



**Social-Ecological Systems Dynamics and
Rangeland Governance in Borana Pastoral System: A Case
Study of Yabello District, Southern Ethiopia
Teferi Tolera**



**A Dissertation Submitted to Center for Environment and
Development, College of Development Studies
Presented in the Fulfillment of the Requirements for
the Degree of Doctor of Philosophy in Development Studies
(Environment and Development Studies)**

**Addis Ababa University,
Addis Ababa, Ethiopia**

June, 2019

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Declaration

I, the undersigned, declare that this is my original work, has never been presented in this or any other University, and that all the resources and materials used for the dissertation, have been fully acknowledged.

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This dissertation has been submitted for examination with my approval as University Supervisor.

Supervisor name: _____

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Dissertation Approval
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School of Graduate Studies

This is to certify that the thesis prepared by “Teferi Tolera” entitled: Socio-Ecological System Dynamics and Rangeland Governance in Borana Pastoral System: A Case Study of Yabello District, Southern Ethiopia and submitted in fulfillment of the requirement for the Degree of Doctor of Philosophy (Environment and Development Studies) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Socio-Ecological System Dynamics and Rangeland Governance in Borana Pastoral System: A Case Study of Yabello District, Southern Ethiopia

ABSTRACT

This dissertation strived to understand the social-ecological systems (SES) dynamics in the Borana rangelands, how these transformations derived pastoral system vulnerability and how pastoralists are responding to the changes. In relating pastoral system vulnerability with the crisis in environmental governance, the paper strived to unpack the Borana rangeland governance systems including customary institutions, evolving pastoral development policies, and network form of rangeland governance. The study employed a mix of primary data collection methods such as focused group discussions (FGDs), key informant interviews, observation and household survey of 186 respondents randomly selected from six purposively selected kebeles in Yabello district. To examine network governance structures, social network analysis (with a total of 53 actors) was conducted. To analyze the collected data, various tools such as descriptive statistics, index and econometric (logit) model were employed. The Borana pastoral SES has undergone negative transformations due to interrelated deriving forces such as climate, socio-economic, policy, and geopolitical dynamics. As a consequence, the resilience of the SES of the pastoral system has considerably been deteriorated. Indigenous rangeland governance institutions are weakening due to reinforcing internal and external factors which, in turn, endangered the sustainable governance of the human-rangeland ecology interactions. Although they are less likely to abandon pastoralism, most of the Borana pastoral households were found to have already embraced diverse non-pastoral activities (some of which have negative implications for the resilience of the pastoral system) to sustain their life in the face of internal and external pressures. The social network analysis revealed that the current rangeland governance structures have limited capacity to develop a collaborative process and sufficiently respond to complex rangeland governance challenges. Based on the findings, it is recommended that in the first place the mono-centric and top-down governance approaches that decoupled human subsystem from ecological subsystem should be shifted towards holistic approaches and collaborative process that encourage the networks of actors enabling the use of scattered resources and capacities across scales, sectors, and domains of the governance system. In line with this, as customary institutions are deep-rooted in the indigenous knowledge and value systems, revitalizing the customary institutions is suggested to establish multi-governance structures that can enhance SES resilience.

Key Words: Borana, Pastoral System, Socio-ecological dynamics, Rangeland governance, social network

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DEDICATION

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Table of Contents

ABSTRACT.....	iv
ACKNOWLEDGMENTS.....	v
DEDICATION.....	vii
Table of Contents.....	viii
Lists of Tables	xi
Lists of Figures.....	xii
Chapter One: Introduction	1
1.1. Background.....	1
1.2. Problem statement.....	7
1.3. Objectives of the Research.....	11
1.4. Research Questions.....	12
1.5. Organization and structures of the thesis	12
1.6. Significance of the Study	13
1.7. Scope and limitation of the Study	14
Chapter Two: Literature Review	16
2.1. Introduction.....	16
2.2. Defining pastoralism	16
2.3. Social-ecological systems.....	18
2.4. Conceptualization of Resilience, Vulnerability and Adaptation in SES	23
2.4.1. Resilience in SES.....	23
2.4.2. Vulnerability of SES	25
2.4.3. Adaptation.....	32
2.5. Governance for SES resilience.....	35
2.5.1. Institutions.....	37
2.5.2. Governance of the commons.....	39
2.5.3. Emergence of Adaptive Governance	45
2.5.4. Governance through Network	46

2.6. Integrated conceptual framework of the study.....	47
Chapter Three: Research Methodology	50
3.1. Introduction.....	50
3.2. The Study Location.....	50
3.1.1. Borana Zone	50
3.1.2. Description of Yabello district, a case study area	54
3.3. Philosophical Underpinning and the overall research design.....	56
3.4. Sampling Procedures.....	58
3.5. Data sources and data collection methods.....	60
3.6. Method of Data Analysis and Presentation.....	63
3.6.1. <i>Rangeland ecosystem dynamics</i>	64
3.6.2. <i>Pastoral household Vulnerability Analysis</i>	64
3.6.3. <i>Determinants of Adaptation Strategies</i>	66
3.6.4. <i>Social Network Analysis</i>	70
Chapter Four: Customary Rangeland Governance System and Ecological Condition of Rangelands.....	78
4.1. Introduction.....	78
4.2. Rangelands ecosystems dynamics as perceived by pastoralists	78
4.2.1. <i>Change in land tenure structures and land use patterns</i>	78
4.2.2. <i>Perception of pastoralists on the rangeland condition</i>	81
4.2.3. <i>Perceived Causes of rangeland degradation</i>	85
4.2.4. <i>Conclusions</i>	87
4.3. Customary Rangeland Governance System.....	89
4.3.1. <i>Pasture Land Governance</i>	89
4.3.2. <i>Water Resource Governance</i>	97
4.3.3. <i>Contemporary Challenges of Commons Property Regimes in Borana</i>	99
4.3.4. <i>The need for revitalizing customary institutions in the Borana context</i>	108
4.3.5. <i>Conclusions</i>	114
Chapter Five: Understanding Pastoral System Vulnerability Dynamics and Adaptive Responses	116

5.1. Introduction.....	116
5.2. Evolving Land use and pastoral development policies: <i>Marginalization process</i>	117
5.3. Exposure to climate stressors	128
5.3.1. Climate trends of the study area.....	128
5.3.2. Perceptions of herders towards climate variability and change.....	130
5.3.3. Hazards reported by pastoral households.....	131
5.3.4. Socio-economic and Bio-physical Vulnerability Indicators.....	133
5.3.5. Vulnerability at Household Level.....	135
5.4. Underlying drivers of pastoralism vulnerability to climate variability/change.....	138
5.5. Conclusions	152
5.6. Adaptation Strategies to climate variability/changes	155
5.6.1. Introduction.....	155
5.6.2. Types of adaptation practices adopted by pastoral households.....	155
5.6.3. Determinants of adaptation strategies choices	165
5.6.4. Conclusions	171
Chapter Six: Analysis of Network Forms of Rangeland SES Governance.....	174
6.1. Introduction.....	174
6.2. The Whole Network Characteristics	174
6.3. Actors' connecting roles in the network and their importance.....	177
6.4. Conclusions	180
Chapter Seven: General Conclusions and Ways Forward	183
8. References	192
Appendixes.....	215
Appendix 1: Household Survey Interview Schedules.....	215
Appendix II: Interview schedules used for Social Network data collection	223
Appendix III: Focused Discussion and key informant: Broad question on Climate change, and Institutional aspects in rangelands resource management	224
Appendix IV: Actors included in the analysis of network governance	226

Lists of Tables

Table 1 Description of Variables considered in the logistic regression models of adaptation strategies.....	70
Table 2 Opinion of Borana pastoral households on general rangelands conditions	82
Table 3 Perceived Causes of rangeland degradation	85
Table 4 Opinion of respondents towards the status of adherence to customary institutions.....	100
Table 5 Perception of Borana pastoralists on temperature and rainfall (N=186).....	130
Table 6 Hazards reported by Borana pastoral households (N=186).....	132
Table 7 Selected indicators of vulnerability and their effect on vulnerability level	134
Table 8 Component scores of coefficient for first PCA for adaptive capacity indicators	136
Table 9 Classification of households based on calculated Vulnerability index	138
Table 10 Pastoral household adaptation choices	156
Table 11 Differences in household characteristics in the use of selected adaptation strategies.....	166
Table 12 Parameter estimates of the logistic regression models on determinants of pastoral household adaptation choices.....	169
Table 13 Top ten actors' centrality scores in Borana rangeland governance network...	178

Lists of Figures

Figure 1. An Illustration of Rangeland SES.....	22
Figure 2 Conceptual Framework of Vulnerability, based on IPCC (2007)	28
Figure 3 Drivers of pastoral system vulnerability	31
Figure 4 Conceptual Framework for adaptation to climate variability and changes in Borana Context:	34
Figure 5 Conceptual Framework, Adapted from Ostrom, 2011	43
Figure 6 Conceptual framework of the study	48
Figure 7 Map of Borana Zone.....	51
Figure 8 Study location	55
Figure 9 Schematic representation of some of network typologies	75
Figure 10 Extent of Rangeland Degradation	83
Figure 11 Perception of Borana pastoralists on the rangeland degradation indicators. ..	83
Figure 12 The territorial levels of the customary Natural resources governance	95
Figure 13 Schematic Representation of Land use system in Borana	96
Figure 14 Perception of respondents on the trends of livestock sharing in Borana.	103
Figure 15 (a) Minimum Monthly Temperatures, (b) Maximum Monthly Temperature of the study area	129
Figure 16 Annual rainfall of the study area	130
Figure 17 Social Network of Rangeland Governance in Borana, Yabello district	180

Lists of papers intended for publication that are included in the Dissertation:

1. Pastoralists' perceptions on the rangeland ecosystem dynamics: the case of Borana Rangelands, Southern Ethiopia (Under preparation)
2. Pastoral Households Vulnerability to climate variability and Change: Evidences from Borana, Southern Ethiopia (in review Climate change and Development)
3. In Search of Socio-ecological Systems Resilience: The role of Customary Institutions the Case of Borana Rangelands, Southern Ethiopia: (Accepted with revisions with the journal of Ecosystems and People).
4. Pastoralists under Pressure: Double Exposure to Climate and Political and Socio-Economic Stresses: the Case of Borana Pastoralists, Southern Ethiopia (In review process with the Journal of SNA)
5. Pastoral System in the Face of Climate Variability: Household Adaptation Strategies in Borana Rangelands, Southern Ethiopia: Journal of *Environment, Development and Sustainability* <https://doi.org/10.1007/s10668-019-00339-y> [Online].
6. Collaborative governance: Social Network analysis of the Borana rangeland governance system (Under preparation)

Chapter One: Introduction

1.1. Background

Pastoralism is a livestock production system that relies on the use of extensive grazing in the rangelands, mainly in the drylands and it is believed to be practiced by about 500 million people all over the world including nomadic populations, transhumant herders, and agro-pastoralists (McGahey et al., 2014; FAO, 2018). They produce about 10% of the global meat demand (Blech, 2001). In Africa, inhabiting about 50% of its landmasses, pastoralism supports an estimated 268 million people (AU, 2010). Similarly, in East Africa, an estimated 20 to 30 million people depend on pastoralism (FAO, 2018).

Coming to Ethiopia, pastoralism directly sustains about 12 – 15 million people and occupies about 62% of the total landmasses (Pantuliano and Wekesa, 2008; PFE et al., 2010). From the total pastoralists in Ethiopia, the Somali region pastoralists accounts for 57%, the Afar region accounts for 26%, the Borana and Karrayu pastoralists together accounts for 10% and the remaining 7% belongs to the pastoralists that inhabit the lowlands of the Southern, Gambella and Beni Shangul regions (PFE et al., 2010). Generally, pastoralism in Ethiopia, as elsewhere in the world, is defined by a high reliance on the extensive use of spatially and temporary dispersed communally owned drylands resources in an opportunistic way through mobility as an adaptive strategy to environmental variability (Berhanu and Fayissa, 2010; PFE et al., 2010; Upton, 2012).

Pastoralism plays vital roles in reducing poverty, providing employment opportunities, generating economic growth, managing the environment, promoting resilient SES dynamics in arid and semi-arid ecosystems through making use of the drylands not suitable for conventional agricultural production without environmental degradation (Blench, 2001; AU, 2010; Berhanu and Fayissa, 2010; PFE et al., 2010; McGahey et al.,

2014). The contribution of pastoralism to the total GDP varies between 10 to 50% in African countries where pastoralism is practiced (FAO, 2018). In Ethiopia, the contribution of pastoralism to the total GDP is estimated at 9% while its contribution to the agricultural GDP is estimated to be 35% (Aklilu, 2002; Berhanu and Feyera, 2009; AU-IBAR, 2012). Moreover, the ability of pastoralism to co-exist with wildlife and pastoralists' cultural values play a significant role in green economy development (McGahey et al., 2014). With respect to environmental values of pastoralism, the rangeland vegetation helps to protect fragile soil profiles, store carbon and provide habitat for wild animals (Lund, 2007).

However, the contribution of the pastoralism has been overlooked due to widespread prejudice about pastoralists' land-use system. Despite the progress in understanding the pastoralism, still to date, contradictory policy directions are dominating the literature towards pastoral development interventions. On one side, some views pastoralism ways of life-based on extensive use of spatially and temporally dispersed drylands resources through mobility as 'backward' and environmentally destructive (Coppock, 1994; Nori, 2007; Tache, 2008). This has led to policy interventions that promoted sedentarization, privatization of rangelands and ranch development (Scoones, 1995; Ayalew, 2004; AU, 2010; PFE et al., 2010). This notion was primarily initiated by Garret Hardin's of the "Tragedy of the Commons" (Hardin, 1968), which asserted that the common property resources such as pastoral lands led to overgrazing and degradation of the environment (Helland, 2006; Flintan, 2011; AU-IBAR, 2012).

On the other side, many studies (Nori and Davis, 2007; Rueff et al., 2014) demonstrated that in drylands, pastoralism is more environmentally sustainable and efficient than any other land use systems. For instance, a study undertaken in Afar region, Ethiopia, confirmed that pastoralism was found to bring higher returns per hectare than irrigated cotton and sugarcane production (Behnke and Kerven, 2013). Stating the marginal

position of pastoralists both in terms of ecology and participation in decision-making and unavailability of alternative economic opportunities, proponents of this idea argue that understanding pastoralists' view, customary institutions and indigenous knowledge system that have long history of resilience to environmental variability is a primary step in putting the pastoralists on the paths of sustainability (Homann, 2008; Behnke and Kerven, 2013; Degefa, 2018).

As a result of the above-stated controversies, inadequate pastoral development policy exists still to date in Ethiopia (Lemessa, 2015; Berihun, 2016). The public policy instruments regulating the rangelands governance system largely founded on misconceptions of pastoralism ways of life (Desta and Coppock, 2004). Pastoralists continue to suffer from social, economic and political marginalization and misguided interventions which ultimately resulted in broken-down of long-practiced common property regimes that provide sufficient tenure security and enabled the pastoralists to effectively manage their natural resources (Helland, 2006; Tache, 2008). These situations eventually put additional pressure on natural resource management (López-i-Gelats et al., 2016).

The Borana rangeland is assumed to be one of the best cattle rangelands in the country and Africa (Coppock, 1994). The Borana pastoralists belong to the Oromo ethnic group renowned by well-structured Gada institutions that govern the cultural, social and political spheres of the Borana people (Asmarom, 1973; Helland; 2006; Tache, 2008). Derived from Gada institutions, the Borana pastoralists have elaborated customary rangeland resource governance systems and long applied strategies that enabled them to cope with resource patchiness and climate variability mainly based on mobility (Ayana, 2007; Homann, 2008; Tache, 2008). In recent years, however, due to ever-increasing complex socio-political and environmental changes induced stressors such as insecure communal land tenure, human population growth, market failures, misguided

policy environment, rangeland degradation and fragmentation, and recurrent climatic shocks, pastoral system's adaptation strategies are under increasing pressure and hence, some coping mechanisms are no longer effective (Ayana, 2007; Tache, 2008; Eyasu and Feyera, 2010; Bekele, 2013; Yibeltal, 2014; Berihun, 2016; Pantuliano and Wekesa, 2008).

Given the high dependency on scarce natural resources particularly pasture and water, the pastoral system is highly vulnerable to climate variability and changes (Bekele, 2013; IPCC, 2014). An increase in temperature severely affects livestock productivity by limiting pasture and water availability and posing thermal stress on animals (Nardone et al., 2010). Moreover, long-term climate change affects the dynamics of the ecological system in altering rangeland vegetation composition, particularly in increasing non-palatable bush plants and reducing herbaceous grasses (Ward, 2010) which ultimately affects the production and productivity of the livestock.

Empirical evidence suggests that climate variability and change have already been observed in Borana, such as declines in amount of rainfall, unpredictable rainfall seasonality, and increasing frequency and intensity of droughts (Nori and Davies, 2007; Williams and Funk, 2011; Viste et al., 2013; Bekele, 2013; Wassie and Fekadu, 2016). As noted by Viste et al. (2013) from the early 1980s onwards, the average annual rainfall showed a decreasing trend with increased unpredictability. On average, the annual rainfall in the 1980s has decreased by 9.7 mm in the 2000s (Wassie and Fekadu, 2016).

Increasing frequency and intensity of drought is threatening local coping and adaptation strategies (Bekele, 2013; Debasu, 2013; Wassie and Fekadu, 2016). In the past, the Borana pastoralists had adaptive capacity to deal with drought (Opiyo et al, 2014). However, climate variability and change potentially increased the frequency and intensity of the drought which, in turn, undermined the pastoralists' adaptation strategies (Homann, 2004; Ayana, 2007). The adverse impact of the droughts on the

cattle population in Borana is visible. For instance, the periodic drought shocks occurred in Borana in between 1980 and 2000 caused considerable declines in cattle population, for example by 43% in 1983/1984, 42% in 1991/1992, 25% in 1996 and 53% in 1999/2000 (Cossins and Upton 1988; Ayana, 2007; Tache 2008; Bekele, 2013) resulting in an estimated loss of about 45 million US dollars (Desta and Coppock, 2004).

