerable differences in soil, landform and agro-climate that reflects differences in the availability of rangeland resources.

The economy of the sub-basin is based mainly on livestock herding, in some cases cropping and forest products (OBLEP, 2010). However, the resource base is under threat due to the widespread land degradation, cultivation of marginal lands, misuse or inappropriate use of the natural resource base, recurrent drought, scarce productive land, erratic and unreliable rainfall and food insecurity. Due to the uncertainty of rainfall, the arid and semi-arid rangelands, as well as the sub-moist agro-climate zones of the Dawa sub-basin are not suitable for crop farming (OBLEP, 2010). Previous studies (Oba, 1998; Angassa and Oba, 2008; OBLEP, 2010) have shown that successful crop harvest occurs only in three years out of ten years. In years of unsuccessful crop harvests, the communities rely on the local market for grain purchase by selling their livestock or on relief food. This indicates the failure of crop farming under rain-fed conditions to guarantee food security in the arid and semi-arid rangelands of Genale-Dawa river Basin.

In recent years, the expansion of crop cultivation in the rangelands has transformed parts of the communal rangelands to private crop farms or enclosures (Angassa and Oba, 2008). Some of the recent crop lands that have been converted to cropping are the prime dry season grazing reserves. The loss of the dry season rangelands to crop cultivation makes livestock resources more vulnerable to the impacts of droughts when the dry season grazing areas are in greater demand for grazing by livestock. Besides, conversion of key grazing areas that were used as dry season grazing reserves will disrupt the ecological balance of the region and affect ecosystem goods and services. Furthermore, the use of once a dry season grazing area as a permanent crop land by agro-pastoralists turns into source of conflict between pastoralists and agro-pastoralists.

2.1.2. Wabi-Shebele River Basin

Wabi-Shebele river basin has an area of 202,697 km2, covering parts of Oromiya, Harari and Somali National Regional States. The basin has the lowest elevation of 184 m and the highest elevation of 4182 m above sea level (masl). The total mean annual flow from the river basin is estimated at about 3.16 BMC. A total of 149 potential irrigable sites have been identified in the basin with approximately 41 small-scale, 77 medium-scale and 31 large-scale irrigable lands (OBLEP, 2010). It has an estimated potential of 237,905 hectares of irrigable area. Out of these potentials, about 10,755 hectares are for small-scale, 55,950 hectares for medium-scale and 171,200 hectares are suitable for large-scale irrigation development (OBLEP, 2010).

The Wabi-Shebele river basin is a transboundary river basin shared between Ethiopia and Somalia. The part in Ethiopia is located between 4°45’ N and 9° 45’N latitude and 38°45’E to 45° 30’E longitude, including the closed watershed of the Fafen and Bio Ado (Fig.2). It springs from the Bale mountain ranges of the Galama and Ahmar about 4000 masl and drains into the Indian Ocean crossing Somalia. About 72 percent of the catchment (202,220 km2) is found in Ethiopia. The basin covers about 19 percent of the area of the country (Adane, 2009).

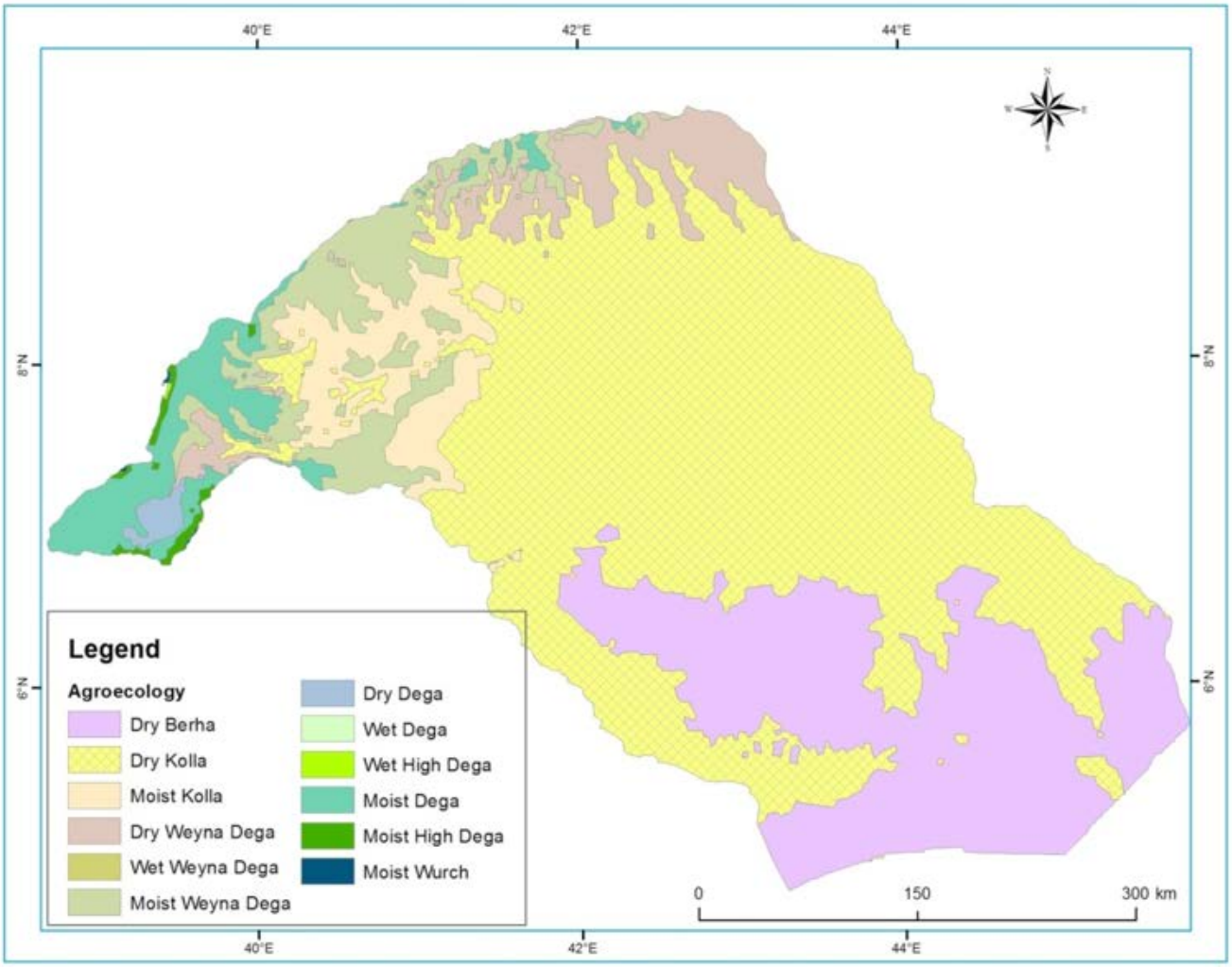


Figure 2. Agro-ecology map of the Wabi-Shebele basin

The amount and distribution of rainfall vary from 271 mm at the lowest arid portion at Gode to 1320 mm in the upstream highlands of the basin at Seru (Adane, 2009). The area is dominated by Mesozoic sedimentary formations though to some extent there are also volcanic rocks at the north-west of the basin and isolated ridges and hills within the sedimentary basin (OBLEP, 2010). Metamorphic rocks outcrops to a small extent at the northern part of the study area. Alluvial deposits are also distributed linearly along the Wabi-Shebele, Jerer, and Fafen rivers and fan deposits of seasonal floods and stream beds. It is bounded by Genale basin in the south west, Rift Valley in the west and north west, Awash basin in the north, AyshaDewele in the north east, Ogaden in the east and Somalia in the south (Adane, 2009). The basin includes Oromiya, Somali, Harari and a small area at the source of the Wabi-Shebele River in SNNPR. Out of these, Oromiya and Somali regional states cover about 38 percent and 60 percent of the basin's area respectively (Adane, 2009).

2.1.3. Population

The total population of the Wabi-Shebele basin is about 5.8 million (Adane, 2009). Out of this, 70.1 percent of the population belongs to parts of four Zones of Oromiya Region while about 27.4 percent are residents of Somali Region. The remaining population belongs to Harari and SNNPR. Population density is highest in Arsi (78.5 people/km2) whereas it is lowest in Warder Zone (4.2 people/km2). Large percentage of the population in the highlands depends on agriculture while the lowlanders in general are pastoralists. About two-thirds of the area is populated with less than 20 person/km2. Most of the less populated area lies in the arid to semi-arid lowlands of the Basin.

2.1.4. Topographic Features

The Wabi-Shebele river emerges from the mountain areas of the north western borders of the river basin near a place called Hebeno. About 11 percent of the total basin area is highland (Adane, 2009). The altitude varies from 200 m above sea level (masl) north of Mustahil in Somali region to about 4000 masl on the highlands of Bale (Fig. 3). From its source, the Wabi-Shebele river flows eastward until it meets with another major component of the main river joining from Harari region where most of the left bank tributaries originate and then it changes its course to flow southwards. Downstream of Melka-Wakena hydropower dam site, the river flows through a deep gorge up to north of Imi and emerges in its lower valley. The lower valley is a vast alluvial plain stretching up to Somalia border with a very gentle slope of 0.25 to 0.35 m/km. Most of the tributaries after this portion do not add substantial flow to the main water course. The Fafen and Jerer watersheds are closed watersheds (Adane, 2009).

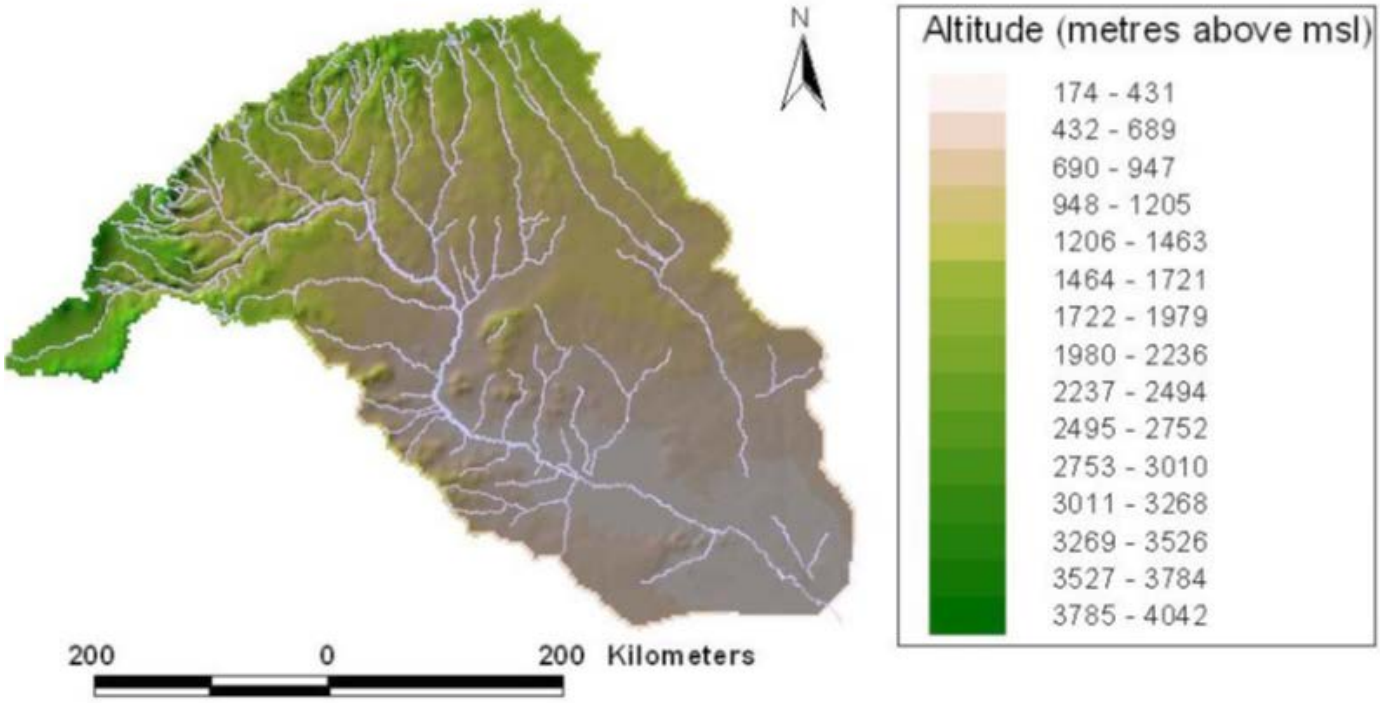


Figure 3. Digital elevation model of Wabi-Shebele basin (Source: Adane, 2009)

2.1.5. Land use and land cover

A small dense forest is found at the north-western part of the Wabi-Shebele river basin. Dense shrubland is the predominant land cover in the Wabi-Shebele river basin. The shrubland occurs mainly on the semi-arid parts and often consists of patches of shrubs interspersing grasslands with some scattered low trees. Patches of exposed rock or sand surfaces are found in parts of Bale and Hararghe lowlands in the southeast. Afro-alpine vegetation is found in some parts of the central Arsi and northern Bale zones. These consist mostly of short shrub and heath vegetation used partly for sedentary grazing and browsing, and where the terrain permits, for some cultivation of barley. Riparian woodland and bushland occur along the river banks and on floodplains, and are important in the semi-arid and arid parts of the basin where they are used for grazing and browsing and scattered seasonal crop cultivation on some of the floodplains. The land use consists of a large part of pastoral production system. Areas found on the highlands of Arsi, parts of Harerghe highlands and northern Bale are intensively cultivated lands (Adane, 2009). The major seasonal crops in the basin include maize, barley, wheat and sorghum while the perennial crops include coffee, chat and fruit trees.

Generally, the Wabi-Shebele river basin is endowed with enormous livestock population, diverse rangelands favorable for livestock production, irrigation potential for pasture and crop production along the riverbank, and other natural resources and wildlife management. The key economic base of the rangeland units of the Wabi-Shebele river basin is pastoralism. The Wabi-Shebele river is the main source of water for humans, livestock and agricultural needs in the basin. Population of the basin is predominantly pastoral and earns livelihoods from livestock and certain opportunistic farming. The climate is characterized by low, erratic, unpredictable and short duration rainfall, and high temperature in the arid rangelands. The irregular rainfall pattern tied with the degraded rangelands of the upper stream causes flash floods and slow onset flood disasters. The recurrent droughts, long dry season and lack of skill for alternative livelihoods diversification adversely affected the food security of the pastoral communities in the basin. The pastoral communities, therefore, move seasonally in search of pasture and water for their livestock. In some cases, such movement and competition over water and grazing resources cause ethnic conflicts in the basin.

3. SITUATION ANALYSIS

3.1. Rangeland resources and their characteristics in Genale-Dawa River Basin

The rangelands in the Genale-Dawa basin represent a precious economic resource to the pastoral communities and the country at large. The rangelands of the basin comprise huge diversity of ecosystems, cultures and spatially extensive grazing resources. The indigenous vegetation resources are used as feed for grazers and browsers. The rangelands of the basin include the lowlands of Borana and Bale zones in Oromiya Regional State and Liben zone of Ethiopian Somali Regional State. These communal rangelands are mainly used by pastoral (90-95 percent) and agro-pastoral communities. The unique features of the basin's rangelands are the diversity of fauna and flora, changing landscapes, human-wildlife-livestock interactions and environmental consequences. The arid conditions and unreliable rainfall has made the rangelands of the basin marginal to the national economy. Where past development intervention was implemented, it was based on equilibrium policy approach, which is inappropriate for arid rangelands. Past development interventions ignored the indigenous knowledge systems for managing the natural resources because development policies were built on equilibrium theory that maintains inappropriateness of the indigenous systems of land use. Land alienation and transformation of grazing systems made the rangelands vulnerable to the impacts of climate change and variability. In the rangelands of the basin, conflicts over grazing lands, restriction of transboundary access to grazing and water resources, restricted mobility, compression of the population into a fraction of the vast rangeland territory, ecological degradation caused by the expansion of bush encroachment, internal pressures on the grazing lands by croplands, and fodder banks put the rangeland resources under severe pressure. Decline in livestock productivity and increasing reliance of the pastoral community on food aid are few examples of the current challenges. Solutions to rangeland management must be based on improved understanding of the ecology of arid lands and role of indigenous knowledge in rangeland management and security of resource tenure rights.

The rangelands of Genale-Dawa basin are already degraded. Some of the causes of rangeland degradation include internal response to loss of the communal rangelands to cropping, range enclosures and ranching. Rangeland degradation is also worsened by unplanned water development. The indigenous land use patterns between wet and dry season grazing areas are altered and year round grazing has become common practice in most rangelands of the basin. Locally, the rangelands are deteriorating due to bush encroachment and shifts

in herbaceous composition. Vast areas of the rangelands have been endangered by bush encroachment (Oba, 2009). Soil erosion is becoming a growing threat on cropping areas and around permanent ponds. The former grasslands have already been replaced and dominated by unpalatable fobs. Ban of fire, as a tool for rangeland management, is believed to be the major cause of bush encroachment in the rangelands of the basin.

The rangelands of the basin are adversely affected by changes in resource tenure regimes. Changes in resource tenure regimes were related to (i) expansion of crop cultivation in the communal rangelands; (ii) external pressures caused by ethnic conflicts leading to loss of grazing lands between clan boundaries; (3) internal adjustments to declining resources by reallocating portions of the communal rangelands to cropping and establishment of fodder banks; and (4) privatization of the communal rangelands as ranches. Crop farming is an internal response to the declining condition of livestock productivity, whereas fodder banks are used to promote feed security for livestock in settled and degraded areas. It may provide an opportunity to integrate different land use systems in areas where resources are under intensive pressure although it is not a substitute for the wet and dry season grazing patterns. Past rangeland development interventions in the lowlands of the basin were focused on improvement of infrastructure, veterinary services, livestock marketing and water development. Development of ranches was designed to demonstrate the advantages of altering the indigenous system of rangeland management

3.2. Rangeland resources and their characteristics in Wabi-Shebele river basin

The Wabi-Shebele river basin in Somali region of Ethiopia is predominantly a pastoral area. As with most pastoral areas, it is affected by extreme climate variability and increased population pressure. These factors have triggered rangeland degradation and intensified the effects of droughts in the region. Climate variability and drought affected rangeland productivity adversely, which in turn creates feed scarcity for livestock with significant implications on local food security. Over recent years, patterns of access to grazing resources have drastically altered with the expansion of bush encroachment, rangeland degradation, and land enclosures. Allocating communal rangeland resources into small private enclosures and crop lands is a significant step towards adopting more sedentary settlement and land use patterns. It has unintended consequences on access to communal resources for pastoralists. There has been a gradual expansion of agriculture and sedentarization with a shifting pattern of pastoral way of life along the Wabi-Shebele riverbank. High population growth and refugee flows due to regional insecurity have increased pressure on rangeland resources and contributed to the gradual transformation of pastoral land use in the basin. Alteration of the communal rangelands has been further intensified by climate change and variability as evidenced by recurrent drought in the basin. Changes in communal rangelands have not only impacted rangeland resources but also restricted the free movement of livestock and created extra workload for pastoral households to manage livestock on small portion of private enclosures. Pastoral households face a huge burden during the dry season searching feed for their livestock because livestock cannot move from place to place as in the past especially in settled areas. When the nearby village has no feed, family members especially women have to travel long distances in search of fodder or are forced to buy it from other enclosure owners. Land enclosures are a barrier as they prevent livestock mobility from moving around in search of pasture. Livestock cannot feed from all trees, shrubs and grasses as it was the case in the past. Pastoralists believed that free movement of livestock within the vast communal rangelands is good for the body condition of their animals as staying in one area for a long time will affect animals' body conditions.