On the other hand, the Borana pastoral system has been facing complex socio-economic and political stressors like state policies, land tenure arrangements and development interventions which undermine the adaptation strategies of the communities to the climate variability and change (Tache, 2000; Beyene, 2006, Flintan, 2012; Yibeltal, 2014). Along with poor social services such as education and health (Fekadu and Wassie, 2016, Degefa, 2018), a key problem which pastoralists have been facing is that lack of security over their land resources (Helland, 2006; Flintan, 2012). Pastoral areas are being highly threatened with the rangelands becoming increasingly fragmented and barriers to mobility are rising.

On top of that, the governance systems have undergone many regime changes in Ethiopia. Throughout regime changes, however, the central element of pastoral development policy reform focused on the sedentarization of the pastoralists (Helland, 2006; Mohammed, 2015; Lemessa, 2015). Sets of pastoral development policies emerged from ill-informed premises mainly promoted the allocation of rangelands to the uses other than pastoral productions such as crop production, appropriation of rangelands for commercial purpose and private ranches (Tache, 2013; Napier and Solomon, 2011).

As a result, pastoralists' lands have been given over for national parks, commercial farms, mines, military camps, airports, oil exploration and cropping (PFE et al, 2010). In Borana rangelands, there are about five big private and state ranches occupying about 33,000 ha (Eyasu and Feyera, 2010). Studies have shown that the area allotted to private

or group ranches were the better parts of the rangelands. The pastoralists were left with either too degraded or infested with bush encroachment. The infestation of unpalatable invasive species is partly caused by the government policy that prohibited the burning of unwanted bushes (Kelemework, 2016).

Above all, misconceived pastoral development policies in the country succeeded in breaking-down of the customary institutions that helped the Borana pastoral communities to fair ensure sustainable access utilize and manage which ultimately led to the degradation of rangelands beyond repair (Tache, 2008; Berihun, 2016). Worth noting, the rangeland degradation is more complicated by increasing population densities of the drylands of Borana leading to mismanagement (Kelemework, 2016).

The expansion of opportunistic crop production and private rangeland enclosures promoted by settlement policy has reduced the availability of grazing resources and restricted access to pasture and water resources which, in turn, have constrained their adaptive strategies to environmental changes (Ayana, 2007; Eyasu, 2008). Overall, studies highlight that non-climatic factors like reduced pastoral lands, restricting the mobility of livestock, market fluctuations are more important than environmental factors in deriving increased vulnerability of pastoralists (Gautier et al., 2007).

Understanding how pastoral SES can be resilient to SES transformations has become a constant theme of discussions. A continuous deterioration in SES resilience is mainly stemmed from the crisis of governance system, the inability of establishing effective institutions that govern human behavior (Levins et al., 2013). Natural resource governance is a complex problem with no clear path to resolution (Berkes et al., 2003; Agrawal, 2003; Folke et al., 2010). The conventional state-centric, fragmented and top-down governance approaches have already failed to nurture natural capital and often

resulting in inefficient use, inequitable distribution of scarce resources and conflicts (Boyd and Folke 2012; Li and Li, 2012; Linstädter et al., 2016).

In addressing these challenges, multiple collaborative approaches have been promoted, such as community-based natural resource management (Kellert et al., 2000), adaptive management (Folke et al., 2005), the network governance (Roberts, 2000), co-management (Berkes, 2005) and adaptive co-management (Sandstrom and Rova, 2010). The common element all concepts have in common is that the complexities inherent in both ecological and social arrangements of rangelands can be more adequately addressed through involving different actors with differing knowledge, values, and interests (Adger et al., 2005; Bodin and Crona, 2009; Armitage et al., 2012).

In connection with network governance, the existence and nature of social networks among different actors determine the effectiveness of any natural resource management through improving the collaborative governance process (Folke et al., 2005; Olsson et al., 2008; Bodin and Crona, 2009). Social networks facilitate the generation, acquisition, and diffusion of knowledge and information, mobilization and allocation of key resources for effective governance, commitment to common rules and conflict resolution (Carlsson and Berkes, 2005; Crona and Bodin, 2009). Overall, drawing on the perspectives of SES, this dissertation research project strived to understand the SES dynamics in the Borana rangelands and how the governance system is responding to the changing SES.

1.2. Problem statement

Similar to other SES, the Borana pastoral SES has undergone profound transformations attributed to political, socioeconomic, demographic, and environmental factors. Studies show that in recent years, due to ever-increasing complex sociopolitical and environmental change-induced stressors and stresses, the customary institutions that

provided effective frameworks for sustainable use and management of the rangeland resources for pastoral communities for centuries have already been deteriorated which caused the vulnerability of the pastoral system (Ayana and Oba, 2007; Tache, 2008; Eyasu and Feyera, 2010; Bekele, 2013; Yibeltal, 2014; Berihun, 2016; Pantuliano and Wekesa, 2008). Vulnerability is a product of magnitude and characteristics of exposure or change-induced stressors, the sensitivity and adaptive capacities of the SES (Turner et al., 2003; IPCC, 2007; Tyler, 2007). The likely impact of SES changes induced stressors is uneven (O'Brien and Leichenko, 2000). More specifically, the degree of vulnerability to SES changes among different individual households or groups of people is different, largely influenced by their adaptive capacities (Susan et al., 2008) reflecting the importance of systematic investigation of the pastoral households' relative vulnerability profiles.

Like others, the pastoral communities are not only passive victims of SES change-induced stresses. Rather, they often demonstrate significant ability to be constantly flexible and respond to changes through developing both technical and institutional innovations (Bohle, 2007; Yohannes et al., 2010). Imminently, this social process can alter the interactions of ecosystems and societies which, in turn, sustain or erode the resilience of SES (Reid et al., 2014). This often entails understanding how the SES has responded to perturbations in the past can be of great advantage in the efforts to design effective interventions that support the adaptation process through policies guided by scientific evidence (Mertz et al., 2009; Wassie and Fekadu, 2016). Failure to recognize local innovations, for instance, can erode the local knowledge system and increase the vulnerability of the pastoral system (Hurst et al., 2012; Crane, 2013). Besides, pastoral household's vulnerability profiles to environmental and socio-political change driven forces and their adaptation strategies are basically influenced by several socio-economic

and institutional factors and these factors are often site and household-specific due to diverse situations (Deressa et al., 2009).

Generally, the pastoral system's vulnerability dynamics is essentially shaped by the nature of the socio-political and environmental changes and the communities' adaptation strategies. Understanding of the SES dynamics such as ecological attributes, climate variability, natural resource governance institutions and socio-cultural attributes of the community and their effect on the resilience of the pastoral system is, therefore, a key to understanding the pathways towards resilient SES of the Borana rangelands.

Earlier studies attempted to assess the negative impacts of environmental and sociopolitical change-induced stressors on the Borana pastoral system concentrate on measuring poverty tracks (Tache, 2008), livestock mortality and food security (Bekele, 2013), policy-induced rangelands encroachment (Eyasu, 2008), impacts of rangeland enclosure (Napier and Solomon, 2011), policy-induced weakening of customary institutions (Helland, 2006; Berihun, 2016), adaptation strategies pursued by pastoral households (Wassie and Fekadu, 2016) and rangeland ecosystem dynamics (Ayana, 2007). While these studies have tried to identify the adverse impacts of various environmental and socio-political factors on pastoral systems, relatively little attention has been given to the combined effects of simultaneously occurring environmental and socio-political changes on the pastoral system. This dissertation would fill the gap in the literature on how socio-political variables interact with environmental factors and co-produce a new pastoral system's vulnerability pathway.

Earlier studies mostly rely on the notion that the pastoral system vulnerability and adaptation strategies are simply a technical issue that requires only technological solutions. Social and ecological systems have been studied as if they operate

independently. Yet, there are no or little empirical studies that focus on understanding the dynamism, interconnectedness, and complexity of the interactions between human and ecological subsystems, particularly in the Borana pastoral system. Related to this, for long, natural resource management has been dominated by a mono-centric and hierarchical decision-making approach which has attempted to simplify the complexity of such systems by focusing on a few variables, but that inevitably results in eroded SES resilience (Adger et al., 2005; Folke et al., 2005; Walker et al., 2006; Reid et al., 2014). In the face of apparent failures to govern complex environmental problems by centralized management and reductionist approaches, network forms of governance approaches have emerged which is captured in the concept of collaborative governance (Newig et al., 2010). The SES concept also recognizes that actors' engagement lays a ground to govern SES resilience and sustainability of rangelands as elsewhere in the other SES (Folke et al., 2005).

The collaborative governance system that involves social networks comprised of various actors including government, non-government and civil society across geographical and jurisdictions governance scales, levels and units is more likely to be effective in responding to the evolving complexity and unpredictability of the environmental problems (Ostrom et al., 2007; Bodin and Crona, 2009; Armitage et al., 2010). Collaborative governance system plays an important role in facilitating collective learning, producing common understanding or shared goals, mobilization of key resources, deliberation of commitment and collective actions and resolution of conflicts (Carlson and Berkes, 2005; Scholz and Wang, 2006; Newig et al., 2010).

However, the existence and engagement of multiple actors alone are not enough to build effective natural resource governance (Scholz and Wang, 2006). The types and features of individual actors and networks among actors fundamentally determine whether actors behave in the constructive or destructive manner in governance regimes

even more than the existence of formal institutions (Scholz and Wang, 2006; Walker et al., 2006; Bodin and Crona, 2009; Larson et al., 2013) reflecting the critical importance of investigating the characteristics and influence of each individual actors in the network and the overall features of relational ties (Bodin and Crona, 2009). Therefore, understanding the existence and structure of social networks the Borana rangelands, in this case, is important to search the ways in which “collaborative barriers” can be overcome in addressing the complexities in the rangeland resource governance (Bodin and Crona, 2009; Larson et al., 2013). However, to the best of our knowledge, empirical evidence on the effect of social networks on natural resource governance regimes in general and rangelands resources, in particular, is still lacking. Against this backdrop, this thesis attempted to examine the Borana rangeland network governance structures affecting the capacity and effectiveness of the governance system by applying social network analysis. Overall, grounded on the concepts of the SES and network governance, the present study attempted to investigate the Borana pastoral system transformations and how these dynamics driven factors are affecting the pastoral system resilience by relating it with the rangeland governance system.

1.3. Objectives of the Research

The general objective of the research is to investigate SES transformations of the Borana pastoral system and options for inclusive and encompassing multi-actors governance of rangeland resource management in building the resilience of SES rangelands in the face of SES changes. The specific objectives of the research are the following:

1. To examine the perceptions pastoral households on the dynamics of rangeland ecosystem in the study area;
2. To analyze vulnerability of pastoralists to climate variability/change and socio-political stresses

3. To explore adaptation strategies in response to multiple socio-political and climate stresses;
4. To examine institutions and institutional arrangements engaged in rangelands governance system in the study area and
5. To analyze social networks of the key stakeholders engaged in rangeland governance system.

1.4. Research Questions

Based on the purpose and objectives of the study, the following major research questions were addressed in this research:

1. How severe is rangeland degradation as perceived by Borana pastoralists?
2. What are exposures, sensitivity and adaptive capacity profiles of pastoralists?
3. How pastoralists cope with exposure to current climate-related and curtailment of internal and external stressors?
4. What are the factors determining adaptive capacity of pastoralists to SES transformations in the study area?
5. What are the various institutional arrangements that govern the access, use and control over rangelands resources and how inclusive are the public institutions in terms of decision-making process?
6. Which actors involved in rangeland governance system, what their collaborative relationships, how their interactions affect the effectiveness of the governance system and which actors play a coordinating and bridging roles?

1.5. Organization and structures of the thesis

This dissertation contains seven major chapters. The first chapter deals with the introduction to the research subject and describe problem statement and research questions. The second chapter provides a critical review of existing theoretical

perspectives related to the research subjects such as SES dynamics, SES governance, SES vulnerability and resilience, adaptation, collaborative natural resource management, and network forms of governance. The third chapter outlines the research design, process, research philosophies, data collection, data analysis methods, and potential research limitations. The fourth chapter presents comprehensive study findings on the customary rangeland governance institutions, and trends or dynamics in rangeland resource use and condition of the rangelands. The fifth chapter focuses on exploring pastoral household vulnerability dynamics, adaptation strategies, and non-climate drivers of pastoral system vulnerability. The sixth chapter deals with a network form of rangeland governance structures. The final chapter of the dissertation outlines the final conclusions and implications for policy directions and future researches.

1.6. Significance of the Study

At present, different studies reveal that pastoral economy is increasingly under pressure from contemporary environmental and socio-political changes. Moreover, rangeland resources management has been dominated by a mono-centric governance approach which has attempted to simplify the complexity of such systems by dismantling ecological and human variables, but that inevitably results in eroded SES's resilience.

Finding empirical evidences on how contemporary SES dynamics is deriving pastoralists' vulnerability, how the pastoral system is currently responding, and on how current network governance structures contribute to vulnerability of the Borana pastoral system could help the concerned bodies to design effective intervention options that fit to a system. Analysis of social network provides window which allows us to examine the ways to organize and institutions that enable diverse actors and competing interests to produce collective action to address shared interests. Therefore,

this study will benefit different actors that seized stake in rangelands resource governance to setup governance arrangement that effectively manage SES resilience. The output of the study can be used by policy makers to rethink in establishing effective resource governance regimes which reverse the vulnerability of pastoral communities through building ensemble rules, norms and practices that motivate collective actions.

It can also encourage other investigators to conduct similar investigations at different areas of the country. It can generate topic for research and can serve as preliminary information for those who show inclination towards conducting research around this area. Finally, it will come up with the entry points for non-government organizations and community based organizations to assist the pastoral community.

1.7. Scope and limitation of the Study

The founding idea of this study is to investigate the SES dynamics, how pastoral system is vulnerable to these dynamics and how social networks and their structural properties in rangelands governance regimes affect the qualities of collaboration efforts and process and ultimately how the governance regime affected the adaptive capacities of SES. It also strives to examine how contemporary socio-political landscapes derive pastoral system vulnerabilities to climate variability/changes and vice versa.

Although rangeland ecosystems also respond to change, this dissertation limits its discussion to human system process and responses. In understanding the ecological process and responses, this study essentially relies on perceptions of the pastoral communities. Due to multi-scale nature of governance, to address rangeland governance issues, the study examined rangelands institutions at all levels starting from local to national governance scales. However, for the purpose of the household survey, the study covers only Yabello district of the Borana Zone due to time and resource constraints. The sample households selected for this study was limited to Yabello

district; thus, the ability to generalize to the entire population of the pastoral community throughout the country in general and Oromia in particular is limited. The sample however is similar in nature to the pastoral population of the country. Therefore, the results of the study can also give sense for other similar areas in the region. The other limitation of the study could be the rangeland ecosystem also responds to changes in SES, however, this thesis limits its discussion to the human system responses due to complex nature of the SES transformations.

Chapter Two: Literature Review

2.1. Introduction

This chapter provides the theoretical foundation of the study which integrates the concepts of system thinking, SES resilience thinking, institutions and environmental governance perspectives to understand the pastoral SES transformations, vulnerability dynamics and adaptation process to understand the current Borana pastoral system transformations. Section 2.2 defines pastoralism livelihood. Section 2.3 provides an overview of system thinking and SES and its implication of understanding pastoral system dynamics. Then after, resilience thinking in SES is conceptualized in section 2.4. Section 2.5 briefly illustrates the concepts of governance, institutions, adaptive governance, and network forms of governance. Finally, section 2.6 provides integrated framework employed for the study.

2.2. Defining pastoralism

The term pastoralism is defined in various ways basically based on a production system, types of land used and cultural attributes. Based on the production system, FAO (2018) broadly defined pastoralism as the use of extensive grazing in rangelands for livestock production. However, this definition excludes pastoralists in Americans (Jenet et al., 2016). Similarly, Swift (2001) defined pastoralists as people who earn more than 50% of their income from livestock and livestock products directly derived from rangelands. This definition of pastoralism also fails in clearly distinguishing pastoralists from ranchers as they share generally the same rangelands in which the former essentially depend on the communal property while the latter uses private ownership of the land and more capital intensive (Jenet et al., 2016).

Pastoralism is usually identified based on where pastoralists live. It has been widely argued that pastoralists operate in fragile ecosystems where extensive livestock farming is the most appropriate use or the potential for crop farming is marginal because of low and variable rainfall (Davis, 2007). It was generally identified that pastoralism uses drylands which are characterized by a high degree of uncertainty and variability in the amount and distribution of rainfall which, in turn, affect the distribution of rangeland resources, water and pasture (e.g. FAO, 2018). Along with livestock production and nature of land use system, pastoralism constitutes culture and identity (Jenet et al., 2016). As quoted in Degefa (2018), Randall (2006) described pastoralism as an inborn behavior affected by attachment to a specific social group or ethnicity.

Overall, defining pastoralism requires an understanding of various cultural, social, ethnic identity and ecological factors. By combining these major factors Jenet et al. (2016) defined pastoralism in a comprehensive way as a livelihood system based on extensive grazing livestock that is used by communities specialized in the sustainable management of usually communally owned marginal areas or drylands using their indigenous knowledge and customary institutions passed down over generation. Pastoralists generally depend on the drylands where the availability of nutrients and water vary greatly over both time and space.

In adapting to the patchiness of the rangeland resources, mobility is a key common management strategy employed by pastoralists. Based on mobility practice, pastoralism can be categorized as nomadism (where no permanent place of settlement exist and irregular movement is common), transhumance (where a permanent residence exists, and the herders send their animals to distant grazing areas, usually on a seasonal cycle to exploit temporal and spatial availability of pastures), and sedentary (where people have a permanent place of settlement and practice crop cultivation which commonly

known as agro-pastoralism, and where for long periods, the livestock keepers travel to distant grazing areas) (Blench, 2001; Jenet et al., 2016).

In summary, pastoralism is a livelihood system comprised of people, natural resources, livestock and social relations (PFE et al., 2010). Based on mobility practice and knowledge of drylands resource management, the Borana pastoralists as elsewhere have withstood and maintained a healthy and biodiverse rangeland ecosystem. However, over the last century, pastoralism is becoming ever more threatened due to multiple external and internal factors.

2.3. Social-ecological systems

It is relevant to provide an overview about the concepts of system thinking and complexity of the system before directly go to the concept of SES. In responding to critical limitations of the reductionist thinking, fragmented and discipline-based approaches of defining a problem situation and associated failure in addressing a complexity in natural resource management, system thinking has emerged (Checkland, 1999). Jackson (2008) defined system as a complex whole, the functioning of which depends on its parts and the interactions of those parts or elements. It is a group of elements or subsystems that are connected in such a way that they act as a whole; where the properties of the whole arise from the relationships or the interaction between the component parts (Behrens and Williams, 2004). The key point needs to be given emphasis is that the 'emergent properties' cannot be observed or changed by studying or taking action at the level of individual components as system characteristics comes about as a result of the integrations between the system components and the emergent behaviors and unintended consequences that may result from these interactions (Ibid).

In all, system thinking is a way of mentally framing the way we see the world or the problem situations as opposed to reductionists, system thinking is a perspective that views that problem situations cannot be addressed through reducing the systems to their components parts. It focuses on understanding the patterns of interactions and underlying structures that shape the emergent patterns of systems' behavior as the uniqueness and behavior of the system is only present when the system is together (Jackson, 2008).

One of the presented benefits of systems thinking is its greater ability to help us in dealing with two interrelated phenomenon: complexity and uncertainty (Behrens and Williams, 2004). The term complexity is the multiplicity of interconnected interactions among elements in the system at multiple scales or levels (Berkes *et al.*, 2003). It refers to the understanding of how large-scale complex, organized, and adaptive behavior can emerge from the interactions of small-scale interactions among myriad elements in the system (Simon *et al.*, 2013). The term complexity here also indicates the non-linearity, uncertainty, unpredictability and surprise in the interactions of elements in the system (Walker *et al.*, 2006). For instance, rangeland ecosystem, the service it provide and the people who use and manage them comprises a complex adaptive system. Even though it is not beyond human comprehension, it is difficult to predict the outcome of the interactions between human system and ecosystem and its implications as the interactions occur at multi-levels and in non-linear ways.

As a result of complex interactions, new system behavior will emerge, for instance, climate change and rangeland degradation in this particular case. The concept of uncertainty is captured in the future is inherently laden with unknown and surprise (Walker *et al.*, 2006). Even though science and technology has contributed in anticipating change associated with the world dynamics, given complex interactions in the system, future is still filled with unpredictable scenarios which vastly contributes to

the challenges in natural resource management. The major focus of discussing complexity and uncertainty concepts in system thinking is that if it is intended to build resilient SES in any system, we need to focus our lens towards understanding the complex interactions and embrace wide range of emergent outcomes rather than a few precisely determined elements/variables.

Turning to the concepts of SES, with increasing understanding of complex systems, new lens of looking the interaction of human with natural environment emerged. The SES views humanity as an integral part of bio-physical world. In regards to the definition of SES, it is best defined by Berkes (2006) as:

“The social-ecological system represents the integration of the social/political and ecological scales. It emphasizes the view that social and ecological systems are in fact linked, and that the delineation between the two is artificial and arbitrary. Such integrated systems of humans-in-nature are more likely to work if there is a fit between the level and boundary of the eco-system and the institution designed to manage it. However, this is not to say that there can or should be political levels that perfectly much the ecological levels.”

The central premise of SES is that the human dependence on the capacity of ecosystems to generate essential services, and the vast importance of ecological feedbacks for societal development, suggest interconnection of social and ecological systems (McGinnis and Ostrom, 2014). The SES concept places humans within nature and focuses on the way in which interconnections between people and their biophysical contexts produce complex adaptive systems (Folke *et al.*, 2010). Both social and ecological systems contain elements that interact interdependently and each may contain interactive subsystems as well. A social system includes economy, actors and

institutions in mutual interaction that may either directly influence or execute policies that influence the ecological state of the system (Folke *et al.*, 2006; Simon *et al.*, 2013).

SES is considered as a system composed of organized collections of humans, physical environment and process of interactions in spatially determined geographical settings. According to Ostrom (2007), we can see seven major components of the communal rangeland SES for analytical purpose namely: a resource system, resource units, users, governance system, external social, economic, and political settings, and related ecosystems which intricately interact to produce important outcomes reflecting establishment of effective governance structures demands an understanding the features of each element and their interactions.

Overall, the pastoral system can be recognized as complex adaptive system (Reid *et al.*, 2014). From the SES points of views, this dissertation strongly argues that the conventional approaches of designing intervention that try to dismantle human and ecological systems and simplify the wicked problems associated with the complex interactions among the components leads us nowhere. For instance, purely technical interventions in rangeland management without understanding their impact on the social system often fail. The establishment of effective institutional arrangement that can balance between human and ecological systems requires an understanding of the interaction between them. Focusing only on one dimension without the other will not be sufficient to guide toward sustainability or resilience which was widely observed approaches in the Borana pastoral system.

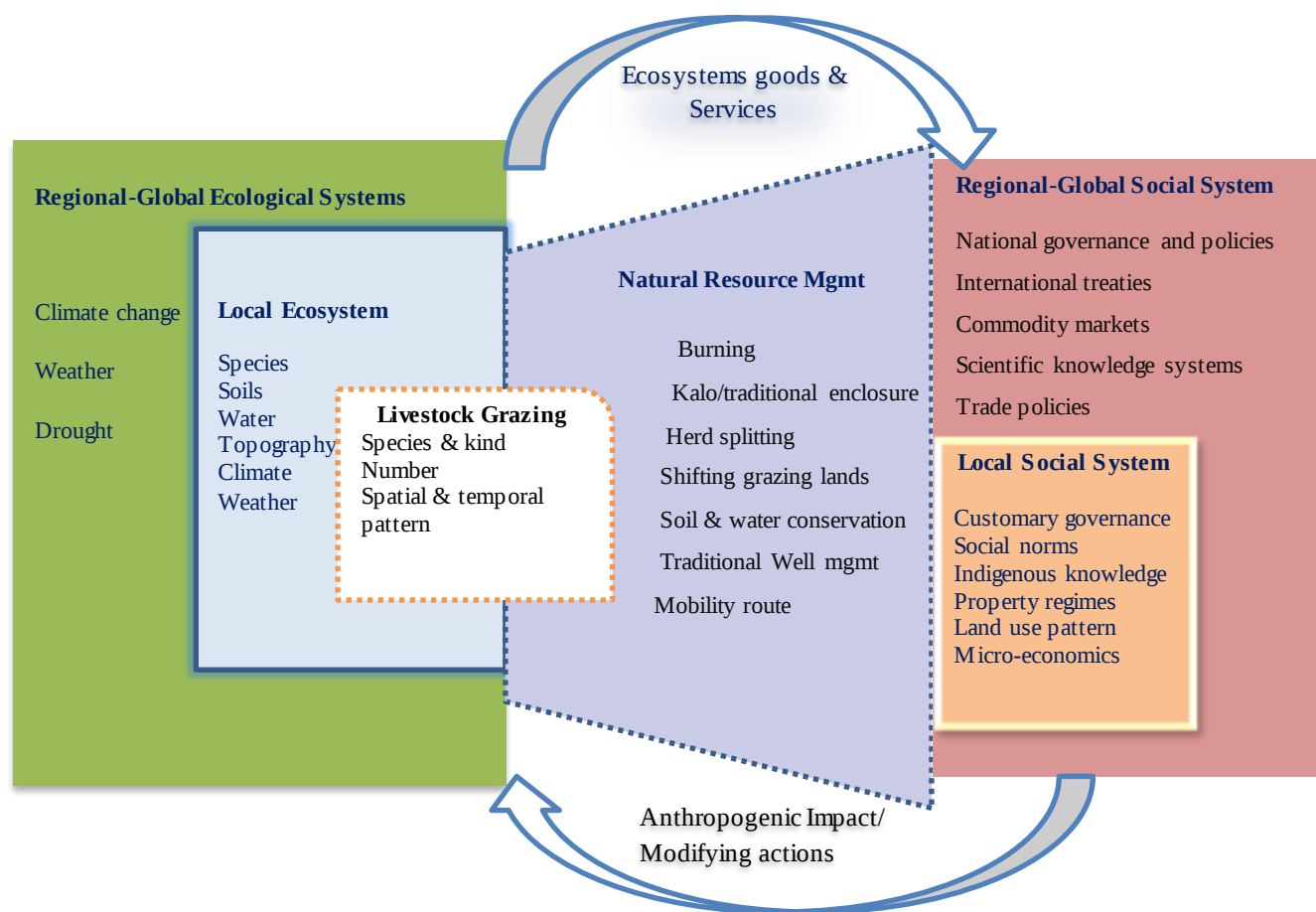


Figure 1. An Illustration of Rangeland SES

Source: Adapted from Reid et al., 2014

As illustrated in Fig. 1, pastoralists and the rangeland ecosystem interact in countless and complex ways. The interactions are governed and influenced by natural resource management activities. Social process ranging from local to global can all shape natural resource use, management and governance. While resource policy may be designed at large geographical scales (national or regional at Ethiopian context for example), rangeland management activities are implemented within a single ecosystem. Pastoral communities indirectly interact with rangeland through managing their livestock and livestock grazing system.

2.4. Conceptualization of Resilience, Vulnerability and Adaptation in SES

Recently, the terms resilience, vulnerability and adaptive capacity have been used in numerous studies regarding the interactions between human being and physical environment. However, the difficulties in finding single standard definition have been acknowledged by many scholars (Walker *et al.*, 2004). Many people define differently based on the discipline and context in which they are operating. A review of the concepts and particular implications of the terms used in this study is given below.

2.4.1. Resilience in SES

As noted, the concept of resilience is widely used in ecology but its meaning and measurement are contested. The term resilience was originally used in the natural sciences as a measure of the ability of natural systems to absorb changes and persist in delivering ecological services (Holling, 1973). Since then, different meanings of the term have been suggested. Holling (1973) defined resilience as the buffer capacity or the ability of a system to absorb perturbations, or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behavior. In contrast, other definitions of resilience emphasize the speed of recovery from a disturbance, highlighting the difference between resilience and resistance, where the latter is the extent to which disturbance is actually translated into impact (Adger, 2000).

According to this definition, resilience is measured by the ability of the system to resist perturbation and the speed at which the system returns to the equilibrium condition after disturbance. The current development in the field comes up with evolutionary resilience concept (Walker *et al.* 2004; Folke *et al.*, 2010). In this perspective, resilience is not conceived of as a return to normality, but rather as the ability of complex SES to change, adapt, and, crucially, transform in response to stresses and strains (Gunderson

et al., 2006). Similarly, Folke *et al.* (2010) defined resilience as the capacity of a system to continue to function despite disturbances, either by recovery to its original condition or by some degree of transformation that changes components in a system or the relationships between components in a system. A SES perspective of resilience acknowledges that changes are not linear and predictable but subject to unpredictable, random effects (Gunderson *et al.*, 2006; Walker *et al.*, 2004).

In describing the difference between social and ecological resilience, Adger (2000) noted that social and ecological systems are themselves linked, in ways which have likened to synergistic and co-evolutionary relationships. Thus the resilience of social systems is related in many ways to the resilience of the ecological systems. The same source further explained that seeking to analyze the resilience of social systems is mainly addressed by examining institutional dynamics as it govern all social process such as economic structures and others. As already stated, institutions are taken here in the widest sense to incorporate both modes of socialized behavior as well as more formal structures of governance or law.

The main focus in studying the social system resilience is based on institution's historical evolution and their inclusivity or exclusivity, and hence how effective they are in oiling the wheels of society (Folke *et al.*, 2010). The cultural contexts of institutional adaptation, and indeed the differing conceptions of human–environment interactions within different knowledge systems, are central to the resilience of institutions (Adger, 2000). Therefore, to build resilience in SES needs strengthening of existing regional and local organizations and supporting the development of local institutions (Vasseur, 2015).

In conclusion, the current study is framed by SES perspective of resilience which recognizes that humans and nature are intricately interconnected (Folke, 2006), each

affecting the other, often in unpredictable ways. In this context, resilience refers to the capacity of a system to continue to function despite disturbances, either by recovery to its original condition or by some degree of transformation that changes components in a system or the relationships between components in a system. It is also very interesting to note that resilience is not only about being persistent to environmental changes, but also about the opportunities that disturbance opens up in terms of learning and recombination of evolved structures and processes, renewal of the system and emergent properties of the SES.

2.4.2. Vulnerability of SES

The term vulnerability is used in many different ways by various scholars in different knowledge domains. Conceptualizations and interpretation of vulnerability have implications for what is measured and how it is measured (O'Brien and Leichenko, 2000). In conceptualizing vulnerability, therefore, it is important to understand the characteristics of the system of interest, in this case, the Borana pastoralist system (Vincent, 2004). This study draws on the SES framework to conceptualize vulnerability of Borana pastoral system. The central premise of SES is that the human dependence on the capacity of ecosystems to generate essential services, and the vast importance of ecological feedbacks for societal development, suggest interconnection of social and ecological systems (Folke et al., 2010). It recognizes the complex interactions of humans and ecosystems.

As a result of these complex interactions, the new system's behavior will emerge, for instance, climate variability and change. These emerged properties also trigger unprecedented environmental and social changes which in turn affect the resilience of the SES (Adger et al., 2005). For instance, as Tyler et al. (2007) noted, in the pastoral system, livestock, herders and natural and human systems represent coupled SES

comprised of various components closely and functionally linked. The vulnerability of the Borana pastoral system, therefore, is significantly influenced by the interactions of a wide range of social and natural systems variables. In studying vulnerability, looking separately at social and ecological aspects ultimately leads us to erroneous conclusions. Thus, as per this view, this paper is based on understanding the interactions of components of coupled SES.

In general term, vulnerability can be defined as the susceptibility to be harmed (Blaikie *et al.*, 1994). IPCC (2001, 2014) also defined vulnerability as the degree to which a system is susceptible to and is unable to cope with adverse effects of climate change. In this sense, vulnerability is considered the reciprocal state or antonym of resilience (Vincent, 2004). Turner *et al.* (2003) moved a step forward in using the concept of SES in defining vulnerability. They defined the term vulnerability as the extent to which a system, sub-system, or system component is likely to be harmed as a consequence of exposure to a hazard such as a perturbation or stressor. Adger (2006) also summarizes vulnerability as the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt. In all formulations, we can find the key parameters of vulnerability such as the stress to which a system is exposed, its sensitivity, and its adaptive capacity (Fussler, 2007).

For the purpose of the study, vulnerability is understood as a function of the character, magnitude, and rate of climate and non-climate variations to which a system is exposed, its sensitivity, and its adaptive capacity as suggested by IPCC (2014). Exposure deals with the extent, duration and/or frequency of stress (Xiaoqian *et al.*, 2013). Sensitivity measures the degree to which a system is affected by stress, either positively or negatively (Adger, 2006). It is a susceptibility of the system to variable conditions. Sensitivity determines the potential impact of stress on the systems status-quo that cannot be influenced by human intervention in a realistic way or within a reasonable

timeframe (Schneiderbauer et al., 2013). In contrast, the adaptive capacity of the system measures the ability of a system to adjust to changes. It deals with elements of the system that can be altered by potential future adaptation actions (Schneiderbauer et al., 2013) and it involves wealth, education, technology, information, skills, infrastructure, access to resources and management capabilities (McCarthy et al., 2001).

Regarding vulnerability measurements, there are three major vulnerability assessment approaches evolved over time. The first classical approach is known as a risk-hazard approach which rooted in the natural science and economics researches. This perspective focuses on measuring the 'endpoints' (Piya et al., 2012) or damage caused as a result of environmental stresses (Fussel, 2007). Overall, this vulnerability conceptualization is based on assessments of hazards derived from biophysical factors such as temperature, precipitation, and extreme climatic events and their impacts neglecting underlying roles of human system, especially, adaptive capacity of the system, in mediating the outcomes of hazard events (Adger et al., 2004; Piya et al., 2012). As a major limitation, the fact that it totally disregards the role of structural factors of social systems and focusing on biophysical factors, it is not sufficient to capture the complex and dynamic nature of vulnerability (Adger et al., 2004; Fussel, 2007).

The second vulnerability analysis frameworks (political economy or people oriented) view vulnerability as a state that exists within a system before it encounters a hazard event and considered as 'starting point' analysis (Adger et al., 2004; Piya et al., 2012). It is termed as the socioeconomic vulnerability assessment approach which focuses on the internal socio-economic and political status of individuals or groups prior to the occurrence of the hazards. It concentrates on identifying the adaptive capacity or internal characteristics of the communities/individuals in defining vulnerability (Vincent, 2004; Fussel, 2007). The limitation of the socio-economic approach emanates

from its foundation that the vulnerability of the community is determined solely by internal characteristics of the vulnerable community (Fussel, 2007). In reality, the susceptibility of any system is not only determined by the internal situation but also by the nature of hazards (Vincent, 2004).

The third vulnerability conceptualization is named as an integrated approach, which combines both socio-economic and biophysical vulnerability concepts and emerged to fill the limitation of both approaches. The previous vulnerability conceptualization narrowly focuses on either socio-economic or perturbation/stress, however, integrated vulnerability assessment approach expands the conceptualization of vulnerability into consideration of both external stress and adaptive capacity of the system (Piya et al., 2012).