3.2.1. Spatial and temporal variability of grazing resources

Rangelands are generally complex and dynamic systems (Westobyet al., 1989), alternating between woodland and grassland states given that the balance between the woody and herbaceous layers are maintained. Such dynamics includes the spatial and temporal distribution of rangeland resources, extreme rainfall variability, seasonal and inter-annual fluctuations in forage availability, livestock mobility, disease outbreak, effects of droughts on pastoral herds, human adaptation and the drivers responsible for the shifts in vegetation resources (Angassa, 2007). Rainfall variability is the salient feature of rangelands in the basins. This causes spatial and temporal variability in rangeland resource availability. Some parts of the basins experience a longer dry season than other areas. The remarkable differences in seasonality and year-to-year rainfall variability results in fluctuating forage production in time and space creating feed scarcity for livestock (Le Houerou and Hoste, 1977; Le Houerouet al., 1988). Inter-annual rainfall variability in the rangelands of the two basins is largely characterized by a high coefficient of variation that reflects periodic livestock losses (Angassa and Oba, 2007) and local food insecurity (Megersa et al., 2014).

3.2.2. Indigenous knowledge of rangeland management

Indigenous knowledge of rangeland management is widely practiced. Resources are classified at landscape and patch levels. According to the indigenous knowledge of range management, the type of soils and vegetation are important basis for rangeland classification. Rangeland classification is also based on the suitability of different landscapes for livestock management. Grazers and browsers have different preferences and hence, the different landscapes used differently. Oba (2009) pointed out that livestock performance is a good indicator of rangeland suitability. Suitability of landscape is expressed by its capacity for grazing, which is the ability of the rangeland to support high stocking densities without causing degradation. Indigenous rangeland management is based on division of herds into mobile and non-mobile herd management systems. Annual grazing cycle by the two types of management systems involves herd movements between the wet and dry seasons, as well as drought year grazing rangelands (Oba and Kotile, 2001). Pastoral land use is focused on the spatial - temporal use of rangeland resources. For example, the grazing patterns of the Borana pastoralists in the Liban, Dire and Golbo rangeland systems are differentiated arising from the unique ecological conditions and distributions of critical grazing and water resources. As indicated by Oba (1998), some units of the rangelands have limited to dry season and drought year grazing reserves as compared to others where resources are well defined for the dry season and drought year grazing reserves. Water is not only considered a resource but also a tool for regulating rangeland management. Through complex watering rights, access to water points is controlled. This has a restrictive effect on the total number of livestock watered at any water point in the rangelands. Thus, the indigenous knowledge of rangeland management is concerned about the damage unplanned water development might cause to the rangelands. Thus, the indigenous knowledge of rangeland management allows seasonal land use to minimize the damage on rangeland resources. However, the indigenous land use patterns between wet and dry season grazing areas are altered and year round grazing has become common practice in most rangelands of the basins. This implies that pastoral communities who have limited access to dry season and drought year grazing reserves may suffer more drought stress than those pastoral societies where grazing resources are easily accessible for their livestock during the dry season and drought years.

3.2.3. Rangeland trends

The rangelands of the basins have been changed over time from open grassland to bush dominated ecosystem or degraded bare land. Rangeland degradation is a common phenomenon, which is evidenced by vegetation changes that have taken place as a result of woody plant encroachment, expansion of crop cultivation, increased bare land and more erosion. These phenomena have altered most rangelands of the basins with a major change that has important implications for the water cycle and stream flow in the region. For example, Oba (1998) estimates that more than 80 percent of the rangelands in the Genale-Dawa basin have been severely degraded

and altered due to bush encroachment and invasion by unpalatable forbs. The term 'rangeland degradation' is used to describe vegetation changes that have been taking place as a result of fire ban, increased density of woody encroachment, concentrated water points in certain areas of the rangeland, restricted mobility, increased pressure and expansion of crop cultivation. Soils are mostly exposed and erosion has occurred or is continuing to occur. Thus, rangeland degradation is an important type of land-use change that potentially affects the water cycle and ecosystem services in the region. Significant rangeland degradation and loss of ground cover have been common in most rangelands of the basins, largely as a result of increased pressure and shrinkage in the size of rangelands. Fragmentation of the original rangelands and loss of key grazing areas to crop cultivation greatly reduced livestock movements between the wet and dry season grazing areas. Alteration of the traditional land use patterns (annual grazing cycles) between the wet and dry season grazing areas to a year round continuous grazing is the major transformation in the rangelands of the basins. As a result, dependency on livestock economy is deteriorating. On the other hand, this may lead to loss of rangeland biodiversity and increased food insecurity of pastoralists.

3.2.4. Status of bush encroachment

Bush encroachment is a serious problem in the rangelands of the basins. Pastoralists claimed that grass and milk production are declining due to the effect of bush encroachment. Tick infestation is also a major problem associated with bush encroachment, while predator attack is increasing. Bush encroachment is a challenge for herd management in that (i) it reduces visibility (ii) creates a barrier for herd movement (iii) poses physical damage to the body of animals. Bush encroachment has fundamentally changed the communal rangelands from open savanna grasslands to bush thickets. Pastoralists mentioned that bush encroachment has adversely affected the carrying capacity of grazing lands and hence the cattle population. As a result, the livelihood of pastoralists is deteriorating due to the impact of bush encroachment. The expansion of bush encroachment has resulted in the loss of grasses that may be associated with changes in the grazing patterns of livestock (Angassa and Oba, 2008). Heavy livestock grazing has reduced the herbaceous vegetation cover, which could be used as a fuel load for burning to improve the status of the rangeland conditions (Coppock, 1994; Oba et al., 2000b). On the other hand, the ban of fire in the rangelands might have promoted the expansion of bush encroachment (Coppock, 1993), due to reduced fuel load and fire frequency (Archer, 1995; Scholes and Archer, 1997).

3.2.5. Rangeland degradation

The rangelands of the basins are gradually degrading. The causes of rangeland degradation include internal responses to the loss of rangelands to crop cultivation, evolution of rangeland enclosures and loss of key grazing areas to ranching, large-scale agriculture, and national parks. Rangeland degradation is also aggravated by unplanned water development interventions, fire suppression, and consequently the proliferation of bush encroachment and the changing climate. The traditional practices of seasonal mobility between the wet and dry season grazing rangelands have been altered, and sedentarization of the pastoral population is ever increasing. The rangelands are deteriorating due to the invasion of bush encroachment and changes in composition of the herbaceous vegetation. In some cases, soil erosion is a growing threat, especially in areas where crop cultivation has been expanding and around permanent ponds due to the high concentration of livestock and trampling effect. Generally, pond development and settlements can attract high concentration of livestock resulting in severe degradation of the rangelands. Bush encroachment is apparently caused by the effect of climate, history of land use and ban of fire use as a tool for rangeland management. Oral sources suggest that bush encroachment became a problem following the ban of fire use in the early 1970s (Angassa and Oba, 2008). Furthermore, climate variability is frequently cited as one of the most serious environmental challenges to human development in dryland areas (Schipper and Pelling, 2006). The negative effects of climate change on rangeland resources include increased rainfall variability, frequent dry spells and droughts, favourable conditions for further bush encroachment, possible emergence of aggressive weeds and loss of indigenous herbaceous species.

3.2.6. Internal pressure

The rangelands of the basins are adversely affected by changes in resource ownership. Changes in resource rights are related to various practices such as (i) encroachment of crop cultivation in the rangelands by immigrant farmers from the neighboring highland areas; (ii) external pressures caused by ethnic conflicts, which leads to loss of grazing lands between clan borders or regional boundaries; (iii) internal adjustments to the changing resources by reallocating parts of the communal rangelands to farm land for cropping and establishment of fodder banks and (iv) allocation of the communal rangelands for ranching and other investments. Internally, reallocation of the communal rangelands to farming and fodder banks has used the traditional rules and regulations of access to grazing resources. Crop farming may be an internal response to the loss of livestock caused by frequent drought and declining livestock productivity, while fodder banks are used to promote livestock feed availability in settled and degraded areas. For example, allocation of fodder banks followed the Proclamations of the Pan Borana General Assembly of Gumi Gayo (Oba, 1998). It provides an opportunity to integrate different land use systems in areas where resources are under heavy pressure. However, allocation of fodder banks never substitutes the traditional systems of land use (i.e.,wet and dry season grazing patterns), which was used to minimize livestock losses during drought and land degradation by giving rest to certain portion of the rangelands.

3.2.7. Loss of resource tenure

The concept of resource tenure among pastoral communities is well recognized. For the pastoral communities, pasture and water are the two key resources. Water is not only considered a resource but also a tool for regulating rangeland management and access to pasture (Angassa and Oba, 2008). For instance, access to the wet season grazing pastures in the basins is controlled by the limitation of surface water, while access to the deep wells is controlled through the complex watering rights. Watering rights and indigenous water management have restrictive effects on the total number of livestock watered at any water point in the two basins. Therefore, pastoralists are more concerned about the damage unplanned water development may cause to their environment. Careful development of water points for humans and livestock consumption may improve the sufferings of pastoral communities from recurrent drought. Wells are the property of the sub-clans and maintenance and excavations are the responsibilities of the clan. Ponds may have property rights but are managed by the users. Conflicts are resolved by the sub-clans. Hence, pastoralists use a reliable system of keeping track of ownership rights of water points and other resources.

4. PAST EFFORTS

4.1. Past efforts and challenges to rangeland development in the two basins

Past development interventions in the rangelands of the basins were based on inappropriate ecological and socio-economic models (Oba et al., 2000a; Oba, 2009). Past rangeland development projects overlooked the importance of climate and indigenous knowledge systems for managing the rangeland resources in the two basins. Rangeland development strategies were founded on the notion of equilibrium theory that assumes the indigenous systems of land use inappropriate. Past development interventions replaced the indigenous rangeland management instead of strengthening the system's resilience to the uncertainty of climate and arid land conditions. Wrong perceptions dominated the development agenda of past interventions in the rangelands of the basins. Such perceptions were used to advocate the backwardness of pastoralists and environmental deg-

radation as consequence of pastoral land use. As a result, the key developmental policy agenda in the last five decades were promotion of restricted grazing based on the concepts of western ranching, settling pastoralists and privatization of the communal rangelands. However, the impact of past development interventions by changing the traditional patterns of land use weakened the indigenous pastoral systems by creating land degradation. The impact of past projects, environmental degradation, conflict over resources, recurrent drought, poverty and donors' withdrawal created socio-economic crisis in parts of the region. Thus, past efforts were not very successful because of the misguided policy assumptions from climatic point of view, misguided design of development projects and disregard to the indigenous knowledge of land use.

4.1. 1.Current initiatives and institutions

More recent development initiatives in the Wabi-Shebele and Genale-Dawa basins have involved the Pastoral Community Development Project (PCDP), the Oromiya Pastoral Area Development Commission, the SNNPR Pastoral Affairs Bureau, the Somali Pastoral Development Affairs, Oromiya Research Institute, Somali Research Institute and various Non-Governmental Organizations (NGOs) such as USAID, CARE, FAO, Save the Children UK, Save the Children US, Action for Development (AFD), SOS Sahel, Mercy Corps, World Food Program, Catholic Relief Services, LVIA, Farm Africa, Ministry of Agriculture and Rural Development (MOARD), UNICEF and Volunteers in Overseas Cooperative Associations (VOCA). The various governmental and Non-Governmental Organizations have designed to incorporate participatory approaches to pastoral development in addition to provision of infrastructure and support services. Despite advances in pastoral development concepts since 1975, impact of pastoral development activities has been routinely constrained by shortages of operating funds, policies, trained manpower and periods of insecurity. For instance, different research and development organizations collaborated in the rangelands of Ethiopia between 1982 and 1990 to better understand the pastoral systems and design some development interventions. Those efforts included the Third Livestock Development Project (TLDP), the International Livestock Centre for Africa (ILCA), CARE-Ethiopia, the Institute of Ethiopian Agricultural Research and the Relief and Rehabilitation Commission (RRC) working in the Southern Rangeland Development Unit sub-project area.

4.1.2. Policy approach

Past rangeland development interventions in the Wabi-Shebele and Genale-Dawa basins were based on inappropriate ecological and socio-economic models (Oba, 2009). Past rangeland development strategies were based on the notion of equilibrium theory that maintains inappropriateness of the indigenous systems of land use. The key developmental policy agenda were promotion of restricted grazing based on western ranching, settling pastoralists and privatization of the communal rangelands. Those interventions overlooked the role of climate and indigenous knowledge systems and implemented against the traditional rangeland management practices instead of strengthening the system's resilience to the uncertainty of climate and arid land conditions. Oba (2009) has indicated that changes in resource tenure regimes that influenced the rangelands of the basins are sudden and disruptive as opposed to the indigenous systems of resource tenure rights. Generally, past interventions deeply weakened the indigenous systems of land use by creating land degradation. The failed projects, environmental degradation, conflict over resources, recurrent drought, poverty and donors' withdrawal created socio-economic crisis in the rangelands of the basins. Thus, past efforts were not successful because of misguided policy assumptions, misguided design of development projects and disregard to the indigenous knowledge of land use.

It has also been argued that the country has no suitable land use policy for the rangelands. A policy that has been developed for the crop based highland areas of the country is implemented in the rangeland areas. According to Oba (1998), two important land "Proclamations of the Federal Government of Ethiopia have

implications for the rangelands of the country". As indicated by the same author, "the Federal Negarit Gazeta, 1st year No.1 Addis Ababa-21st August 1995 under Article 40, the 5thitem and the Federal Negarit Gazeta No. 54 of Proclamations No. 89/1997, under Part 2 Section 6 confirm the security of pastoralists' rangelands from eviction or displacement for any reason". The current trends of cropland expansion in the communal rangelands in the pastoral areas are a major threat for the sustainable use of communal rangelands. Allocation of the rangelands and transformation to other forms of land use is one of the biggest challenges for the free movement of livestock and their access to grazing resources. Oba (2009) also pointed out that the idea of under-utilized land is contrary to the pastoral way of land use. According to the pastoral view of space, there is no land which is "unoccupied" as every grazing unit is cautiously put aside for different uses at different times of a year to minimize risks of livestock losses and humanitarian crisis. Pastoral way of land use is in accordance with the erratic nature of rainfall and forage availability in time and space. The traditional grazing system entails rotational resource use patterns between the wet season and dry season rangelands. Lack of proper land use policy for the rangelands is likely to lead to misuse of the communal rangelands that can interfere with the adaptive coping strategies of pastoralists. The evidence has relevance to the pastoral rangelands of Ethiopia. It will be crucial to follow up on such an issue and ensure the implementation of future policy guideline that secures resource tenure rights of the pastoral societies and conservation of arid land ecosystems. Failure to do so would make the rangelands of the basin more vulnerable to the impacts of climate change and consequently will lead to economic and humanitarian crisis (Angassa and Oba, 2008).

4.1.3. Development interventions

The World Bank funded arid rangeland projects in Ethiopia were classified into the following four phases.

i. The ranching phase (mid 1960s to early 1980s): This phase focused on transfer of western ranching technology to the arid rangelands of the country and elsewhere in Africa. The ranching phase includ ed heavy capital investments (fencing, block grazing, water development and introduction of exotic breeds) by converting the communal rangelands to state ranches. Typical examples of this category was the Arero rangeland development project in southern Ethiopia

ii. The third livestock development project: This was operated from the mid-1970s to late 1980s by focusing on the development of communal rangelands through the funding of pond water establishment, roads, veterinary services, markets and other infrastructure. In many instances, projects in this category had a strong involvement in grazing and land rights adjudication (to pastoral groups). Key examples of this category were the World Bank-funded Third Livestock Development Project in three regions of Ethiopia (Southern Rangeland Development Unit-SORDU, Jigjiga Rangeland Development Unit-JIRDU and North-Eastern Rangeland Development Unit-NERDU)

iii. The Pastoral Association Phase: This phase focused on the development of pastoral associations/ cooperative groups. It distinguishes itself from the previous category by giving more attention to the overall policy framework of pastoral association, and the need for mobility and flexibility in grazing rights allocation.

iv. The Integrated Natural Resource Management Phase: This phase evolved from pastoral association projects to give more comprehensive attention to natural resource management and involve all stakeholders in the project. Support to private institutions for the provision of services and management of resources and attention to the incentive and institutional framework was developed. An example of such project was the Borana Lowland Development and Natural Resource Management Project implemented by GTZ.

4.1.4. Indigenous knowledge

Pastoralists have a detailed knowledge of their environment (Oba and Kotile, 2001; Angassa and Oba, 2008). The indigenous knowledge of rangeland management is extremely useful in classifying rangeland resources at landscape and patch levels. At the landscape level, the types of soil and vegetation resources are important basis for rangeland classification. Rangeland classification is also based on its suitability for livestock management. Cattle, camels, sheep and goats have different preferences and, therefore, the different landscapes are utilized by different livestock species. Oba (2009) pointed out that livestock performance is a good indicator of rangeland suitability. Suitability of landscape is expressed by its capacity for grazing, which is an ability of the land to support high stocking densities without causing degradation. Indigenous rangeland management is based on division of herds into different herd structures (mobile and non-mobile or lactating herds). Annual grazing cycle by the sub-division of herd management systems involves movements between the wet and dry seasons grazing areas, as well as the use of drought year grazing lands (Oba and Kotile, 2001, Oba, 2009). Pastoral land use pattern is focused on the spatial and temporal availability of rangeland resources. For example, grazing patterns of pastoralists in the basin may be distinguished arising from the unique ecological conditions and distributions of critical grazing and water resources. As indicated by Oba (1998), some units of the rangelands are limited to the dry season and drought year grazing reserves as compared to others where resources are well defined for the dry season and drought year grazing reserves. This implies that pastoral communities who have limited access to the dry season and drought year grazing reserves may be more drought stress than those pastoral societies where grazing resources are easily accessible for their livestock during the dry season and drought years.

4.1.5. Conflict over resources

Pastoral communities of the basins inhabit the rangelands located in Oromiya and Ethiopian Somali Regional States, which are characterized by arid and semi-arid climate with highly diversified natural resources. The area has extensive borders with neighboring Somalia and Kenya. Dollo-Ado, Moyale and other towns are important gateways that allow the trans-clan and trans-national trade network for the movement of goods and people. The area is economically tied to a trade network linking the region to the Gulf States, where livestock are exported. The income from live animals is used to purchase manufactured goods and food items. Genale and Dawa rivers traverse the area from north to south and confluence at Dollo-Ado and then flow together as Juba River (in Somalia) to the Indian Ocean. The Wabi-Shebele River also crosses to Somalia and flows to the Indian Ocean. The riverbanks of these rivers form an agricultural belt used by agro-pastoralists. Outside this farming corridor, rangelands of the basins are used by pastoral groups practicing traditional livestock husbandry. Traditionally, these regions are endemic to conflicts among different pastoral groups over rangeland resources such as pasture and water. Group discussions with the local community showed that in the 1990s, the frequency and magnitude of conflicts has increased. In 2000 for instance, three major conflicts occurred between major pastoral groups (Borana versus Garri, Merehan versus Digodi, Digodi versus Borana) in Genale-Dawa basin. Competition over access to water for humans, livestock and small-scale irrigation, as well as land for farming and pasture are principal sources of conflict in Genale-Dawa and Wabi-Shebele basins. Access to pastoral resources is based on social organizations where each clan is associated with a particular territory, which may or may not coincide with the boundaries of district or zonal administrative units. Clans defend their grazing territories forcefully if necessary particularly at times when grazing and water resources are in short supply. However, as pastoral demand necessitates, often scarce and unevenly distributed rangeland resources have to be shared between herders from different clans for the wellbeing of the wider pastoral society. As a result, pastoral groups have undergone continuous changes in their ethnic composition, territorial boundaries and process of interaction. The increased conflict over scarce rangeland resources could be due to the deterioration of the livelihood of pastoral communities triggered by frequent drought and escalated by ineffective social and political organization. Some literatures have noted that food aid supplied by donors to pursue non-development objectives and aid disproportionately supplied to a certain group might have exacerbated conflict in pastoral areas of the two basins.