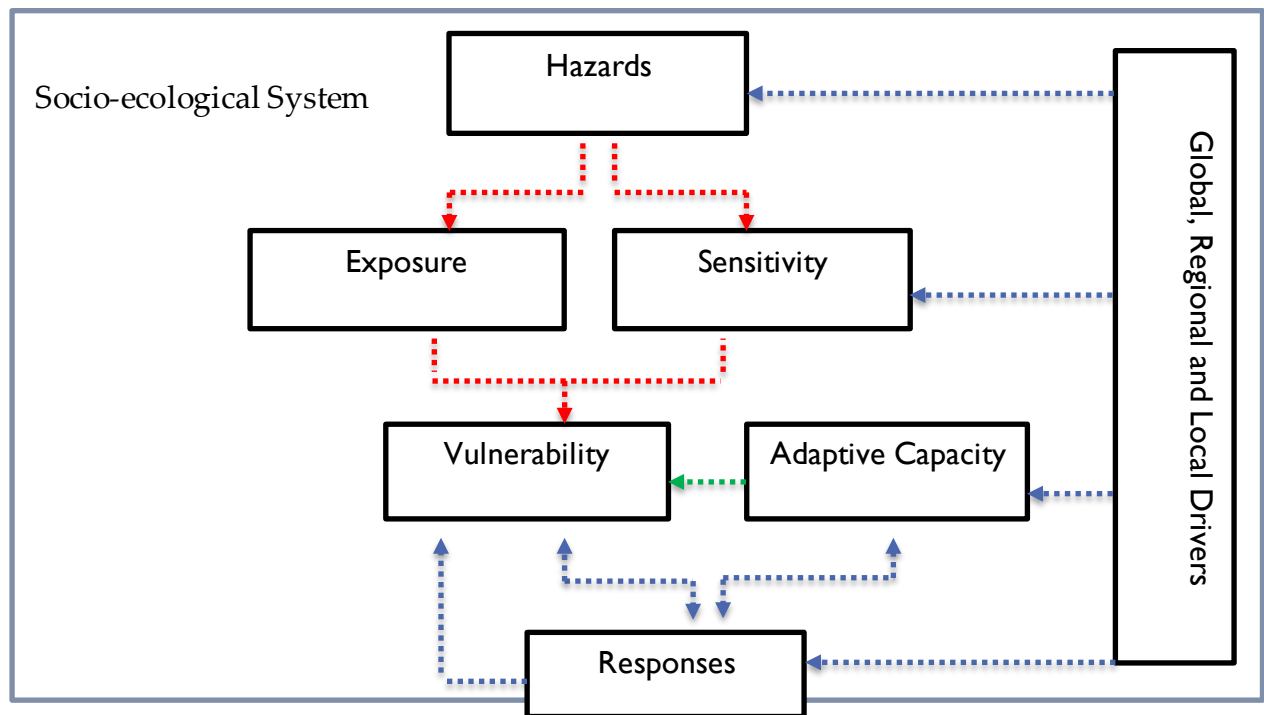


Figure 2 Conceptual Framework of Vulnerability, based on IPCC (2007)

Green arrows indicate positive impact, red arrow indicates negative impact, brown arrow stands positive/negative impact

As noted by Fussel (2007) this approach considers the interaction of external exposure and social profile of the community or system under analysis. Thus, this research employs an integrated vulnerability assessment approach which combines three dimensions of vulnerability, Exposure, Sensitivity, and Adaptive capacity to develop vulnerability profiles at the household level (Fig 2).

2.2.2.1. Concept and frameworks of double exposure

The conceptualization and measurement of vulnerability evolved and triggered scholars to propose various conceptual frameworks regarding vulnerability over the last decades. Earlier vulnerability conceptualizations and measurement focused only on single stressor-single outcome (Eakin and Luers, 2006). Consequently, in most vulnerability studies, the impacts of socio-political dynamics and environmental changes on the vulnerability of SES are discussed separately rather than addressing the two issues simultaneously (O'Brien and Leichenko, 2000). The earlier vulnerability frameworks focus on studies of outcome vulnerability which tend to identify vulnerable groups and measure the extent to which they are vulnerable merely depending on biophysical data and overlooking the contextual vulnerability which is the root political and socio-economic causes of vulnerability (O'Brien *et al.*, 2009).

With evolving conceptualization of vulnerability, however, multi-disciplinary vulnerability conceptualization is emerging. Among these, O'Brien and Leichenko (2000) introduced double exposure conceptual framework which brought focus on the interaction of both process of human-environment interactions. In their work, O'Brien and Leichenko (2000) defined double exposure as the process by which SES will be confronted both by environmental change impacts and by the consequences of socio-political dynamics. In addition to increasing evidence of environmental change effect on the pastoral system, the socio-economic transformations, especially, rangeland

encroachment, marginalization and misinformed policies are driving the vulnerability of pastoral system to environmental changes.

As any economic system, pastoralism is not free from environmental change-induced vulnerability, what López-i-Gelats et al. (2106) described as strategic vulnerability. Simultaneously, pastoral SES encounters external policy related stressors like poor land tenure security and marginalization process that essentially undermine pastoral institutions and production mechanisms, identified as induced vulnerability (López-i-Gelats et al., 2106). Moreover, the interaction of the induced and strategic drivers triggers the vulnerability of the pastoral system, as shown in Fig. 3. To shed a bit light, non-climate transformations pose significant challenges on the adaptation capacities of the pastoral system to environmental factors and vice versa. Thus, the interaction of political and socio-political change and environmental factors co-produce new pathways of pastoral system vulnerability.

Double exposure framework argues that in order to better understand the vulnerability of SES in particular time and space, an examination should be conducted on how political and socio-economic and environmental processes affect the vulnerability level and how these processes interact, and then how these interactions, in turn, exacerbate or offset each other in shaping vulnerability landscapes (O'Brien *et al.*, 2004; Silva *et al.*, 2010).

Leichenko and O'Brien (2008) further discussed that double exposure framework not only deals with how the SES are simultaneously and sequentially exposed to multiple political and socio-economic and environmental changes-induced stressors. It rather, acknowledges the interactions of these stressors, and hence, influences the exposure and capacity of the system or people to respond to these stressors. This in turn, results in new contexts for experiencing and responding to change i.e. pathways to increased

vulnerability or enhanced resilience (Fig 3). Both environmental change and socio-political and economic changes are simultaneously ongoing processes and will impact SES differently (Leichenko and O'Brien, 2000).

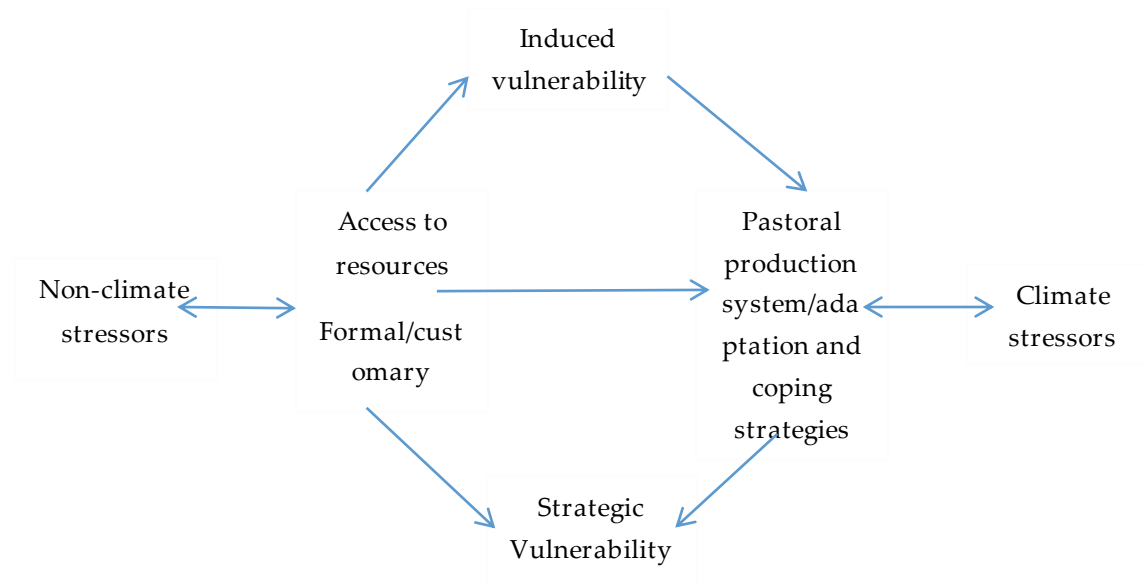


Figure 3 Drivers of pastoral system vulnerability

Source: Adapted from López-i-Gelats et al. (2106)

Double exposure framed in such a way that it provides a means to identify expected winners or losers from these process (Brook *et al.*, 2010). Winners are considered as those populations or social groups that are likely to benefit from ongoing process, while losers are those that are disadvantaged by the process (O'Brien *et al.*, 2004).

Summing up, double exposure framework draw attention to social, political and economic forces related to both the causes and the effects of environmental change and it can be used in wider and diverse situations (Leichenko and O'Brien, 2008). This thesis, therefore, attempts to employ double exposure analytical framework (Fig 2) to examine the Borana pastoralists' exposure to both climate change induced stressors and political and socio-economic stressors, mainly through paying attention to contextual

vulnerability or the root causes of vulnerability to understand how Borana pastoralists are losing or gaining from undergoing human-environment process.

2.4.3. Adaptation

Adaptation can be understood as the process of adjustments in SES in response to actual and or future potential changes (Mitchell and Tanner, 2006). It involves the changes in process and practices and structures to moderate the potential damage and to benefit from opportunities associated with climate variability and change (IPCC, 2001; IPCC, 2007). Berkes et al. (2003) further capture the concept of adaptation as capacity of a SES to learn, combine experience and knowledge, adjust its responses to changing external drivers and internal processes, and continue to develop. As conceptualized by Agrawal and Perrin (2009), adaptation strategies can be categorized into mobility (for instance pastoral mobility or wage migration), storage, diversification, communal pooling (for instance, natural resource management) and market exchange (well-structured market access).

The terms “adaptation” and “coping strategy” are used sometimes synonymously and other times, differently. According to Agrawal (2008), adaptation and coping strategies differ in terms of temporal scales in that coping strategies mainly comprises short term measures when facing unexpected events such as drought. Adaptation usually involves planned, longer-term practices (Thomas et al., 2007). In fact, there is strong link between the two in that coping responses may contribute to longer-terms adaptation strategies or put in danger the resilience of the system (Susan et al., 2008). The adaptation process may require actions of multi-actors at different scales of governance levels including individuals, communities, private companies, government and non-government bodies to increase the adaptive capacity of the system (Mitchell and Tanner, 2006).

Adaptations do not take place in a vacuum, rather within SES settings and hence adaptation strategies involve transformations in institutional arrangements (Folke et al., 2010; Hurst et al., 2012). Adaptation strategies are not solely technical issues; rather it is largely a function of institutional change (Crane, 2013). The choice of pastoral household's to embrace particular adaptation strategy is shaped by the interaction of multiple institutions (both customary and formal), and viewing an adaptation strategy as a simple technical issue may lead to erroneous conclusions. Moreover, adopting a particular adaptation strategy may also drive institutional changes, for instance, as in Borana, adoption of opportunistic crop cultivation and private range enclosures brought about shifts in property regimes (Napier and Desta, 2011).

The Borana pastoral system as elsewhere in east Africa has undergone profound SES transformations (Desta and Coppock, 2004). As a result, a pastoral system that functioned well in the past has eroded. In fact, the challenge is not with the pastoral system, rather with policy environment and development interventions mainly dictated by the incorrect assumption that pastoralism is economically inefficient and environmentally destructive (Ayana, 2007; Tache, 2008; Eyasu and Feyera, 2010).

It is worth mentioning that initiated by western colonial mentalities along with tragedy of the commons thesis, the notions that view common pool resource management causes natural resources degradation and pastoralism as economically unproductive is still exerting a major influence on contemporary policy environment that sees privatization of common property, destocking and commercial ranching as fundamental development interventions in enhancing pastoralists' socio-economic development (Nori and Davis, 2007). Stresses associated with misguided policies include loss of prime grazing lands, rangeland degradation and reduced pastoral mobility which is strategic for use of highly variable rangeland resources, usually systems with 33% or more C.V. in rainfall.

Moreover, climate variability and change factors exacerbate the vulnerability of pastoral communities, and further weaken customary institutions. Supporting adaptive processes therefore demands understanding and balancing these interwoven drivers and dynamics of change (Crane, 2013). As a result of interacting biophysical and human system factors, currently, the pastoral productivity has started to decline and already has reached unsustainable level (Desta and Coppock, 2004; Eyasu and Feyera, 2010).

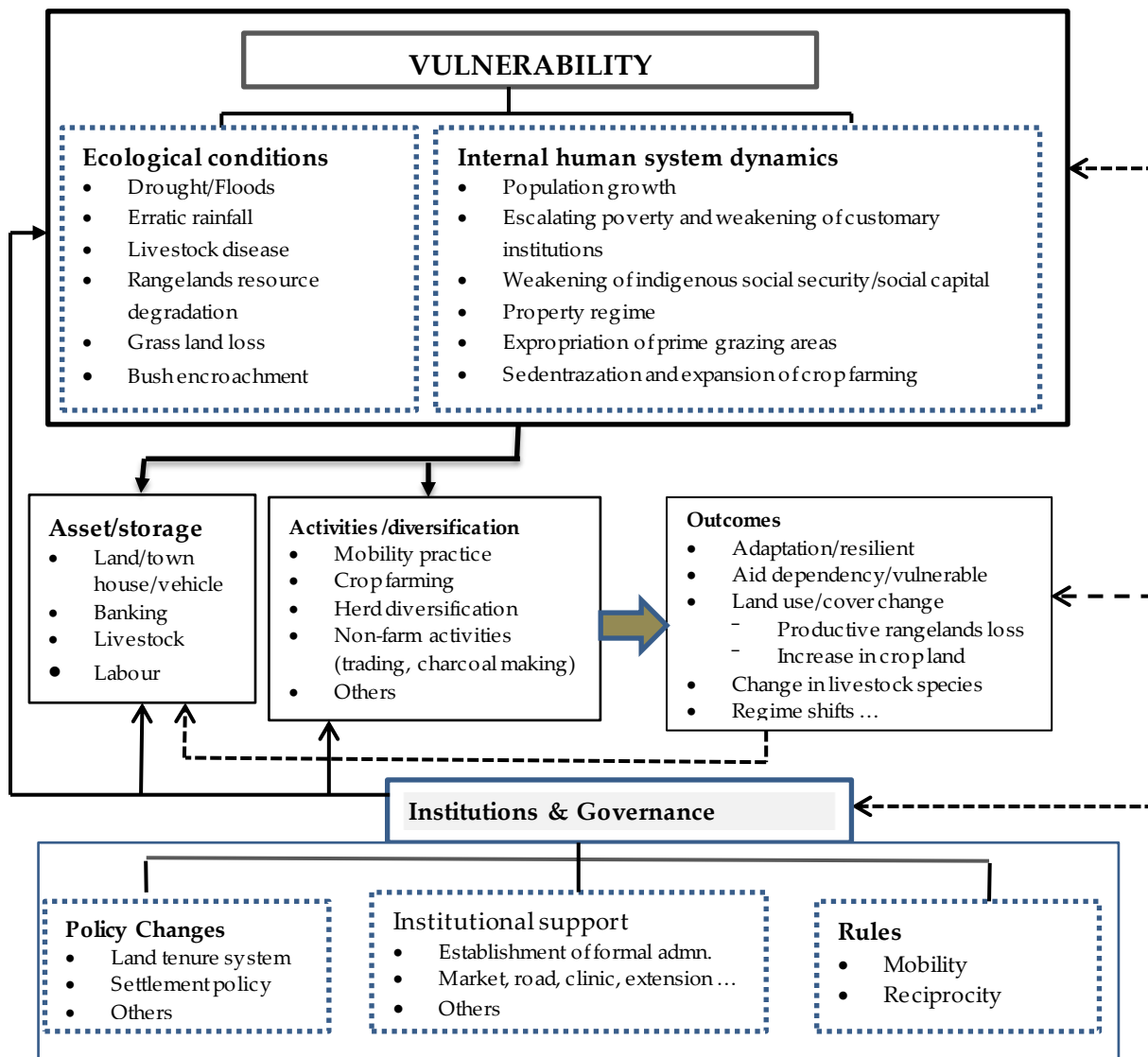


Figure 4 Conceptual Framework for adaptation to climate variability and changes in Borana Context:

Source: Adapted from Ellis (2000). The Solid arrow indicate direct influence, dotted arrow indicates indirect influence

This break down of well-functioning and resilient pastoral system drives pastoral households to start adopting and experimenting with new land use systems and income diversification options. In this study, the framework (Fig 4) was used to understand adaptation strategies employed by Borana pastoral households. The framework describes the general relationships in that vulnerability of pastoral system is basically instigated by interacting bio-physical and socio-economic and political stressors.

Pastoral households also adjust coping and adaptation strategies, and the ability of pastoral households to adapt to climate variability is constrained by state-led external intervention such as pastoral development policies and land tenure arrangements. Studies (for example Turner, 2003) show that the term adaptation like resilience, has its origins in the natural sciences, where it is generally defined as the development of genetic or behavioral characteristics by organisms in order to survive and reproduce in the face of environmental change. In SES, adaptations can be viewed as changes the system undergoes in order to deal with stresses and sensitivities (Moss *et al.*, 2002. Similarly IPCC (2001) defines adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

2.5. Governance for SES resilience

Governance is the most contested term in social science and an increasing challenge. It is widely discussed that it is one of the most factors for ensuring or restraining the resilience of the SES (Bennett and Satterfield, 2018). In response to mounting complexity and uncertainty challenges, conventional governance structures have changed from government to governance. The central argument of the governance lies in the shift from monocentric and hierarchical to more collaborative and network based forms of the decision-making (Armitage *et al.*, 2010; Bennett and Satterfield, 2018). Before

discussing the concept of environmental governance, it is important to make distinctions between environmental management and environmental governance. According to Pahl-Wostl (2009), environmental management focuses on the detail operational activities such as planning, implementation and monitoring activities; while environmental governance deals with rules and decision-making process under which a management system operates to maintain the natural resource base within desirable bounds.