4.1.6. Lessons learned from past interventions

As it was well documented (Sandford, 1983, World Bank, 1985; Oba et al., 2000a), the first generation of rangeland projects produced generally unsatisfactory results, due to inappropriate development intervention and weak institutional framework, inappropriate technologies combined with lack of appreciation for the efficiency of the traditional system of rangeland management, and wrong project objectives (yield per animal versus yield per hectare of land) from the point of climate variability and ecological potential of the region. The rangeland development projects in three regions of Ethiopia, which were operated under the second and third livestock development projects, had a more varied performance. For example, the rangeland development component under the third livestock development project on average performed below expectations. In Ethiopia, rangeland development projects in southern, south eastern and north eastern rangelands were operated with little success (Oba et al., 2000a). Important causes for failures in the past rangeland development projects in the country included (i) wrong assumptions; (ii) inappropriate incentive frameworks, especially in the early phases when projects suffered from government-controlled marketing monopolies and livestock prices; (iii) extremely rigid imposition of controlled grazing and land rights; (iv) major institutional weaknesses within the implementing agencies, especially ignorance of the inter-disciplinary nature of pastoral development and focus on only single-disciplinary livestock development projects; (v) unplanned pond water establishment followed by sedentarization and expansion of crop cultivation, which resulted in the loss of key resource areas (Oba, 2009). Although theoretically appropriate, one cannot approach pastoral land-use issues in isolation, without attention to the other users/or many institutions involved. Implementation of any development intervention will not be successful without considering the unique ecological potential of arid rangelands and participation of the target communities.

5. CURRENT CHALLENGES AND OPTIONS FOR DEVELOPMENT INTERVENTIONS IN THE TWO BASINS

Field observation and group discussions with the local communities and other stakeholders were conducted between 28 April and 07 May 2014 in Delo-Mena, Arero, Dire, Bensa and Godie districts. Local communities reported that there has been a declining trend in livestock production. As a result, few pastoralists were forced to shift their mode of production from pastoral way of life to agro-pastoralists. Several reasons were suggested by the pastoral and agro-pastoral communities for the changing patterns in their mode of production, among others, the declining trends in rangeland productivity and expansion of bush encroachment. Local communities' observations showed that grass productivity is declining, while some species had already disappeared. Participants also mentioned that livestock numbers per household and milk productivity declined, while the body conditions of animals and local livelihood deteriorated. Shifts in vegetation towards less palatable species and woody encroachment adversely affected livestock production in the basin. The following reasons were perceived by the local communities for the decline in grass productivity:

- Climate change (shortage of rainfall and recurrent drought)
- Increase in both livestock and human population
- Bush encroachment
- Ban of range fire as a bush controlling strategy
- Expansion of crop cultivation in the rangelands

5.1. Current development challenges in Wabi-Shebele and Genale-Dawa basins

Bush encroachment: Bush encroachment is a major challenge for rangeland development in the Wabi-Shebele and Genale-Dawa basins. Shifts in vegetation towards less palatable species and the proliferation of encroachment have adversely affected livestock production in the region. In most of the visited sites, local people indicated that cattle are more vulnerable due to the loss of grass. Rainfall variability, expansion of crop cultivation in the rangelands and increased bush encroachment are among the reasons perceived by the local communities for the decline in grass productivity. The problem is common to all of the visited woredas (Delo-Menna, Arero, Dire, Jigjiga and Gode). Primary factors causing or contributing to the increase, spread and invasion of bush encroachment include excessive grazing, reduction of fire use, seed dispersal by grazing animals, seed dissemination by small animals, climatic flactuations, cultivation, local denudation and increase in commerce and transportation. The most invasive woody species in the Genale-Dawa basin includeed Acacia drepanolobium, Acacia mellifera, Acacia brevispica, Acacia bussie and Commifora africana. Moreover, Prosopis jullifera is one of the most notorius invasive woody species in the Wabi-Shebele Basin. Both the Wabi-Shebele and Genale-Dawa river basins are well known for their potential of gum producing woody species.

Water Scarcity: Water is one of the most limiting and important resources for the livelihoods of pastoral people. Water availability regulates livestock mobility, seasonality of grazing patches, and settlements. This is one of the causes of livestock movement between wet and dry season grazing areas. Particularly, livestock movements between the two systems take place when the seasonal water resource supply is exhausted. As a result, the pasture gets time to recover until livestock return to the former place. The water sources should be strategically distributed over the rangeland to allow livestock mobility and get access to wider grazing/browsing areas. Livestock mobility helps pastoralists to avoid overgrazing. An even distribution of water points within the rangeland is very crucial for proper rangeland management. However, water sources are concentrated in a certain part of the rangelands of Genale-Dawa river basin attracting settlement and livestock concentration around permanent water points throughout the year, which leads to excessive utilization and rangeland degradation. Usually, areas with concentrated water points show signs of degradation because they attract many livestock concentration while remote areas from water points are underutilized because of limited seasonal water availability. Water resources in the basin include two perennial rivers (Genale and Dawa), deep wells, ponds, small dams, Birkas (stonework tank that are used to harvest runoff water from the surrounding catchments) and cisterns.

Rangeland degradation: Rangelands of the two basins have for centuries provided forage for livestock. However, much of the rangelands have recently degraded and bush encroachment is now becoming a major problem. The causes of bush encroachment are ban of fire, heavy grazing, cultivation, dispersal of seeds of invasive species by animals, and climate change. The Federal and Regional Governments have begun to address the problems of bush encroachment and land degradation through policy adjustments and implementation of different projects. In parallel, some research and development initiatives are taking place. There are major

impediments to addressing the problem. The importance of rangelands for pastoralists and the country is generally underestimated. Legislative protection is incomplete and often ineffective, while little attention is paid to the indigenous knowledge of rangeland management, which is appropriate from the environmental point of view. There is insufficient technological support and the government is not able to invest sufficiently to effectively restore and develop rangeland resources.

Conflict over resources: Conflicts over pasture and water resources are common among different ethnic groups in the pastoral areas of the two basins. The frequency and magnitude of conflicts over access to resources have been increasing with the diminishing trends of rangeland resources. The local communities perceived that conflict could also be escalated by ineffective social and political structures. Furthermore, Borana pastoralists mentioned that conflict is becoming common every year between Gujjii and Borana clans. Different conflicts also occurred between major pastoral groups (Borana versus Garri, Merehan versus Digodi, Digodi versus Borana) at different times. These conflicts, combined with severe drought, resulted in displacements of pastoral households. Communities' observations indicate that competition over access to water for humans, livestock and small-scale irrigation, as well as land for farming and pasture are principal sources of conflict in the region.

5.1 1. Options for rangeland related development interventions in the two basins

Bush encroachment control: Range improvements are special treatments, developments, and structures used to improve rangeland resources or to facilitate their use by grazing animals. Rangeland seeding, controlling undesirable plants, and applying fertilizers are direct means of developing and improving rangeland resources. Rangeland improvements such as livestock water point development and fences are some of the indirect improvement of range forage resources. Control of invasive plants involve evaluation of desirability of a range of plant species for feed, forage, herbage, browse and pasturage. Evaluation of desirability of rangeland plants may also include factors such as feed value of the plant, undesirablity of the plant in light of planned land use, and poisnousness of the plant. There are three levels of invasive plant control:

- Prevention- avoiding contamination or infestation by a noxious plant still absent from the area
- control- manipulation and management for reduction of noxious plants
- eradication- complete kill or removal of noxious plants, including all plant structures capable of sexu al or vegetative reproduction.

Generally, there are four methods of bush control:

i. biological control (using browsing animals and highly specific insects to host plants)
ii. mechanical control
iii. herbicidal control
iv. rangeland improvement by prescribed or controlled burning.

Advantages of rangeland improvement: some of the benefits of bush encroachment include the following: (i) increased quantity of forage production: accessibility and maintenance of an adequate supply of forage is the basis for successful rangeland management and livestock production; (ii) increased quality of

forage: providing forage of high palatability, high nutritive content or long green growth is often desired; (iii) increased animal production: this is the primary goal by considering increased number of animals and offspring or reduced death losses; (iv) proper handling and care for rangeland animals: this could be accomplished through bush control, rangeland fencing, stockwater development; (v) control of poisoning of livestock by poisnous plants: this can be accomplished by removing poisonous plants, replacing existing vegetation by non-poisonous species, providing alternative sources of palatable, non-poisonous forage; (vi) reduced fire hazards: such possibilities include prescribed burning of forest slash or other flammable materials during low hazard period and constructing fire breaks; (vii) increased water yields on watersheds: by replacing woody species with herbaceous species; (viii) soil control by stabilizing erosive soils: on low potential sites, soil stablization may justify restoration with only secondary consideration given to forage production

Water resources development: Unplanned water development is one of the main limitations to resilience in the arid rangelands of the country. Many development partners have implemented water development interventions in the rangelands of the two basins for human and livestock use that have different degrees of success. Service delivery to pastoral areas often results in constraints to mobility (a central strategy that ensures viability of the pastoral production system)-affecting pastoral productivity and reducing economic performance. As a result, the pastoral livelihood systems in many parts of the basins are deteriorating, as illustrated by the recent drought induced disaster. Development of water sources in pastoral environments to enhance water coverage needs to be carefully formulated in order to promote mobility and to ensure the sustainable utilization of grazing and browsing resources across the rangelands. Pastoralists' survival has been devastated by both natural and man-made disasters. The emergence of regional states changed the natural resource bounders and mobility routes. As a result, pastoralists believe that they are trapped and helpless in terms of free access to the vast rangeland resources across regional boundary. The pastoral communities consider their future survival and hope to be directly connected to the resource tenure rights. Other priorities include water development, control of bush encroachment, safety of grazing lands, banning the process of allocating the communal rangelands to private ranches, recognition of indigenous resource tenure rights, proper extension services and education for agro-pastoral communities on farming and use of farm implements, livestock diversification, traditional institutions, availability of suitable seeds, emergency relief during drought years, and education of the younger generation to participate and promote watershed based natural resource management in a sustainable manner (Annex 2).

Management of conflicts over resources: Ethnic conflicts over the use of rangeland resources are common in the pastoral areas of the two basins. Conflicts between ethnic groups are usually settled by the local elders using indigenous systems of conflict management. For example, Borana individuals between the age of 40 and 48 are considered to be elders with a social responsibility of keeping peace and stability within the local community. Informants also indicated that such a tradition is also common among the Somali pastoralists of Ethiopia. The relevance and application of the indigenous institution in dealing with conflicts that may arise over the use of water and grazing resources have been common in the pastoral areas of the two basins. There is a need to integrate the indigenous systems of conflict management with governmental and non-governmental institutions in dealing with conflict resolution between different ethnic groups over the use of rangeland resources. Thus, governmental and non-governmental structures need to appreciate, collaborate, and complement the indigenous methods of resolving conflicts.

6. ENABLING ENVIRONMENT AND IMPLEMENTATION STRATEGIES

There is a need to improve rangeland management both in terms of economic development and provision of ecosystem services that rangelands provide for people and nature. This will require integration of rangeland protection, development, and utilization with economic development and ecological management. The key strategic objectives should be to establish a multi-investment fund that will transform and add value to rangeland products and secure ecosystem services; enforce rangeland protection regulations, especially implementation of rangeland policy; strengthen the organization of development of the rangeland industries; and extend investment in range science and technology. From the herder's perspective, the relevant basic traditional administrative units should be encouraged to cooperate and support rangeland restoration programs. Incentives should also be created to increase cooperation among herders.

Land tenure is the most important issue influencing the development of wider and extensive rangelands in the country. More specifically, expansion of crop cultivation, private enclosures, restricted mobility and allocation of the communal rangelands to large scale investments may seriously impact land tenure issues in pastoral areas of the two basins. A legislative framework and comprehensive land use policy for facilitating sustainable rangeland use is required. Institutional strengthening activities are required at the organizational level to focus on increasing capacity to implement the legislative framework and sustainable rangeland management. This requires institutionalization of rangeland legislation, together with intensive capacity building activities that increase the ability of the Government, private and community sectors to ensure the enforcement of sustainable rangeland management systems. There is a need for comprehensive national rangeland management plan that encompasses systemic, institutional and technical issues related to rangeland management, extending to the development and implementation of research programs and establishment of links with regional and national research institutes. Every pastoral group has a certain right to use specific areas of the rangelands. Pastoral communities are capable of accurately identifying and delineating their territories. It is, thus, recommended to avoid further readjustment of traditional boundaries of the land to be allocated to each pastoral group because any modification of the traditional boundaries would restrict access to rangeland resources and bring about conflicts among different ethnic groups. At an individual level, technical capacities must be strengthened in rangeland inventory and classification, preparedness for drought, natural resource use and management planning (community based natural resource management, participatory methodologies, seasonal based rotational grazing systems, improved fodder production, etc), monitoring and evaluation, database management and information analysis, and capacity development (encompassing both public awareness and technical training).

7. CONCLUSIONS AND RECOMMENDATIONS

Changes in the arid rangelands of the two basins may have begun during the previous decades but accelerated very recently. The emerging modern and government structural arrangements that replaced the traditional pastoral social structure and insecurity of resource tenure have caused substantial effects on the pastoral economy in the two basins. Loss of grazing and water resources following ethnic conflicts and re-arrangement of the local administrative and regional boundaries has caused the pastoral societies to be compressed into a fraction of the former vast communal rangelands. As a result, mobility routes and access to rangeland resources are restricted. Within the remaining and deteriorating condition of rangelands, population pressure on grazing and water resources has increased. The pressure on the environment has resulted in severe rangeland degradation. The rangelands are heavily utilized and the original grassland states have been invaded by bush encroachment.

Communities' observations suggest that livestock production and productivity are declining, while drought survival has deteriorated. It was mentioned that successive droughts recently killed more herds than the previous years and post drought recovery was very slow. It seems that confidence in livestock as a source of a household's subsistence is deteriorating due to increased pressure and diminished rangeland resources. Pastoralists' priorities are proper water development for human and livestock. Rain water harvesting in cisterns for human use is most likely gaining acceptance in pastoral areas. It would also be necessary to develop an environmentally sound water scheme where permanent water sources or traditional deep wells are limited and water supply is scarce for human use.

It is important to consider lessons learned from past mistakes and failures to think about the future interventions in the rangelands of the two basins to build resilience for the sustainable use of rangeland resources. Prospects for large-scale farms, increased crop cultivation and ranches may induce unusual property speculation, land grabbing restricted mobility and conflict over resources. In the future, any development intervention and decision regarding the communal rangelands needs consultation and full participation of pastoral communities. It is suggested that careful land use policy that acknowledges the unique ecological potential of the rangelands should be developed and ratified. Interventions in water and road developments have wider impacts on various sectors. There is a need to promote integrated approach for target thematic areas implying that water development should be linked with pasture and livestock development as well as human development. Future development interventions should consider both scientific and indigenous knowledge systems, as well as recognition of local institutions. Technical support from all stakeholders may ensure the sustainability of future interventions. Any intervention in the future has to be linked to knowledge institutions such as universities and research institutions.

By way of recommendation, future methodologies for land and water related development interventions in the two basins should address the following:

i. Tap into indigenous natural resource management practices
ii. Establish clear land use policy for the sustainable use of arid and semi-arid rangelands of the country, which also have serious policy implication on the conservation of biodiversity
iii. Conduct arbitration of land to favor the pastoral societies based on communal land use in preference to promoting private ranches/investments and expansion of crop cultivation
iv. Reduce land use conflicts between different ethnic groups by promoting fair sharing of common re sources and putting conflict management and resolution mechanisms in place
v. Develop appropriate land use policy for the rangelands of the country on concrete scientific and in

digenous knowledge systems of the environment

vi. Link bush encroachment control with the development of fodder banks at the community level

vii. Promote water harvesting technologies and cistern water development for human and livestock use

viii. Avoid construction of boreholes in the already existing deep water wells zones

ix. Develop alternative livelihood diversification options according to the potential of the basins and availability of resources focusing on the small homogenous units

x. Promote formation of community-based drought management and early warning committees

xi. Popularize the use of national and international climate data by the pastoral and agro-pastoral com munities for decision making.

8. REFERENCES

Adane A A. 2009. Hydrological Drought Analysis-occurrence, severity, risks: the case of Wabi-Shebele River Basin, Ethiopia. PhD Dissertation. University of Siegen, Germany.

Allen-Diaz, B. Rangelands in a Changing Climate: Impacts, Adaptations and Mitigation, pp. 131-158.

Angassa, A., Oba, G. 2007. Relating long-term rainfall variability to cattle population dynamics in communal rangelands and a government ranch in southern Ethiopia. Agricultural Systems 94: 715-725.

Angassa, A., Oba G. 2008. Herder perception on impacts of Range Enclosures, Farms and Bush encroach ment on the rangelands of Borana, Southern Ethiopia. Human Ecology 36: 201-215.

Angassa, A., Oba, G., Stenseth. N.C. 2012. Community-based Knowledge of Indigenous Vegetation in Arid African Landscapes. Consilience: The Journal of Sustainable Development Vol. 8, Iss. 1 (2012), Pp. 70-85.

Barnett, J., Adger, W.N. 2007. Climate change, human security and violent conflict. Political Geography 26: 639-655.

Behnke, R. H., and Scoones, I. 1993. Rethinking range ecology: Implications for rangeland management in Africa. In: Behnke, R. H., Scoones, I., and Kerven, C. (eds.), Range ecology at disequilibrium: New models of natural variability and pastoral adaptation in African savannas. Intermediate Technology Publications, London, UK. pp. 1–30.

Behnke, R. H., Scoones, I., and Kerven, C. 1993. Range ecology at disequilibrium: New models of natural variability and pastoral adaptation in African savannas. Overseas Development Institute, London, UK.

Berkes, F. 1998. Sacred ecology: Traditional Ecological Knowledge and resource Management. Taylor and Francis, Philadelphia.

Breman, H., de Wit, C.T. 1983. Rangeland Productivity and exploitation in the Sahel. Science 221: 1341-1347.

Cernea. M. 1993. Pastoralist organization for resource use in West Africa. In: Proceedings of the Seminar: Livestock Services for Small holders, Yogyakarta, Indonesia. November 1992.

Coppock, D. L. 1993. Vegetation and pastoral dynamics in the southern Ethiopian rangelands: Implications for theory and management. In: Behnke, R.H., Scoones, I., Kerven, C (Eds.) Range Ecology at Dis equilibrium, New Models of Natural Variability and Pastoral Adaptation in African Savannas. Overseas Development Institute and International Institute for Environment and Development, Lon don, UK, pp. 42-61.

Coppock, D. L. 1994. The Borana plateau of southern Ethiopia: Synthesis of Pastoral Research, Development and Changes 1980-1990. International Livestock Centre for Africa, Addis Ababa, Ethiopia.

deHaan. C. 1990. Changing Trends in World Bank Funding for Range/Livestock Production. In: Proceedings

of the International Rangeland Symposium. Phoenix Az. USA.