Governance is, therefore, the process and structures by which government and non-government actors such as private entities, industries, different interest groups and the communities at large interact to produce rules and regulations, practices through which the outcomes are achieved (Bulkley, 2005). Specifically, environmental governance can be defined as the set of regulatory process and structures through which actors influence a management of environment (Adger *et al.*, 2003; Pahl-Wostl, 2009). Environmental governance comprises the rules, practices, policies and institutions that shape how humans interact with the environment (Bulkley, 2005). Governance signifies a new process that is eventually concerned with creating the conditions for ordered rule and collective action (Stoker, 1998), which facilitate the effective participation of stakeholders in natural resource management.

More specifically, rangeland governance can be understood as a broad set of political, economic administrative systems that determine access to resources, management and development of the rangeland resources (Russell *et al.*, 2011). For the purpose of operational definition, rangeland governance is structures and processes, through which actors in the society make a decision, share power, facilitate conditions for ordered rules and regulations and collective actions aimed towards a common goal (Hatfield *et al.*, 2007). The governance structures or institutional arrangement used to address rangeland issue are greatly depend on the interaction of various national and

regional policies, customary institutions, local norms, values and rules. In the context of this study, rangeland governance is thus essentially the interplay, mediating the formal and informal negotiation of decisions between actors with different forms and degrees of influence such as conferred by their resources, information, policy influence and other factors (Lebel *et al.*, 2006).

Reductionist perspectives and conventional environmental governance treats human system as external to ecosystem and never tries to address the interconnection between them. However, recently it is recognized that human and ecological systems are coevolved and intricately linked and hence, SES governance requires a comprehensive understanding of the relationship and interaction dynamics between human systems and natural systems. Therefore, rangeland resource governance implies establishing compatibility between ecosystems and social systems, sustained provisions of basic functions without degradation of the natural resource bases regardless of global changes-induced disturbances (Pahl-Wostl, 2009). It involves the establishment and enforcement of embedded social rules that structure interactions between social and ecological systems (Folke *et al.*, 2002). The connectivity pattern within and between social and ecological systems plays an important role in designing effective institutions for sustainable resource use and management (Adger *et al.*, 2005).

2.5.1. Institutions

Environmental governance takes into account the contexts of designing institutions that govern the human-environment interactions (Ostrom, 1990). In fact, there is no standard definition of institutions. According to North (1990) and Ostrom (1990) institutions are the rules of the games in a society. They are rules of human behavior that provide incentives under which rational people act (Sisay, 2001). They involve laws, social norms, traditions, beliefs and other established rules of human behavior embedded in

the culture of the society and govern the interactions of human being with their environment (Ostrom et al., 1999).

Institutions structure both incentives and disincentives to human activities in all aspects, being political, social or economic (Hodgson, 2006). Institutions both constrain and enable behavior. Institutional change shapes the way societies act. Therefore, whether organizations and individuals can serve a constructive or destructive purpose in environmental resources management basically depends on the institutional framework in which they operate (Elobeid, 2012).

Institutions give rise to social practices, assign roles to the individuals and organizations in these practices, and govern the interactions among the actors (Young, 2003). Environmental and resource regimes are types of institution. They address situations in which actions can degrade ecosystems through overuse of natural resources or due to unintended side effects. Approached in this way, institutions constitute important components of governance systems at all levels of social organization ranging from the local to the global. Institutions are means through which resilience in SES is enhanced or undermined. It is also important to note that institutions are dynamic and they are time and context specific (Pahl-Wostl, 2009).

Hence, the main discussion point here is that understanding the ways in which we can establish institutional frameworks that enable actors at all levels to behave in constructive rather than in destructive manner. According to Sisay (2001), the critical task for any society is to develop a set of institutions or institutional framework that enable and constrain individuals and organizations to behave in constructive rather than destructive manner in every dimension: social, economic and political activities.

In the literature there are several ways of classifying institutions from which degree of formality is one. Based on degree of formality institutions can be seen as formal and

informal. Informal institutions are systems of rules and decision-making procedures which have evolved from endogenous sociocultural codes and give rise to social practices, assign roles to participants and guide interactions among natural resource users (Ostrom, 2005). Informal institutions are unwritten rules of society such as culture, norms of behavior, and code of conduct. Formal institutions refer to the rules, policies, and laws that guide access, control and management of environmental resources, and which are backed up and enforced by the state. Formal institutions may include: constitutions, laws, property rights, bylaws, statute and common law and regulations as well as enforcement characteristics, social sanctions, and internally enforced standards of conduct (Elobeid, 2012).

In summary, institutions, broadly defined to include governments, private organizations, laws and social norms, contribute to the establishment of recognized standards and the enforcement that create enabling and constraining environment. Hence, either formal or informal institutional development is considered to play key roles in sustainable environmental resource management.

2.5.2. Governance of the commons

2.3.2.1. Understanding the Natural Resources Regime

As far as common property resources are concerned, Ostrom *et al.* (1999) discussed that commons can be categorized into four broad types of property regimes namely: open access, private/individual property, communal/common/group property, and state/government property. Open access refers to the absence of well-defined property rights, where access to the resource is open to everyone. As it can be understood from its name, private property provides individual rights to exclude others, regulates the use of the resource and offers an individual the opportunity to buy or sell a share of a resource. State property involves ownership by a national, regional, or local public

agency, which decides on access to, and levels of, exploitation of the resource. It may also prohibit use by individuals (Khan, 2011). Communal/common property is held by an identifiable community of interdependent users who exclude outsiders while regulating use by members of the local community (Ostrom, 1990). Unlike open access, common property regimes consist of a set of institutional arrangements that define the rules and principles of access to, and control over, a range of benefits arising from collectively-owned and used natural resources (Walker *et al.*, 2004).

2.3.2.2. Theories of Commons Governance

Irrespective of resource types, the rules of exclusion, inclusion and subtraction are considered as critical elements of commons management. The legitimacy of resource users is related to the rules of exclusion and inclusion, whereas subtraction deals with the rules of resource distribution and allocation among the users (Ostrom, 1990; Khan, 2011). Common property resources are considered as the exclusion of the resource users from these resources is difficult and that each user is capable of subtracting from the welfare of others (Cousins, 2007). Because, excluding free-riders and non-contributors from benefiting from the resource is difficult and costly although not impossible in many commons-pool-resources contexts. On the contrary, private goods are characterized by the relative ease of excludability and high subtractability (Ostrom *et al.*, 2007).

The commons governance theories have evolved since the Hardin's 'Tragedy of the Commons'. Hardin's (1968) parable of herdsmen sharing a common pasture has sparked debate in a wide range of disciplines. The main thesis of the Hardin's parable tragedy is that herdsmen sharing a common pasture are led by the relentless logic of individually rational decision for optimizing personal gain. This ultimately leads to overstocking their herds and degrading their common rangeland resources. Over

exploitation and degradation of the common is the consequence of the conflict between the human tendency for the pursuit of self-interest and the need to sustain the benefits derived from the preservation of the commons for local and other communities (Ostrom et al., 2007).

Moreover, Hardin (1968) argued that customary institutions are inherently inefficient system and proposed strong role of formal institutions in the commons governance to avoid common pool resources overexploitation and degradation. He also argued that privatization of rangelands and individualization of tenure would remove the incentives for over-exploitation inherent in collective ownership and lead to more sustainable land and resource use. This weakened the customary institutions generated through generations. Authority to control common resources shifted from customary institutions to formal governance.

The main shortcoming of the Hardin's paradigm has been identified as its failure to distinguish between open access and common property regimes (Elobied, 2012). With prominent work of Ostrom (1990), the Hardin's paradigm was challenged. The central theme of this emerging worldview focuses on the existence of a set of institutional arrangements that define the condition of access to and control over a range of benefits arising from collectively used resources (Cousins, 2007). Ostrom argued that the resource users have their own institutions through which they can effectively and sustainably manage their common-pool resources. The resource users often know how to manage their resource more than any other externals. This paradigm mainly looks for the designing of the rules and principles that enable sustainable management of the common through understanding existed customary institutional arrangements, which enables access to and control over resources (Ostrom et al., 1999).

In the progress, Ostrom and others extended their understanding of polycentric governance structures especially, in responding to limitations of confinement to local level. They started to argue that the commons governance involves multiple independent actors who interact and learn together to achieve the common goals (Elobied, 2012). This paved the ways for the birth of complex SES thinking (Berkes, 2006). The complex SES perspective emphasizes on the analysis and understandings of the nature and dynamics of interactions at multi-scalar levels within the resource governance system. Stemming from understanding of the complexity involved in natural resource management, the concept of SES governance has grown to comprise concepts of adaptive management, adaptive co-management, and network forms of management which emphasize the need for new flexible, integrated, holistic forms of approaches that can deal with the complexity of SES. These concepts are treated in subsequent sections.

2.3.1.1. Institutional Analysis

This section presents the conceptual frameworks used to analyze customary institutions based on institutions and natural resource governance theoretical insights. As illustrated in Fig 5, the framework briefly describes relations between institutions, characteristics of communities and resources and the outcomes of collective decision-making over natural resources. Institutions forms core elements of SES and the success of natural resource governance in building SES resilience highly depends on institutional arrangements put in place (Pandey et al., 2017). Institutions can be defined as socially constructed norms and rules structure human behavior toward collective strategies and actions (Ostrom, 2005; Koontz *et al.*, 2015). Overall, institutional arrangements determine the interactions between human and natural systems and hence, influence natural resource governance outcomes.

As such, the process of establishing effective rangelands governance requires an understanding of the interactions among various subsystems such as resource system, for instance, rangelands, resource users (pastoralists), and governance systems or rules in use in complex SES called action arena (Pandey et al., 2017). These interactions, in turn, produce outcomes such as livelihood diversification, change in land use system and resource use patterns. As depicted by Ostrom (2009), consequently, these possible outcomes feedback into SES and affects the interactions between these subsystems.

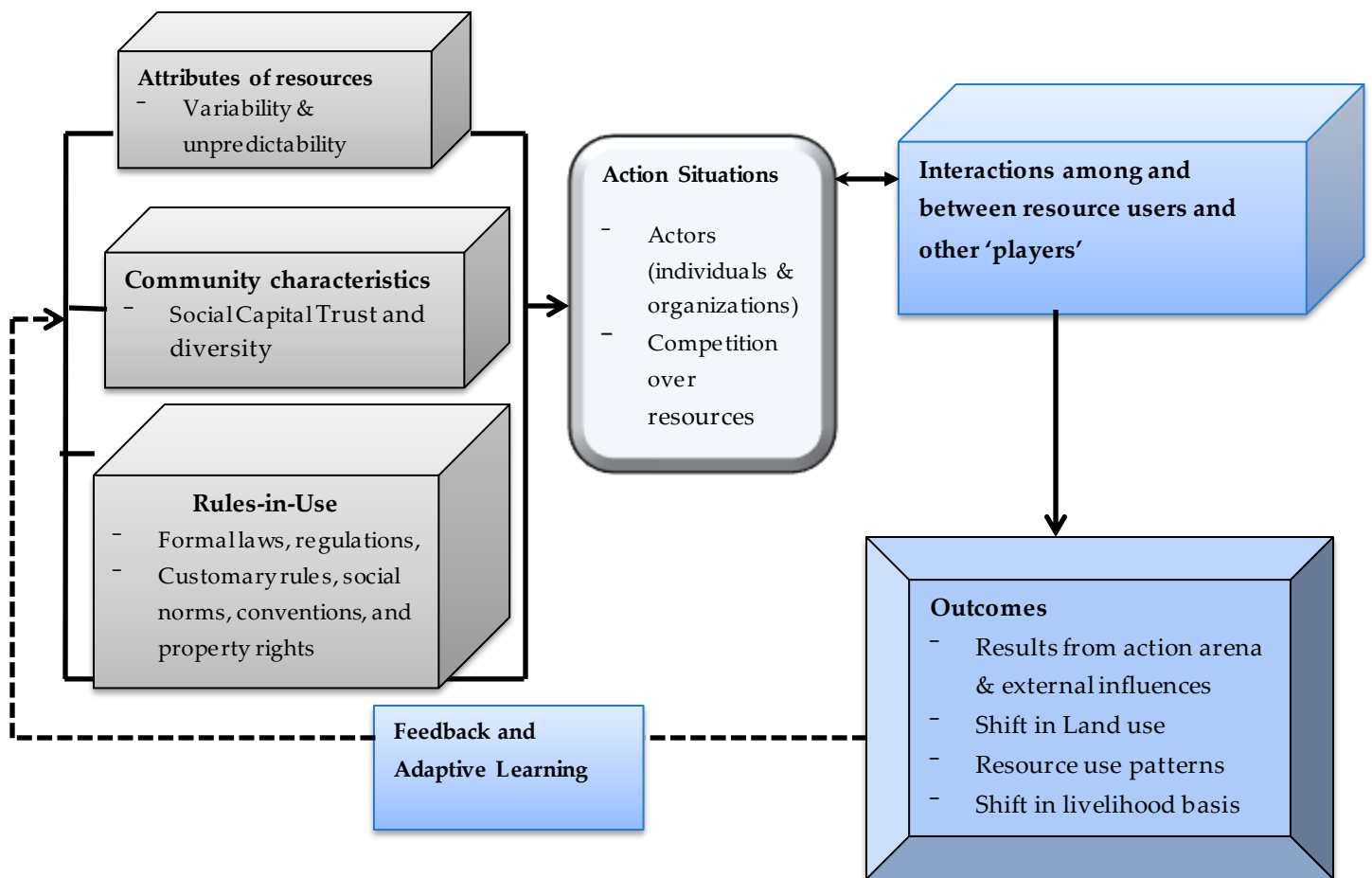


Figure 5 Conceptual Framework, Adapted from Ostrom, 2011

As shown in Fig 5, understanding the characteristics of resources under question also determines the effectiveness of governance systems. According to Ostrom (1990) resources can be classified as a private, common pool, and state property resources on the base of their attributes. As noted by Ostrom (1990) and Heltberg (2002), these attributes of resources include the possibility of exclusion, i. e., the feasibility of access control and the nature of consumption, and whether the consumption of a good or the use of a service is subtractive or joint. Common pool resources are characterized by difficulty of exclusion as public property resources; and that use is subtractive in private property resource i.e. use diminishes or limit the resources for other users (Ostrom, 1990; Heltberg, 2002; Pandey *et al.*, 2017).

Worth noting, the attributes of resource users greatly matter the sustainable governance of human-environmental interactions (Ostrom *et al.*, 2007). The social capital is one of the characteristics of resource users and a vital ingredient for effective common governance regimes through generating trusts and reducing opportunistic behavior (Agrawal, 2003; Cleaver, 2005). Social capital can broadly be understood as a kind of trust, mutual understanding and shared values that allows diverse participants to work together towards collective outcomes (Huppé and Creech, 2012). It is claimed that social capital enables people to participate in effective local decision making in common resource governance structures through impacting the incentives to cooperate, to obey resource management rules and to include the needs of future generations in resource management strategies (Thomson and Freudenberger, 1997). Overall, as Cleaver (2007) persuasively noted, relational ties or social capital highly influence individuals' willingness to abide by collective decisions and to comply with unwritten norms of resource use and management.

Hence, understanding the dynamics of commons governance demands a critical analysis of 'action arena' (Pandey *et al.*, 2017). Action situations are social spaces

whereby individuals and organizations interact, observe information, fight over resources, solve problems and select actions (Ostrom, 2011). The interactions of actors are influenced by all aspects of the social, cultural, institutional, and physical environment that set the context within which an action situation is situated and therefore, determine the effectiveness of institutional arrangements (Ostrom, 2011; Pandey *et al.*, 2017). Actions situations are governed by rules (Ostrom, 2011). In the Borana context, due to external interventions, especially through formal administration set up and hence, boundary rules were interrupted.

Commons governance involves webs of polycentric governance encompassing various and highly inseparably interlinked levels of decision-making process both on horizontal and vertical scales that shape their management (Pandey *et al.*, 2017). Thus, the establishment of effective rangelands governance involves capturing of various roles of multiple actors, their interactions and coordination. The study employed these conceptual perspectives to investigate customary institutional arrangements and their roles in rangeland governance process in Borana pastoralist communities.

2.5.3. Emergence of Adaptive Governance

Under this section, the emergence of the concepts of adaptive governance is briefly discussed. The conception of adaptive governance essentially emerged from system thinking dynamics. The notion of adaptive governance was introduced due to failure in science based and centralized resource management process mainly stemmed from the Tragedy of the commons thesis which gave little or no emphasis to the complexity and uncertainty in SES dynamics and interactions (Olsson *et al.*, 2004). As a critique of this conception, scholars emphasize on importance of integrated and holistic approaches to natural resource management such as adaptive management, co-management, adaptive

co-management and integrated natural resource management sharing similar features and proposing the participation of stakeholders (Hatfield et al., 2007).

The problem of uncertainty and complexity presents the major challenge in environmental management (Folke *et al.*, 2005; Levin, 2013). Beyond the notion of stakeholders' participation, the core argument of the adaptive governance rests on the understanding of complex SES dynamics to deal with changes and uncertainties and therefore, adaptive governance employs the SES frameworks and approaches (Folke et al., 2005).

Adaptive governance can be defined as flexible and learning-based collaborations and decision-making processes involving multi-actors (both governmental and non-governmental), often at multi-scalars, with the aim to adaptively negotiate and coordinate management of SES (Folke et al., 2005; Schultz et al., 2015). Adaptive governance is therefore, a collaborative process for continually improving the institutional arrangement and management policies and practices by learning through continuous feedback to adaptively respond to perturbations and uncertainties (Schultz et al., 2015). One of the key features of adaptive governance is that it pays greater attention to continuous learning process, understanding of the SES dynamics, nurturing of trust, reflection of procedures and structures, and developing collaboration toward common goals (Hatfield et al., 2007).

2.5.4. Governance through Network

Network governance is gaining attention due to apparent failures to govern complex environmental problems by mono-centric approach. The network governance attempts to integrate various government and non-government actors and their respective expertise and resources to adaptively respond to complexity in SES dynamics. Network governance can be defined as relatively stable horizontal articulation of interdependent,

but operationally autonomous actors who interact with one another which facilitate learning process and knowledge and resource sharing to contribute to collective action (Torfing, 2005; Head, 2008; Newig *et al.*, 2010).

The main idea behind is that no single actor can solve a wicked environmental problems and hence, actors in the system starting from community to government and non-government should come together; define the problem to have common understanding, identify their roles and responsibilities and act accordingly (Newig *et al.*, 2010). Network governance create spaces for multiple actors to put their interests to see the problem from differing perspectives, to access information/knowledge and resources from multiple sources and to coordinate collective action which paves the ways for adaptive governance (Torfing, 2005; Head, 2008).

As summarized by Bodin and Crona (2009), if we able to create space for network governance, rangeland resource governance would benefit from agreeing on common rules and practices, coordination usage, engaging in conflict resolution, negotiating various tradeoffs, sharing information and resources and building common knowledge. In related front, with increasing emphasis on adaptive governance, understanding the impacts of social network structures on the effectiveness and capacity of governance structures in managing for SES resilience is getting its momentum.

2.6. Integrated conceptual framework of the study

As discussed under section 2.4.2, the resilience or vulnerability of any SES essentially depends on the nature, characteristics and magnitude of the stresses or disturbances (both environmental, for example severity of drought and socio-political, for example, land tenure insecurity), the sensitivity of the system to these stresses and capacity of the system to respond to them. The sensitivity of the system and exposure are inseparably linked (Adeger, 2000).

Both human and ecological systems respond to the disturbances, but this study mainly focuses on understanding human system response process. It is also worth mentioning that the perturbations may stem from human or ecological systems. As illustrated in Fig. 6, a SES with a given sensitivity is exposed to external sociopolitical and environmental perturbations which disturb the nature of linkage or interconnections between human and ecological systems. The human element of the system reacts to these stresses based on its coping and adaptive capacities. To distinguish the terms adaptive capacity and coping capacity, coping capacity mainly deals with the ability of the system to respond in the short run, while adaptive capacity involves strategies which aim at producing sustainable solutions in the face of changes.

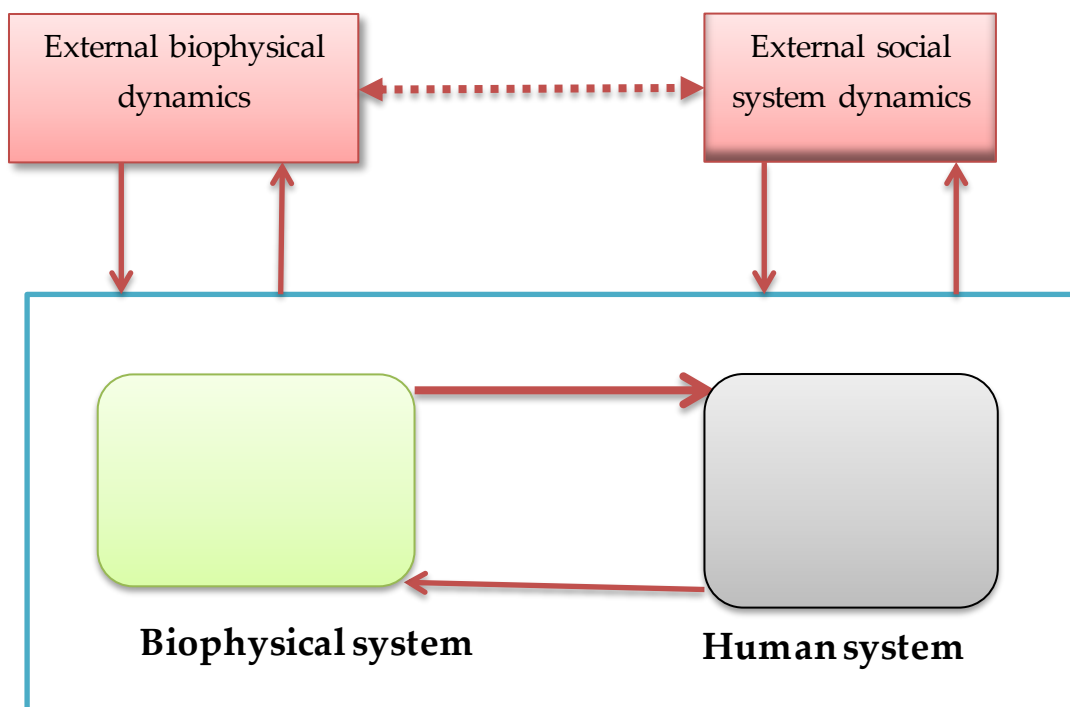


Figure 6 Conceptual framework of the study

Source: Own sketch

The adaptive capacity of the system is determined by many factors availability resources, effectiveness of institutions and governance, collaborative processes, actors'

networks, learning and knowledge transfer etc. High coping capacity of the system contributes to the development of adaptive capacity in the long run. Low coping capacity also leads to the deterioration of long term adaptive capacity and vulnerability of the system and ultimately leads to total collapse of the system. A system with a higher adaptive capacity can develop sustainable adaptation strategies which increase the resilience of the system. This dissertation research focuses on understanding the ongoing rangelands SES process and how these processes influenced the vulnerability/resilience of the Borana pastoral system. At the same time, the study aimed at examining the human responses to the changes, and linking the concepts of resilience to network forms of governance or collaborative governance.

Chapter Three: Research Methodology

3.1. Introduction

This chapter presents an overview of the research methodology used for this study. This study was motivated to understand pastoral SES transformations and rangeland governance system. Toward this end, qualitative research and quantitative household survey were conducted. To understand network forms of rangeland governance social network analysis was carried out. Section 3.2 starts with the description of study locations. The overall research design and underlined philosophies that influenced the research methodology were outlined under section 3.3. This is followed by the descriptions of sampling procedures and techniques followed to select both study areas and survey respondents under section 3.4. Finally, section 3.5 deals with data analysis used for each research questions.

3.2. The Study Location

3.1.1. Borana Zone

The study was conducted in Borana rangelands, southern Ethiopia. The Borana zone is the largest of 20 administrative zones within Oromiya regional state. It is located between 3°36 – 6°38'North latitude and 3°43'- 39°30' East longitude and borders Kenya in the South, Somali Regional Government in the East, and the Ethiopian highland districts in the north. The Borana rangelands cover an area of about 50,000 km² (out of 63,939 km² total area) of which 75% consist of lowland (below 1500 m.a.s.l.) and frequently exposed to droughts. The Borana's total population is estimated to be 1,192,649 in 2014 (CSA, 2015) of which more than 90% of the population still inhabits rural areas.

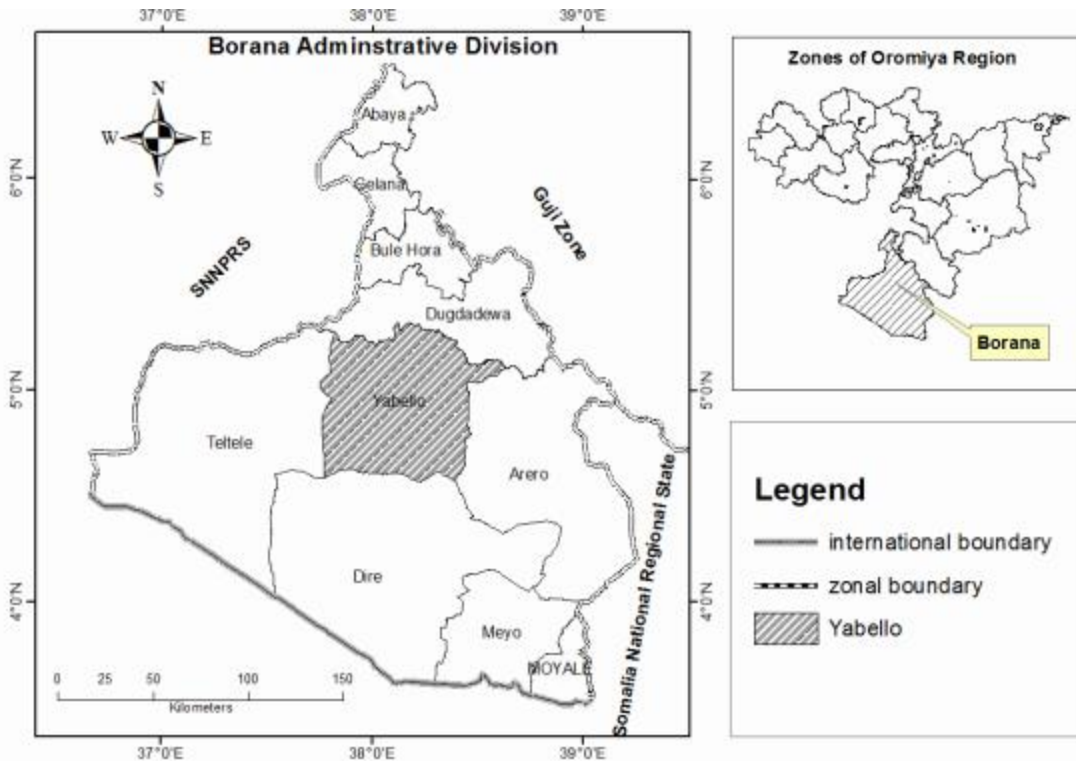


Figure 7 Map of Borana Zone

Source: Degefa (2018)

The Borana rangelands are characterized by an arid and semi-arid climate, with pockets of sub-humid zones. The average annual rainfall varies between 350 mm and 900 mm with a considerable variability of 21 to 68% among years (Lasage *et al.*, 2010). Rainfall is bimodal, with 60% of the annual rainfall occurring between March and May (main rainy-season) followed by a minor peak between September and November (small rainy-season). The long term variability in the quantity and the distribution of the rainfall results in recurrent droughts. In the past, droughts lasting several years occurred approximately once in 20 years and isolated dry years (< 400 mm) once in five years (Coppock, 1994). Recently, the period between droughts has decreased to 5 years, and the latest drought was observed only 3 years after the previous one.

The topography in the Borana rangelands is distinguished by plain rangelands, intersected with occasional mountain ranges, volcanic cones and depressions, and an altitude between 750 and 1,700 m.a.s.l. They are dominated by tropical savannah vegetation, with varying proportions of open grasslands, and perennial herbaceous and woody vegetation (Alemayehu, 2002). Cossins and Upton (1988) classified the Borana rangelands into four ecological zones of different potential grazing capacity; high potential savannah in the northern part, bush land with high shrub cover in the central area, medium potential grassland in the east and volcanic areas in the west.

Evidence suggests that nowadays ecological degradation has become a major threat to the Borana rangelands. Cossins and Upton (1988) estimated that in the beginning of 1980s one third of the rangelands were degraded, mainly in the dry season grazing areas where high stocking densities prevailed over extended periods. Coppock (1994) specified that since the 1980s, significant woody species encroachment and the subsequent extinction of preferred plant species has occurred and that in the early 1990s already 40% of the area were affected.

Similarly, Gemedo (2004) estimated a 52% increase in bush cover following the official ban of traditional rangeland management systems such as fire. The main woody plants species causing the encroachment problems are, among others, *Acacia drepanolobium* (whistling thorn), *Acacia mellifera*, *Acacia seyal* and *Tarchonathus camphoratus*. The condition of bush encroachment is viewed as the process of desertification, climate change and altered traditional rangeland management systems (Sileshi, 2006; Alemayehu, 2002).

Pastoralism is the dominant economic activity in the Borana rangelands. The Borana pastoralists are traditionally specialized in cattle production. Coppock (1994) highlight the high productivity of the Borana cattle production system as a result of high stocking

densities and a high productivity per animal. It means that the livelihoods of Borana pastoralists are highly dependent on livestock production. Livestock production is essential for household food security since the pastoralists use their products directly and to exchange them with other household commodities. In addition, livestock are the most important source of income and widespread form of asset accumulation, particularly assets used as hedges against risk and disaster (Hesse and MacGregor, 2006).

Livestock populations in the Borana rangelands are dominated by cattle, and small ruminants are secondary (Cossins and Upton, 1988). Rearing dromedaries has expanded since the 1990s, after the governmental change induced a period of ethnical warfare, followed by heavy droughts. Homann (2004) estimates the current herd composition in TLU as of 90% cattle, 4% small ruminants and 4% dromedaries. Desta (1999) noted that the ratio of livestock per person has declined within the last 15 years from about 4.1 TLU to 2.25 TLU per person. This indicates a major decline in welfare for many households below the minimum food security (Coppock, 1994).

The Borana pastoralists in Southern Ethiopia have a well-established traditional system of range and water management (e.g. Legesse, 1973; Tache and Irwin, 2003; Ayana and Oba; 2007; Homann, 2004). They developed strong indigenous institutional structure which determine the access, maintenance and rehabilitation of the water and range resources (Homann, 2004). Mobility was also a well-organized strategy by the Borana pastoralists, to make better use of the scattered rangelands resources (Coppock, 1994). These processes are governed by complex indigenous institutions and common property regimes (Homann, 2004; Helland, 2006). The Borana pastoralists developed important mechanisms for risk mitigation and conflict resolution (Cossins and Upton, 1988; Coppock, 1994). However, today rangelands resource management in the study area is under increasing pressure from competing land use systems, encroachment of

woody plants, ambiguity in land tenure system, ecological change (due to changes in management systems), increasing sedentarization, and shrinking area of pasture due to regional border changes (Boku, 2000, Gemedo *et al.*, 2006; Helland, 2006).

3.1.2. Description of Yabello district, a case study area

In consultation with regional and zonal level experts, Yabello district was selected as case study area based on existence of the cases of the research and manageability within time and budget limits of the study. Yabello district is one of 13 districts located in the Borana Zone encompassing a total area of 5556.7 km². Yabello district is characterized mainly by lowlands and hills. It lies between 1350 and 1800 meter above sea level. Obida highland and El-wayaa lowland are the major features in the district. There are no known rivers and streams in the district, except traditional wells and ponds. Unfortunately, there is no perennial river that crosses the boundary of the study area.

The land use system in Yabello district is steadily changing. According to the Yabello district Pastoral Development Office (2017), the land use and land cover type in the district is characterized as cultivated lands (17, 063 hectares), grazing lands (292,028 hectares), natural forests (39,129 hectares), arable lands (11,971 hectares), degraded lands (2,272 hectares), and others such as wood lands, shrub lands and swamp lands (192,537 hectares).

The mean annual temperature which was recorded at Yabello, Surupha and Dhedhertu stations is 18.9 °C, 20.03 °C, and 20.14 °C respectively. The mean annual rainfall at the above stations is 605mm, 711mm, and 684mm respectively. During the period from 1980-2004 the mean annual rain fall for the nearest stations was 478mm year⁻¹. Besides, the area is characterized by droughts, occurring every five years (Coppock, 1994). Based on current administrative demarcations, the district comprises 18 lowest administrative units called kebeles from which 8 kebeles mainly depend on pastoralism. The

remaining 10 kebeles, with increased pastoral household's involvement in crop farming, were largely inhabited by agro-pastoralists.

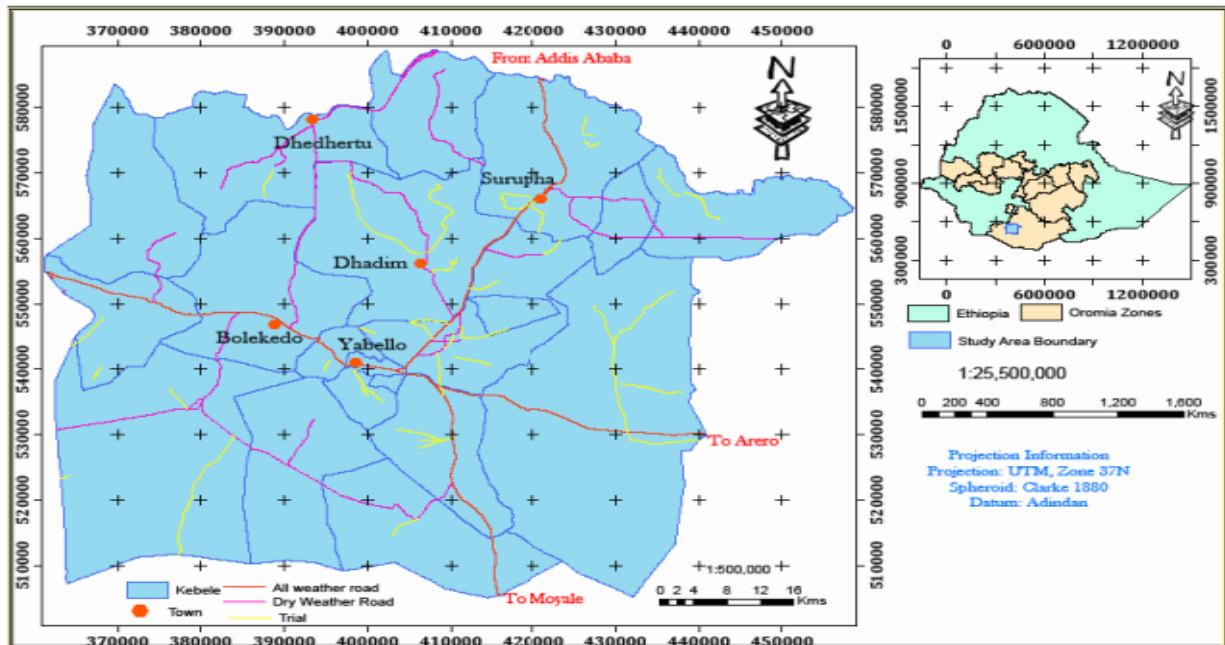


Figure 8 Study location

Source: Dessalegn et al. (2013)

According to Oromiya Livelihood Profile of Borana Zone (2006), Yabello district is situated at the heart of Borana-Guji Cattle Pastoralist Livelihood Zone. As elsewhere in the zone, the livelihood of the district population heavily depends on cattle production. With changing environmental conditions, other livestock species such as camel and goat are currently kept by many pastoral households. The data of livestock population estimated by the Yabello Finance and Economic Office (2015) showed that there were 265,897 cattle, 44,042 camels, 222,779 goats, 6,646 donkeys, 833 mules, 106 horses in Yabello district. Regarding the opportunistic crop farming, Maize, teff, wheat, barley and haricot bean are widely grown in the case study area.