Desta, S. 1999. Diversification of livestock assets for risk management in the Borana pastoral system of Southern Ethiopia. Ph.D. Dissertation, Utah State University, Logan.

Downing, T.E., Patwardhan, A. 2004. Assessing vulnerability for climate adaptation. In: Lim, B., Spanger-Siegfried, E. (Eds.), Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies, and Measures. Cambridge University Press, Cambridge.

Ellis, E.J. and Swift, M.D. 1988. Stability of African pastoral ecosystems: Alternate paradigms and implications for development. Journal of Range Management41: 450-459.

Eriksen, S., Aldunce, P., Bahinipati, C.S., Martins, R. D'A., Molefe, J.I., Nhemachena, C., O'Brien, K., Olo runfemi, F., Park, J., Sygna, L., Ulstrud, K. 2011. When not every response to climate change is a good one: Identifying principles for sustainable adaptation. Climate and Development 3: 7-20.
FAO.2002. Land degradation assessment in drylands - LADA project. World Soil Resources Reports No. 97. Rome.

Füssel, H.-M. 2007. Vulnerability: A generally applicable conceptual framework for climate change research. Global Environmental Change 17: 155-167.

Helland, J. 1999. Land alienation in Borana: Somme land tenure issues in a pastoral context in Ethiopia. East ern African Social Science research Review, Vol. XIV No. 2 Addis Ababa, Ethiopia.

Le Houerou, H. N., and Hoste, C. H. 1977. Range production and annual rainfall relations in the Mediterra nean Basin and in the African Sahelo-Sudanian Zone. Journal of Range Management 30: 181-189.

Le Houerou, H. N., Bingham, R. L., and Skerbek, W. 1988. Relationship between the variability of primary production and the variability of annual precipitation in world arid lands. Journal of Arid Environ ments15: 1-18.

Little, P.D., McPeak, J., Barrett, C.B. 2008. Challenging Orthodoxies: Understanding Poverty in Pastoral Areas of East Africa.Development and Change 39: 587-611.

Luers, A.L., Lobell, D.B., Sklar, L.S., Addams, C.L., Matson, P.A. 2003. A method for quantifying vulnerability, applied to the Yaqui Valley, Mexico. Global Environmental Change 13: 255–267.

Megersa,B. Markemann,A. Angassa, A. Zárate. A.V. 2014. The role of livestock diversification in ensuring household food security under a changing climate in Borana, Ethiopia. Food Security 6(1), 15-28.
Metzger, M.J., Leemans, R., Schröter, D. 2005. A multidisciplinary multi-scale framework for assess ing vulnerabilities to global change. International Journal of Applied Earth Observation and Geoin formation 7: 253–267.

Oba, G. 1998. Assessments of indigenous range management knowledge of the Borana pastoralists in south ern Ethiopia. Borana Lowland Pastoral Development Program/GTZ, Consultancy paper, Negelle/Bo rana May 1998.

Oba, G., Stenseth, N.C., Lusigi, W.J. 2000a. New perspectives on sustainable grazing Management in Arid

zones of Sub-Saharan Africa. Bioscience 50: 35-50.
Oba,G., Post, E., Syvertsen, P.O. and Stenseth, N.C. 2000b. Bush cover and range condition assessments in relation to landscape and grazing in southern Ethiopia. Landscape Ecology 15: 535-547.

Oba, G. 2001. The effect of multiple droughts on cattle in Obbu, Northern Kenya. Journal of Arid Environ ments49: 375-386.

Oba, G., and Kotile, D. G. 2001. Assessments of landscape level degradation in southern Ethiopia: Pastoralists versus ecologists. Land Degradation and Development 12: 461- 475.Oba, G., Weladji, R.B., Lusigi, W.J. and Stenseth, N.C. 2003. Scale-dependent effects of grazing on rangeland degradation in north ern Kenya: A test of equilibrium and non-equilibrium hypotheses. Land Degradation Development 14: 83-94.

Oba, G., and Kaitira, L. M. 2006. Herder knowledge of landscape assessments in arid rangelands in northern Tanzania. Journal of Arid Environments 66: 168-186.

Oba, G. 2009. Harnessing Pastoralists' Indigenous Range Management Knowledge for Drought -Resilient Livelihood Systems in the Horn of Africa. World Initiative for Sustainable Pastoralism.

Sandford, S. 1983. Pastoral Development in the Third World. Wiley and Son, London.

Sankaran, M, Hanan, N.P., Scholes, R. J., Ratnam, J., Augustine, D. J., Cade, B. S., Gignoux, J., Higgins, SI, Le Roux, X, Ludwig, F., Ardo, J., Banyikwa, F., Bronn, A., Bucini, G., Caylor, K.K., Coughenour, M.B., Diouf, A., Ekaya, W., Feral, C.J., February, E.C., Frost, P.G.H., Hiernaux, P., Hrabar, H., Metzger, K.L., Prins, H.H.T., Ringrose, S., Sea W., Tews, J., Worden, J., Zambatis, N. 2005. Determinants of woody cover in African savannas. Nature 438: 846-849.

Scholes, R. J., and Archer, S. R. 1997. Tree-grass interaction in savannas. Annual Review of Ecology and Sys tematics28: 517-544.

Scoones, I. 1995. Living with uncertainty: New directions in pastoral development in Africa. Intermediate Technology Publications, London, UK.

Sinclair, A.R.E., Fryxell, J.M. 1985. The Sahel of Africa: Ecology of disaster. Canadian Journal of Zoology 63: 987-994.

UNEP (united Nations Environment Programme). 1998. Early Warning of Emerging Environmental Threats, Meeting report, December 8, Washington, D.C.

World Bank (1985). The Smallholder Dimension of Livestock Development Operation and Evaluation De partment, Internal report. The World Bank, Washington D.C.

Washington-Allen, R. A., R. D. Ramsey, N. E. West, and B. E. Norton. 2008. Quantification of the ecological resilience of drylands using digital remote sensing. Ecology and Society 13(1): 33.

http://www.ecologyandsociety.org/vol13/iss1/art33/.
Westoby, M., Walker, B., and Noy-Meir, I. 1989. Opportunistic management for rangelands not at equilibri um. Journal of Range Management 42: 266-274.

9. ANNEX. DEVELOPMENT INTERVENTION MATRIX FOR RANGELAND RELATED INTERVENTIONS

1. Dollo-Mena site

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Shortage of water	Planned water development for livestock	Land degradation around water point	Local	High	High	• Even distribution of water points • Rotational grazing or seasonal land use	• Reduced mobility/settlement of people and livestock and hence opportunity to provide people with social services	New hydro-power project
		Malaria & other water related infestation	Local	Medium	Low	• Prevention around water points and homesteads	• Surveillance capacity developed	
		Potential downstream effects (possible flow reduction)	Local/ regional	Low	Medium	• Watershed management; • Efficient water use	• Improved range productivity; Biodiversity conservation	
		Conflict over water	Local/ regional	Medium	Medium	• Conflict prevention through equitable development	• Increased income generating opportunities; • Improved water availability for other uses;	
Bush encroachment	Bush control using fire	Biodiversity loss	Local/ Regional	High	Low	Prescribed burning;	• Soil nutrient release; • Fast regeneration of forage; Briquette production;	
	Biological control	Potential development into harmful pest;	Regional	Medium	High	• Quarantined options; • Regular monitoring; • Awareness creation; and follow up;	• Time and labor savings	

Devel-opment challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
	Mechanical control	Damage to useful plants;	Local/ regional	Low	High	• Awareness creation on useful species	• Briquette production	
	Chemical control	Harmful to the environment/ useful plants and animals including humans	Local	High	Low	• Surveillance and control • Use of environment friendly chemicals	• Capacity Development • Demand created for chemical producing factories	
Invasive weeds	Weed control	Threat to none-invasive species	Local	Low	Low	• Awareness creation	• Enhanced biodiversity	
Rangeland degradation/ low rangeland productivity	Balance number of livestock to adjust stocking rate with improved breeds and management	Social acceptance problem	Local	High	High	• Awareness creation	• Widespread adoption of improved breeds and management practices and hence improved incomes	
	Pasture improvement through over-sowing and moisture conservation	Risk of invasive behavior	Local/ regional	Low	High	Quarantine/ proper identification of species	New opportunity to identify pests and diseases in time	
	Introducing new fodder trees/ shrubs	Risk of invasion by pests	Local/ regional	Low	High	Monitoring and control	New opportunity to identify pests and diseases in time	
	Termite control using chemicals	Harmful to the environment/ useful plants and animals including humans	Local	Low	Low	• Surveillance and control • Use of environment friendly chemicals	• Capacity Development • Demand created for chemical producing factories	
Rainfall variability	Rainwater management (water storage)	Water related disease (Malaria)	Local	Low	Low	Prevention and Control	Disease surveillance capacity improved	