3.3. Philosophical Underpinning and the overall research design

This section presents the basic school of thoughts that guided the overall research process and the selection of research methods. It is widely discussed that the scientific inquiry process, approaches, and instruments to be utilized is derived from the research premise/philosophy. In social science scientific inquiry, there are several classifications of paradigms informed by philosophical assumptions about the nature of social reality or what do we believe about the nature of reality (ontology) and ways of knowing (epistemology) (Patton, 2002). Broadly, these paradigms influencing the design of social researches can be categorized as positivism, constructivism, and realism.

The positivism emerged from natural science and it holds that the quantitative methods and techniques used in the natural sciences research offer the best framework for investigating the objective social realities (Mertens, 2009). According to proponents of the positivism views, objects around us have existence and meaning, independent of our consciousness of them and the scientific method is the only way to establish the truth and objective reality (Crotty, 1998). Methodologically, positivists recommend the use of quantitative research designs such as experimental, quasi-experimental, correlational, causal-comparative, quantitative and randomized control trials research employing data gathering tools including questionnaires, observations, experiments and tests (Crotty, 1998; Dash, 2005).

However, most social realities, such as customs, norms, institutional arrangements, perceptions, and many others are a social construct and subject to different interpretations and cannot be easily and precisely measured using quantitative approaches. As a result, the second paradigm known as constructivist has emerged. The core argument of this paradigm is that social science is constructed based on experiences, memorization, and expectation (Crotty, 1998). Ontologically, the

constructivist believes that the social reality is socially constructed (Mertens, 2009) and therefore, human mind dependent and embedded in the social and cultural realms. As such, social reality is limited to specific context, space, time and individuals or group and cannot be generalized into the common reality (Kempton, 2017).

Constructivists believe that knowledge or reality is subjective, as it is embedded in the social realms and human minds. Put it differently, the truth is culture-bound, experience, historical and context-dependent (Dash, 2005; Mertens, 2009). In recognition of the assumptions of the multiplicity of realities, the constructivist paradigm follows qualitative research process that begins with no pre-established research questions but to be developed in the progress of the study (Mertens, 2009). The research designs followed by the constructivists include ethnography, phenomenology, biography, case study and grounded theory (Kawulich, 2011).

In responding to limitations of both positivist and constructivist paradigms, a new line of thought, realism which is striking a middle ground between the two has emerged. The core argument of the realism school of thought is that the real world exists independent of a particular observer (Mingers et al., 2013). In standing against the positivist paradigm, the realism school of thought opposes the views that see social realities can be empirically observed and measured. It also opposes the constructivist view that reduces the social reality into human knowledge and experience of it (Kempton, 2017). According to realism, there are various forms of knowledge-physical, social and conceptual having different ontological and epistemological characteristics and recognizes that human capacity to access this social reality is very limited and affected by our perceptual and theoretical lenses. This paradigm recommends the integration of different research methodologies and methods and two-way iterative processes between an abstract (theoretical review) and the concrete (field work) to capture the social reality (Sayer, 1992).

Grounded on this background, this study followed realism oriented research approach and processes because it allows the researcher to employ mixed methods of both quantitative and qualitative methods. It is also suggested that realism oriented research can be useful in understanding SES dynamics (Bhaskar, 2010).

For this study, therefore, in operationalizing the realist-oriented approach, a mixed type research design involving both quantitative and qualitative approaches was employed. The study utilized a variety of methods and techniques such as institutional and household survey, focused group discussions, policy document reviews, in-depth key informant interviews across all governance scales, and published and unpublished materials from reliable sources that helped the researcher to triangulate the data sources and validate the data and allowed the researcher to fully understand the research problems (Cresswell, 2003; Hesse-Biber, 2010).

As suggested by realist oriented social science research, the research passed through the iterative process of abstract conceptualizations of the relationship between pastoral SES vulnerabilities and rangeland governance using the lenses of SES resilience and environmental governance. Then the researcher went to the field to collect the data and then returned from the field and spent a lot of months analyzing the field data and in consulting with related literature. The detail of the specific research design will be discussed in the subsequent section of the paper based on the objectives of the study.

3.4. Sampling Procedures

Given the limited budget for the study, it was decided to focus on one district and Yabello district was selected as a case study based on intensive consultations with zone level experts. Yabello district represents the core of Borana pastoralism system and the cultural sites of the Gada system which govern the overall rangeland resource use (Ayana and Oba, 2007). The *Gada* system is Borana society's traditional institutional

structure that governs every facet of life, providing the “rules of the game” for normal times as well as times of stress (Debasu, 2013). Development interventions such as the establishment of ranches, intensification of cropping, curtailment of mobility, etc. are intensive in this district. This area is being affected by both climate change and socio-political stresses. These factors were considered in sampling the Yabello district. From 18 *kebeles*, six pastoralism dependent *kebeles* were selected in consultation with various stakeholders to capture diverse socio-economic situations in the study area. In selecting *kebeles*, systematic purposive sampling was used to capture variations in the district as much as possible. Following Tache (2008), clusters within *kebeles* were selected randomly using a lottery method.

According to the data obtained from Yabello district Pastoral Development and *kebele* administrations’ Offices, 80 to 100 households dwell in each clusters or encampment. In order to determine the sample size, the formula below was adopted following Kothari (2004).

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N - 1) + z^2 \cdot p \cdot q}$$

Where, n is the desired sample size for the study; Z is the upper points $\frac{\alpha}{2}$ of standard normal distribution at 95% confidence level, which is equal to 1.96; e is acceptable error at a given precision rate (assumed 5%); p is the proportion of households most conservative case that ‘n’ will be the maximum and the sample will yield at least the desired precision; q is 1-p; N is the total households in selected clusters or encampment. The formula yields a minimum of sample size of 192. These households were selected using systematic random sampling; every fifth household was sampled based on an identified sampling frame during site selection and the process of pre-testing of survey instruments. The sampling frames were identified in

consultation with both *kebele* administrations and customary authorities, especially 'Abba Olla', literally father of cluster. If the systematically selected household heads were absent or refused to respond, they were replaced by the next household head in the sampling frame.

It was planned to interview 200 respondents, however, only 186 household heads fully responded to the interview schedules. To some extent, security problems arose due to political uprising throughout the Oromia region during the survey period added some inconveniences and challenges in the process of data collection. For the purpose of key informant selection, random walk and snowball sampling techniques were employed until saturation of information was reached.

3.5. Data sources and data collection methods

To achieve the objectives of the research, both primary and secondary data were used for this study. As noted in the section 3.3, employing a single data collection instrument is insufficient to generate reliable and adequate data. Given, this study was influenced by the realism paradigm, a mixed method of data collection tools were employed to collect both quantitative and qualitative data including document review, analysis of secondary data, and primary data collection via key informant interviews, focus group discussions, household interviews and participant observation. The brief descriptions of the methods used are given below.

Document Review

For the present study, documents from various sources were used. To understand the drivers of pastoral system vulnerability and the scene behind the pastoral development policy process and rangeland governance system, different documents from different sources were reviewed throughout the study period. Based on their sources, these documents can be categorized into three groups. The first groups were scientific

publications, books and dissertations on related issues such as pastoral systems' vulnerability and rangeland SES governance and many other relevant issues. The second sets were policy and law related documents on the areas of pastoral development, rangeland management, and land tenure arrangements. Thirdly, various planning and reporting documents collected from different organizations, federal to district administrative levels were consulted. Rainfall and temperature data were obtained from Ethiopian National Meteorological Service Agency (Unpublished raw data).

Household Survey

The household survey was conducted using pretested semi-structured interview schedules via face-to-face interviews with a total of 186 household heads from October to December 2017. The interview schedules were designed to generate both quantitative and qualitative data pertaining to the socio-economic and demographic characteristics of respondents. The interview schedule was translated to local language, Afan Oromo, so that enumerators would understand the questions. Four enumerators fluent in Afan Oromo were recruited from localities and trained on the purpose of the research, the concept and essence of each question, ethics and procedures of the interview, and method of administering the survey.

All the interviews were conducted at a convenient time and place for the respondents. Prior to the interview, the respondents were introduced with the overall goal of the research and they were requested for their consent. However, due to hot political uprising during the survey period, respondents were suspicious about the aim of the research assuming that it was politically motivated. To reduce the barriers related to mistrust, the researcher took time to explain and confirm that the purpose of the research as only for academic purpose.

Key informant Interviews

To supplement quantitative analysis, qualitative information was generated using Key informant interviews. Key informants are individuals who are relatively knowledgeable and experienced on a certain issue at hand (Cresswell, 2003). For this study, a total of 22 key Informants (taking on average 1 hour) including elders and customary leaders, experts at various levels, national, regional, zone, district and kebele officials were contacted to get detail information on the effects of environmental and socio-political changes, emerging adaptation strategies, rangeland governance collaboration, and triangulate the generated information and supplement household survey in elaborating information obtained from the household survey and the document reviews. In order to guide the key informant interviews, pre-prepared checklists were used, however, the checklists were remained flexible to accommodate newly emerging information.

Focused group discussion (FGD)

A FGD is a form of qualitative research method that involves a gathering of people with similar backgrounds or experiences together to discuss a specific topic of interests and allows the researcher to get detail information in short period of time (Dash, 2005). As an advantage, it allows the participants to reflect or react to the viewpoints of other. In this study, a total of 6 FGDs (one at each sampled *kebele*) consisting of 6 to 8 participants were organized and led by researcher in a loosely structured discussion of various topics of interest such as the role of customary rangelands resources management institutions and structures, the interaction of customary resources management institutions with recent government development policies and interventions, rangeland resource dynamics, rangeland resources, climate change/variability related challenges, adaptation strategies, use and control dynamics and emerging challenges pertinent to customary institutions. The courses of the discussions were guided by checklist and

outline to ensure that all topics of interest are covered. The FGDs and key informant interviews were recorded using a tape recorder and transcribed later. Comprehensive interview notes were also taken.

Observation

In order to gain better insight into the pastoral setting, the researcher visited the study areas for 10 days and held extensive discussions with zone and district level experts. This was intended to observe and capture the general picture of pastoral setting. In the course of all the data collection process, the researcher was able to learn several issues related to the research agenda by observation. The new insights that emerged from observation were used to guide key informant interviews and FGDs in seeking detail information on the issue. The information generated from the observation was also used to reshape household survey instruments.

3.6. Method of Data Analysis and Presentation

The collected quantitative data were analyzed using both descriptive statistics and econometric models, binary logit models. Descriptive statistics, such as mean, percentage, frequency distributions were used to summarize the data. The data collected with qualitative instruments were subjected to in-depth analysis iteratively and narrated based on theoretical and conceptual frameworks. As the nature of qualitative research demands on spot analysis, the synthesis of field notes and labeling of tape records were undertaken in every evening during field work to avoid the missing of relevant data. Then the transcribed data were thematically classified and analyzed to explore the associations and distinctions among themes as they arise in the data through coding, technical memos, and diagrams to systematically scrutinize the data (Stephan et al., 2010). Below are the descriptions of data analysis techniques for each research question.

3.6.1. Rangeland ecosystem dynamics

This study relies on the Borana pastoralists' knowledge to generate information on the dynamics of rangeland resources in the study area. The use of indigenous knowledge is increasingly being used by rangeland ecologists to investigate changes in ecological systems (Kgosikoma et al., 2012). In order to assess rangeland conditions, 13 indicators of vegetation cover and soil conditions of rangelands were selected based on consultation of the related literature and discussions with key informants, particularly, rangeland experts from Yabello Pastoral and Drylands Agricultural Research Center. These indicators include decrease in vegetation cover or yield, decrease in grass diversity, decrease in a proportion of palatable plants, increase in a proportion of poisonous plants, increase in bush encroachment, decrease in height of grass, decrease in ground cover, increase in bare lands, increase in soil salinity, decrease in soil fertility, increase in pest damage and decrease in water availability.

Following Behmanesh et al. (2016), a qualitative Likert five-point scale (strongly disagree, disagree, the same, agree, strongly agree) was used for scoring rangeland degradation indicators. The respondents were asked to reply in terms of the extent to which they agree, to series of statements about stated rangeland degradation indicators. Then, the mean rates of the respondents were calculated and presented using spider graph.

3.6.2. Pastoral household Vulnerability Analysis

The pastoral household vulnerability to climate variability/change stressors in the study areas was analyzed by using an integrated vulnerability assessment approach. Many literatures (Turner *et al.*, 2003; Deressa *et al.*, 2008) suggested that integrated vulnerability approach is superior over other approaches. The vulnerability index was constructed at the household level using selected indicators. Once vulnerability index

was calculated, to identify the determinants of household vulnerability, the ordinal logistic regression model was employed. The detail steps of data analysis were discussed hereunder.

Index computation

Selecting indicators is very critical steps in constructing meaningful vulnerability index, because the selection of wrong indicators may lead to the construction of poor and invalid index (Piya et al., 2012). In this particular study, indicators of exposure, sensitivity and adaptive capacity were selected based on a review of related literature and to lesser extent consultation of experts to validate the indicators. To this end, based on vulnerability conceptualization discussed under section 2.4.2, various social, economic, and environmental indicators were selected to estimate vulnerability at the household level. Once the indicator variables were identified, the vulnerability index was generated by aggregating the indicator variables. To obtain weights for indicators, Principal Component Analysis (PCA) was applied. PCA is a non-parametric statistical method used to extract the linear combinations that best capture the information from a large group of variables (Kaiser, 1960). PCA can be used to generate composite indices is by using the “eigenvalue-greater-than-one” rule which states that there are as many reliable factors as there are eigenvalues greater than one (Cutter et al., 2003). To calculate the vulnerability index, it was assumed that all variables carry equal weights.

Following IPCC (2007), Derresa *et al.* (2008), Gutu (2013) and Opiyo *et al.* (2014) the vulnerability index (VI) can be defined as follows:

$$\text{Vulnerability} = \text{Adaptive Capacity} - \text{Sensitivity} - \text{Exposure} \dots\dots\dots (1)$$

This model can be written as:

$$V_i = (A_1X_{1j} + A_2X_{2j} + \dots + A_nX_{nj}) - (A_{n+1}Y_{1j} + A_{n+2}Y_{2j} + \dots + A_{n+n}Y_{nj}) \dots\dots\dots(2)$$

Where

V_i is vulnerability index

X_s are elements of adaptive capacity, and

Y_s are elements of exposure and sensitivity.

The values of X and Y are obtained by normalization using their mean and standard errors. For instance, $X_{1j} = (X_{1j} - X_{1j}^*) / S_{1j}^*$, where X_{1j}^* is the mean of X_{1j} across the different households, S_{1j}^* is its standard deviation. X_1 is the principal component result of factors. A_i is the Weight obtained from first principal component scores of variables. The first principal component of a set of variables is the linear index of all the variables that captures the largest amount of information common to all the variables.

PCA was run for the selected indicators of exposure, sensitivity, and adaptive capacity separately using Statistical Package for Social Science (SPSS) software version 20. Arithmetic relationships between multiple indicators of adaptive capacity, sensitivity and exposure assigned to develop aggregate vulnerability indices. The loadings from the first component of PCA are used as the weights for the indicators.

3.6.3. Determinants of Adaptation Strategies

To identify determinants of some selected adaptation strategies, a binary logit model was employed. Theoretically, pastoral household response to long-term climatic variability and change could fall under the general framework of utility maximization (Wassie and Fekadu, 2016). In other words, pastoral households are assumed to make rational decision of employing adapting measure in response to climate variability and socio-political dynamics induced shocks to gain benefits over other adaptation options. In modeling adaptation strategies, many studies (for e.g. Deressa and Hassan, 2010) followed statistical approaches that consider adaptation options as polytomous response categories and most commonly employ multinomial logit models to estimate the models. Multinomial logit model is based on a strong assumption of Independence of Irrelevant Alternatives (IIA) (Abera

et al., 2011). In our data cases, we tested whether the assumption of IIA holds in our model using the Hausman and Small-Hsiao tests. However, the test results indicate that the assumption is violated and hence application of multinomial logit model is inappropriate. Hence, we have employed a binary logit model to identify determining factors of adaptation strategies identified during the field data collection. The pastoralist decision to employ an adaptation strategy based on the assumption that it generates benefits can be modeled as a binary response outcome (Wassie and Fekadu (2016). The underlying response behavior in this case can be represented by unobserved (latent) variable (A_i^*) capturing the expected benefits from the adaptation choice with respect to not adopting. It can be specified as:

$$A_i^* = X\beta + \varepsilon, A_i = 1 [A_i^* > 0] \dots \dots \dots (1)$$

The observed adaptation option $A_i = 1$ if $A_i^* > 1$, and 0 otherwise. The vector X broadly represents different groups of explanatory variables corresponding to household demographic, economic, social and institutional support services. Where β denotes a vector of coefficient and ε represents the corresponding random errors. In this study, the logit model was selected to examine factors determining the use of adaptation strategies because of its simplicity over other options, but still meeting the objective of the study. The data analysis was conducted using the Statistical Package for Social Science (SPSS) software version 20.