2. Dire Woreda Site

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Shortage of water	Promote planned water development for livestock	Land degradation around water point	Local	High	High	• Even distribution of water points • Rotational grazing or seasonal land use Prevention around water points and homesteads	• Reduced mobility of people and livestock and hence opportunity to provide people with social services	New hydropower project
		Malaria & other water related infestation	Local	Medium	Low	• Control around water points	• Surveillance capacity developed	
		Potential downstream effects (possible flow reduction)	Local/ regional	Low	Medium	• Watershed management; • Efficient water use	• Improved range productivity; Biodiversity conservation	
		Conflict over water	Local/ regional	Medium	Medium	• Conflict prevention through equitable development	• Increased income generating opportunities; • Improved water availability for other uses; • Security for potential new investments	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Bush encroachment	Bush control using fire	Biodiversity loss	Local/ Regional	High	Low	Prescribed burning;	• Soil nutrient release; • Fast regeneration of forage; Briquette production;	
	Biological control	Potential development into harmful pest;	Regional	Medium	High	Quarantined options; Regular monitoring; awareness creation; and follow up; Use of environment friendly chemical	Time and labor saving Demand created for chemical producing factories	
	Mechanical control	Damage to useful plants;	Local/ regional	Low	High	Awareness creation on useful species	• Briquette Production • Livelihood diversification	
	Chemical control	Harmful to the environment/ useful plants and animals including humans	Local	High	Low	Surveillance and control	• Promotion of chemical industry • Capacity developed	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Rangeland degradation/ low rangeland productivity	Balance number of livestock to adjust Stocking rate with improved breeds and management	Social acceptance problem	Local	High	High	Awareness creation	Widespread adoption if improved breeds and management practices and hence improved incomes	
	Pasture improvement through over-sowing and moisture conservation	Risk of invasive behavior	Local/ regional	Low	High	Quarantine/ proper identification of species Quarantine	No Opportunity to identify pests and diseases in time	
	Introducing new fodder trees/ shrubs	Risk of invasion by other pests	Local/ regional	Low	High	Monitoring and control		
	Termite control		Local	Low	Low			
Rainfall variability	Rainwater management (water storage)	Water related disease (Malaria)	Local	Low	Low	Prevention and Control	Disease surveillance	

3. Dire Site

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Shortage of water	Promote planned water development for livestock	Land degradation around water point	Local	High	High	• Even distribution of water points • Rotational grazing or seasonal land use Prevention around water points and homesteads	• Reduced mobility of people and livestock and hence opportunity to provide people with social services	New hydropower project
		Malaria & other water related infestation	Local	Medium	Low	• Control around water points	• Surveillance capacity developed	
		Potential downstream effects (possible flow reduction)	Local/ regional	Low	Medium	• Watershed management; • Efficient water use	• Improved range productivity; Biodiversity conservation	
		Conflict over water	Local/ regional	Medium	Medium	• Conflict prevention through equitable development	• Increased income generating opportunities; • Improved water availability for other uses; • Security for potential new investments	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Bush encroachment	Bush control using fire	Biodiversity loss	Local/ Regional	High	Low	Prescribed burning;	• Soil nutrient release; • Fast regeneration of forage; Briquette production;	
	Biological control	Potential development into harmful pest;	Regional	Medium	High	Quarantined options; Regular monitoring; awareness creation; and follow up; Use of environment friendly chemical	Time and labor saving Demand created for chemical producing factories	
	Mechanical control	Damage to useful plants;	Local/ regional	Low	High	Awareness creation on useful species	• Briquette Production • Livelihood diversification	
	Chemical control	Harmful to the environment/ useful plants and animals including humans	Local	High	Low	Surveillance and control	• Promotion of chemical industry • Capacity developed	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Rangeland degradation/ low rangeland productivity	Balance number of livestock to adjust Stocking rate with improved breeds and management	Social acceptance problem	Local	High	High	Awareness creation	Widespread adoption if improved breeds and management practices and hence improved incomes	
	Pasture improvement through over-sowing and moisture conservation	Risk of invasive behavior	Local/ regional	Low	High	Quarantine/ proper identification of species Quarantine	No Opportunity to identify pests and diseases in time	
	Introducing new fodder trees/ shrubs	Risk of invasion by other pests	Local/ regional	Low	High	Monitoring and control		
	Termite control		Local	Low	Low			
Rainfall variability	Rainwater management (water storage)	Water related disease (Malaria)	Local	Low	Low	Prevention and Control	Disease surveillance	

4. Jigjiga Site

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Shortage of water	Promote planned water development for livestock	Land degradation around water point	Local	High	High	• Even distribution of water points • Rotational grazing or seasonal land use Prevention around water points and homesteads	• Reduced mobility of people and livestock and hence opportunity to provide people with social services	New hydropower project
		Malaria & other water related infestation	Local	Medium	Low	• Control around water points	• Surveillance capacity developed	
		Potential downstream effects (possible flow reduction)	Local/ regional	Low	Medium	• Watershed management; • Efficient water use	• Improved range productivity; Biodiversity conservation	
		Conflict over water	Local/ regional	Medium	Medium	• Conflict prevention through equitable development	• Increased income generating opportunities; • Improved water availability for other uses; • Security for potential new investments	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Bush encroachment	Bush control using fire	Biodiversity loss	Local/ Regional	High	Low	Prescribed burning;	• Soil nutrient release; • Fast regeneration of forage; Briquette production;	
	Biological control	Potential development into harmful pest;	Regional	Medium	High	Quarantined options; Regular monitoring; awareness creation; and follow up; Use of environment friendly chemical	Time and labor saving Demand created for chemical producing factories	
	Mechanical control	Damage to useful plants;	Local/ regional	Low	High	Awareness creation on useful species	• Briquette Production • Livelihood diversification	
	Chemical control	Harmful to the environment/ useful plants and animals including humans	Local	High	Low	Surveillance and control	• Promotion of chemical industry • Capacity developed	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Rangeland degradation/ low rangeland productivity	Balance number of livestock to adjust Stocking rate with improved breeds and management	Social acceptance problem	Local	High	High	Awareness creation	Widespread adoption if improved breeds and management practices and hence improved incomes	
	Pasture improvement through over-sowing and moisture conservation	Risk of invasive behavior	Local/ regional	Low	High	Quarantine/ proper identification of species Quarantine	No Opportunity to identify pests and diseases in time	
	Introducing new fodder trees/ shrubs	Risk of invasion by other pests	Local/ regional	Low	High	Monitoring and control		
	Termite control		Local	Low	Low			
Rainfall variability	Rainwater management (water storage)	Water related disease (Malaria)	Local	Low	Low	Prevention and Control	Disease surveillance	

5. Gode Site

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Shortage of water	Promote planned water development for livestock	Land degradation around water point	Local	High	High	• Even distribution of water points • Rotational grazing or seasonal land use Prevention around water points and homesteads	• Reduced mobility of people and livestock and hence opportunity to provide people with social services	New hydro-power project
		Malaria & other water related infestation	Local	Medium	Low	• Control around water points	• Surveillance capacity developed	
		Potential downstream effects (possible flow reduction)	Local/ regional	Low	Medium	• Watershed management; • Efficient water use	• Improved range productivity; Biodiversity conservation	
		Conflict over water	Local/ regional	Medium	Medium	• Conflict prevention through equitable development	• Increased income generating opportunities; • Improved water availability for other uses; • Security for potential new investments	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Bush encroachment	Bush control using fire	Biodiversity loss	Local/ Regional	High	Low	Prescribed burning;	• Soil nutrient release; • Fast regeneration of forage; Briquette production;	
	Biological control	Potential development into harmful pest;	Regional	Medium	High	Quarantined options; Regular monitoring; awareness creation; and follow up; Use of environment friendly chemical	Time and labor saving Demand created for chemical producing factories	
	Mechanical control	Damage to useful plants;	Local/ regional	Low	High	Awareness creation on useful species	• Briquette Production • Livelihood diversification	
	Chemical control	Harmful to the environment/ useful plants and animals including humans	Local	High	Low	Surveillance and control	• Promotion of chemical industry • Capacity developed	

Development challenges	Interventions	Risks	Effect	Probability	Significance	Mitigation	Opportunities	Externalities
Rangeland degradation/ low rangeland productivity	Balance number of livestock to adjust Stocking rate with improved breeds and management	Social acceptance problem	Local	High	High	Awareness creation	Widespread adoption if improved breeds and management practices and hence improved incomes	
	Pasture improvement through over-sowing and moisture conservation	Risk of invasive behavior	Local/ regional	Low	High	Quarantine/ proper identification of species Quarantine	No Opportunity to identify pests and diseases in time	
	Introducing new fodder trees/ shrubs	Risk of invasion by other pests	Local/ regional	Low	High	Monitoring and control		
	Termite control		Local	Low	Low			
Rainfall variability	Rainwater management (water storage)	Water related disease (Malaria)	Local	Low	Low	Prevention and Control	Disease surveillance	

Water & Land
Resource
Centre

The Water and Land Resource Center (WLRC) is an autonomous research for development center established in 2011 affiliated to Addis Ababa University (AAU), Ethiopia and Center for Development and Environment (CDE) of University of Bern.

The WLRC is basically a reorganization of the previous Soil Conservation Research Programme (SCRP), which was initiated by CDE in collaboration with Ministry of Agriculture in 1981, and it builds itself on SCRP's research database and set-ups. Both SCRP and the core functions of WLRC has been supported by the Swiss Development Cooperation (SDC). The Center is governed by a Steering Committee constituted from four state ministers - MoA, MoWIE, MoFED, MoST, and the director of CDE as a member. These is co-chaired by AAU and SDC. The Center has been instrumental in generating pertinent information that helps in supporting and informing the current Integrated Water and Land Resource Management (IWLRM) activities in the country both in highlands and lowland pastoral areas.

The core mandate of WLRC is research for development in sustainable water and land management which it delivers through three functions: i) Knowledge Generation (research) of hydro-climate, hydro-sedimentology, Sustainable Land Management (SLM), land use, SLM and Integrated Water Resource Management from closely monitored learning watersheds and observatories some over 30 years, ii) Knowledge Management for cross-sector and cross-scale policy and development actions and iii) Capacity Development of key partners on IWLRM and geo-information technologies and techniques. WLRC has established a web-based and the state of the art Water and Land Resources Information System (WALRIS) (www.wlrc-eth.org; walris.wlrc-eth.org) which is openly accessible for academics, researches and development partners including policy makers.

WLRC closely collaborates with international and national research universities and research institutes in undertaking water and land related researches. It also undertakes a commission research on monitoring and evaluation of IWRM & IWM interventions.

Addis Ababa University

UNIVERSITÄT BERN
CDE
CENTRE FOR DEVELOPMENT AND ENVIRONMENT

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Design & Print by: Amlion Printing and Advertising
www.amlionads.com