Following Gujarati (2004), the functional form of logit model is specified as follows:

$$P_i = E(Y = 1/X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_i)}} \dots \dots \dots (2)$$

For ease of exposition, we write (1) as:

$$P_i = \frac{1}{1 + e^{-Z_i}} \dots \dots \dots (3)$$

The probability that a given household uses adaptation measures is expressed by (3) while, the probability for not using is:

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \dots\dots\dots (4)$$

Therefore we can write:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} \dots\dots\dots (5)$$

Now $(P_i/1-P_i)$ is simply the odds ratio in favor of using adaptation measures. It is the ratio of the probability that the pastoral households implemented the adaptation measures vs. the probability that the household will not adopt it.

Finally, taking the natural log of equation (5) we obtain:

$$L_i = \ln \left[\frac{P_i}{1 - P_i} \right] = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \dots\dots\dots (6)$$

Where P_i = is a probability of using adaptation strategy ranges from 0 to 1

Z_i = is a function of n explanatory variables (x) which is also expressed as:

$$Z(i) = \beta_0 + \sum \beta_i x_i + U_i \dots\dots\dots (7)$$

β_0 is an intercept

β_i = are slopes of the equation in the model

X_i = is vector of relevant household characteristics

Definition of Working Variables

Potential explanatory variables included in the binary logit models of adaptation strategies were: age of household heads, education level of households heads, family size, household active labour force, total livestock holdings, livestock market distance, access to credit, membership in community based organization, access to extension services, training participation, access to climate related information and radio and mobile ownership (Table 1). The choice of these hypothesized explanatory variables

was based on review of literature on climate change adaptation strategies. Adaptation strategies used by household were used as response (dependent) variables.

Table 1 Description of Variables considered in the logistic regression models of adaptation strategies

Independent Variables	Description
Age of HH	Age of the household head in Years
Literacy	Dummy, = 1, if household head can read and write, 0 otherwise
Family Size	Number of household members
Active Labour	Number Household members aged 15 – 65
TLU* Holding	Herd size in total livestock unit
Market Dist.	Distance from livestock market in walking hour, single trip
Radio	Dummy, = 1, if household has radio, 0 otherwise
Mobile	Dummy, = 1, if household has mobile phone, 0 otherwise
Cooperative	Dummy, =1, if household is member in CBOs, 0 otherwise
Early warning	Dummy, = 1, if a household has access to climate info. 0 otherwise
Credit	Dummy, =1 if a household member received loan in last year, 0 otherwise
Extension	Dummy, =1 if a household accessed extension services, 0 otherwise
Training	Dummy, =1 if a household head participated in training, 0 otherwise

TLU: Total livestock Unit based on conversion factors: cows (0.7), heifers (0.65), calves (0.34), young male (0.54), bull/steer (1), small stock (0.1), camel (1.1), horse and mule (0.8), donkey (0.6).

Source: Computed from Household Survey, 2016

3.6.4. Social Network Analysis

3.6.4.1. Defining the network boundary

In studying social network analysis, identification of the network boundary is the first step. However, the network boundaries are largely arbitrary and subjected to the nature of research questions. The unit of analysis considered for the purpose of the social network analysis was rangeland governance system in Yabello district that can be

defined as a group of actors interacting on regular basis and influencing the path to SES resilience. Toward this end, various stakeholders involved directly or indirectly in rangeland management in Yabello district across all governance scales were surveyed.

3.6.4.2. Actors' identification process and data collection

Before discussing the process involved in identification of stakeholders'/actors' considered in network analysis, it is worth highlighting the formal institutional setup related to rangeland resource governance in the country. In Ethiopia, generally, the political administration has five tiers: national or federal level, regional states, zones, districts and kebeles. Generally, institutional setup for natural resource management and governance follows the same jurisdictions. Rangeland use is mainly governed by the Federal Democratic Republic of Ethiopia Rural Land Administration and Land Use Proclamation No. 456/2005. The proclamation provides the general framework and power for national and regional governments to set hierarchical organizational structures down to district level to regulate sustainable land use system. However, there are no formal state organizations specifically dealing with rangeland resources management.

At national level, policy issues and development interventions related to rangeland management are coordinated by Ministry of Environment, Forest and Climate Change (recently named as commission), Ministry of Agriculture and Natural Resources, Ministry of Water, Minerals, and Energy, Ministry of Federal Affairs and Ministry of Livestock and Fishery Development (currently, merged to Ministry of Agriculture and Natural Resources). At regional level, rangeland resource governance and management is shared responsibilities of Bureau of Environment, Forest and Climate Change Authority, Bureau of Agriculture and Natural Resources, Bureau of Rural Land Administration and Use, Bureau of Water, Minerals and Energy and Bureau of

Livestock and Fishery Development. The institutional structures at Zonal and district levels follow the same lines. Alongside with these state institutions, many organizations such as Research Institutes, Universities, Non-government organizations, State Enterprises and Community Based Organizations and/or customary authorities have interest in rangeland management practices.

The Ministry of Federal affairs is mandated to coordinate the overall pastoral development programs and projects in pastoral areas. However, existing reality shows that there have been poor coordination efforts. In connection with this, many argue that the intention of government is largely motivated by recognition of exerting pressure to control pastoral areas (Abdulahi, 2007). More importantly, as indicated by the key informants from stakeholders, the linkages between stakeholders institutions are quite weak at all levels of scales of management, especially between different lines of management.

To identify active stakeholders/actors involved in rangeland resources management, a combination of purposive and snow ball sampling techniques were employed. Initially, successive consultations were made with major organizations which have direct roles in rangeland governance including Borana Zone Pastoral Development Office, Pastoral Commission and Land Use and Environmental Protection offices to recommend other stakeholders actively involved in rangeland governance system. The snowball sampling method was followed until no new organizations were mentioned. The snowball sampling procedure was started from district level actors. From the local actors, 2 actors were interviewed. To avoid biasedness that may arise from the snowball sampling method in overlooking other stakeholders involved in rangeland management issues, available secondary data, specifically, policy documents were consulted to complement the initial process. Ultimately, a total of 53 actors were included in the social network analysis (**Annex IV**).

In representing the selected stakeholders, individuals in key positions such as heads and deputy heads of the organizations, planning officers and senior experts and department heads who have understanding on the functions of the organizations were interviewed. To assess the characteristics of actors' interactions, how various organizations cooperate in governing rangeland resources, the respondents were asked to identify organizations with whom their organization collaborated with on the issues of rangeland management within the last 2 years.

Besides, the respondents were asked to state the mandate and roles of their organizations. The survey was conducted as an in-person interview, in which the researcher himself asked participants questions that are relevant to generate social network data in respect to rangeland management. In the process, the researcher made appointments and completed interviews with all 53 organizations' representatives with exceptions of some organizations, particularly at federal level, the respondents were asked to fill the questionnaires by themselves. All interviews were guided by pre-tested checklists. With regard to types of data, to analyze key characteristics of network structures, quantitative data were employed. Qualitative data were also used to compliment/support the quantitative analysis.

3.6.4.3. Network data analysis

Network Structures

To assess the effectiveness of the rangeland resource governance network, analyzing the nature of actors' interactions in a network is a prerequisite (Bodin and Crona, 2009). The network structures (relational pattern) influence the behavior and actions of actors involved in the network and overall effectiveness of the governance system (Sandström and Rova, 2010). These network structural characteristics, which have strong functional implications for the resilience of the network, broadly include: number of social ties,

degree of cohesion, subgroup inter-linkages network centralization and actor centrality (Bodin and Crona, 2009).

In shedding light on how each of the network structural characteristics affect the overall performance of natural resource governance, the number of social ties, captured by network density, greatly affect the outcomes of the network governance as the more social ties tend to increase the possibilities of collaboration, mutual trust development and joint action (Sandström and Rova, 2010). The existence of higher network density also facilitate for the co-production of knowledge that are useful in SES resilience building (Bodin and Crona, 2009).

The other important structural characteristic, the level of network cohesiveness, measures to what extent the network is separated into distinguishable subgroups. Looking at its effect on the outcome of the network governance, the existence of subgroups, low cohesion, can possibly pose challenges on collaborative process among subgroups (Hannemann and Riddle, 2011). Generally, less cohesive network exhibit high density in the overall network and produce positive governance outcomes as it facilitates sharing of important resources such as knowledge and information (Bodin and Crona, 2009). It is important to note that if connectivity exists between different subgroups (bridging ties) there would be a high possibility in using external resources which in turn improves the capacity of the network governance (Crona and Hubacek, 2010). In the Borana rangeland governance, for instance, the connections beyond the subgroups potentially promote and create collaborative partnership between various types of the actors including NGOs, government line organizations, higher education and research institutes, community based organizations, and customary authorities.

The relative position and influence of individual actors, covered in the concepts of network centralization and actor's centrality, significantly affect the capacity of the

natural resource governance regime in many ways (Bodin and Crona, 2009). The level of centrality deals with the distribution of linkage among actors (nodes) in the network and their structural importance (Bodin et al., 2006). Centrality, the network centrality helps to understand which actors and how they can use their structural position and able to influence the collaborative process and how they are advantageous over the others in accessing important resources (Crona and Hubacek, 2010). Though there are multiple ways to measure network centrality, for the purpose of this study we attempted to measure two metrics: degree and betweenness centrality.

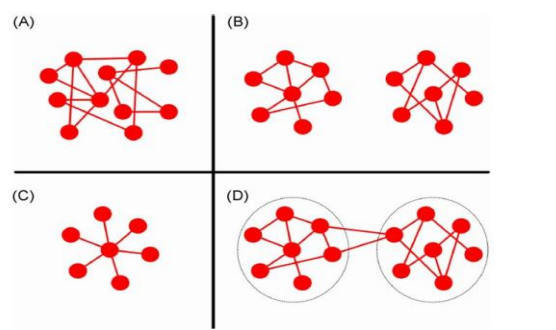


Figure 9 Schematic representation of some of network typologies

Note: (A) represents a network without any clearly distinguishable subgroups (highly cohesive), (B) Stands for networks that is divided into two isolated subgroups (low in overall cohesiveness and high in modularity), (C) presents a highly centralized network (the central node has high degrees of centrality), and (D) represents a network with two distinguishable groups which are connected by two bridging ties.

Source: Bodin and Crona (2009)

In this way, following related literature (Hanneman and Riddle, 2005; Bodin and Crona, 2009; Sandström and Rova, 2010; Prell, 2012; Scott, 2015) methods of social network analysis were used to map, quantify, and analyze the relational patterns or connection between actors in rangeland governance. Structural properties of networks, the ones described above were measured to analyze the effectiveness of network governance. Brief descriptions of the quantitative network analysis on the selected metrics are highlighted in the subsequent sections.

The network density measures the proportion of all possible ties present in a network and used as proxy of social cohesiveness (Bodin and Crona, 2009). Density is calculated by dividing the number of existing connections in the structure by the maximum number of possible connections (Scott, 2015).

$$D = \frac{l}{n(n-1)/2}$$

Where: D denotes density

l = maximum number of links

n = number of actors

The network structures in which all actors are completely connected have a density of 1 reflecting strong cohesiveness in the network structures and effective governance. However, the existence of subgroup in the network may mislead the interpretation of the whole network and the existence of various subsets of actors should be considered (Sandström and Rova, 2010). In our case, the data were clustered into 6 subgroups based on the main organizational goals and governance scales and the density of subgroup structures were examined.

To identify actors' structural position, or coordinating actors that would otherwise have limited or no connections, parameters of the network centrality was analyzed. Network centrality measures how central or well-connected an actor in a network (Sandström and Rova, 2010). It also describes the patterns of power relation and how much an actor has access to the resources in the network (Dkamela *et al.*, 2014; Angst *et al.*, 2018). For the present study, from various versions of centrality parameters, degree centrality and betweenness centrality were considered.

Degree centrality measures the numbers of direct links to and from an actor (Sandström and Rova, 2010). Degree centrality parameter helps to visualize how tightly the network

is organized around its most central point or how 'star-like' the network structure is (Bodin and Crona, 2009; Sandström and Rova, 2010; Scott, 2015). A high degree of centrality is interpreted as well-connected network structures (Sandström and Rova, 2010). In related front, to identify potential bridging actors within identified clusters, betweenness centrality scores were calculated for each actor in the network. Betweenness is the number of shortest paths from all nodes (actors) to all others that pass through one specific node (actor) (Dkamela *et al.*, 2014).

Betweenness centrality helps to quantify how much each actor contributes to minimizing the distance between actors in the network (Bodin *et al.*, 2006). It measures an actor bridging position with respect to other two actors in the network. It is the probability of an actor being on the shortest path between two points, reflecting how often a node lies on a shortest path between any two nodes in the network (Angst *et al.*, 2018). To put it another way, betweenness centrality refers the number of times an actor located between two other actors who are disconnected. An actor with high betweenness centrality is considered to have a great influence over the course of interactions, hence affect how rangeland resources governance system delivers governance assets (Hanneman and Riddle, 2005).

To identify actors playing great role in connecting actors out of the clusters, following Vance-Borland and Holley (2011), we calculated brokerage scores. All network metrics used to describe the characteristics of the governance networks were calculated using UCINET version 6.591 (Borgatti *et al.*, 2002). In order to analysis the network structure, the data were transformed into binary network measures (1 for presence of collaboration and 0 for absence of collaborative relationship). To depict actors' relationship visually, NetDraw software was employed.

Chapter Four: Customary Rangeland Governance System and Ecological Condition of Rangelands

4.1. Introduction

This chapter aimed to understand the Borana customary rangeland governance systems and trends in resource use and ecological conditions of the rangelands. In doing so, this section addresses contemporary challenges posed by pastoral SES transformations on the Borana customary resource management institutions and how the weakening of the customary institutions affected collective actions in the rangeland resource management and the overall resilience of the Borana pastoral system.

Accordingly, this chapter is organized into two major sections. Section 4.2 explores the dynamics of rangeland ecosystems and rangeland conditions based on the perceptions and knowledge of the pastoralists. Next, section 4.3 examines the role of the customary rangeland governance structures that enabled the Borana pastoral system to be one of the most resilient pastoral systems in the world in the past and the underlying challenges that contributed to the weakening of customary commons institutions.

4.2. Rangelands ecosystems dynamics as perceived by pastoralists

4.2.1. Change in land tenure structures and land use patterns

Borana pastoralists, like other indigenous people elsewhere, have accumulated elaborated knowledge and experience about rangeland management passed down through generations, justifying the importance of using aboriginal knowledge in investigating the rangeland ecosystem dynamics and degradation (e.g. Oba, 1998; Ayana, 2007; Kgosikoma et al., 2012). Historic information from elders shows that before a century, the Borana rangelands were exclusively used for extensive cattle

grazing governed by mobility between *fora*-herds and *warra*-herds. During this period, the Borana were pure pastoralists and livestock were their main source of livelihood. As one of the key informants disclosed, ploughing (digging) the land for crop cultivation was strongly prohibited by the *Gada* institutions and the land was totally managed under communal ownership structures. As highlighted in section (4.3), *fora*-herds and *warra*-herds were further subdivided into wet and dry season grazing lands mainly based on the availability of the water sources. Weak and lactating animals and calf were kept at *warra*-herds while relatively stronger animals including male and dry-caws were kept at satellite grazing areas (*fora*).

Since the 1960s, however, attributed to SES transformations-induced deriving forces, the Borana rangeland use system has experienced major shifts. The major land use changes include expansion of opportunistic crop cultivation, private rangeland enclosures, and expansion of ranches (Oba, 1998; Helland; 2006; Ayana, 2007). In line with this, the amount of farmlands and private enclosures are expanding at higher rates. According to elders, the introduction of crop farming is a recent phenomenon. It was introduced following the severe drought-induced famine the Borana experienced in the 1960s. During this period, traditionally, the Borana was under the rule of *Gada Jaldesa Liiban* (1960 - 1968) (Ayana, 2007). As the famine continued, *Gada Gobba Bulee* (1968 - 1976) the Borana pastoral households continued to adopt crop farming as a means of survival borrowing seeds from the nearby sub-humid Guji zone. The adoption of crop farming as coping and adaptation strategy further expanded following the conducive environment by the *Derg's* land proclamation of 1975 (Coppock, 1994; Oba, 1998; Ayana, 2007).

According to this survey result, currently, the majority (79%) practice crop cultivation as a source of livelihood. With regards to increasing expansion of crop cultivation, all of the survey respondents indicated that there was an increase in the size of the cropland

causing a decrease in the size of the communal grazing lands. In Borana zone, the communal grazing land converted to crop land is estimated to be about 1,332,900 ha (Pavanello, 2009). Similarly, as to the data obtained from Yabello district Pastoral Development Office (2017), the land under cultivation is estimated at 17, 063 hectares in the district and expected to increase in the future as per the government plan to promote crop farming as a means of livelihood diversification. As highlighted in section 4.4 (under pastoral policy environment), the current expansion of crop farming is strongly backed by the sedentarization policy pursued by the incumbent government. However, as discussed in section 5.6, due to the unreliability of the rainfall, the sustainability of crop farming is yet under question.

The other observed land use change in the Borana rangeland was wide expansions of private rangeland enclosures. It was initiated in responding to the scarcity of feeds for relatively highly vulnerable groups of herds such as calf and lactating cows (*Seeraa Yabbii system* (calf-grazing reserves): for detail please see section 5.6). Out of institutional innovation, these traditional calf-grazing reserves have been grown into communal range enclosures. Later on, in responding to increased dryness induced by environmental changes, it was decided to establish the communal enclosures by the Assembly of *Gumi Gayo* in 1988 (Oba, 1998). Gradually, this has led to the emergence of private and cooperative rangeland enclosures.

Presently, both the government and non-government organizations are promoting cooperative based enclosures as best practices in adapting to profound environmental changes. Besides, supported by the government land use policy that gave higher emphasis to attracting investment into pastoral areas, private enclosures in the form of ranches have widely expanded in the last years. In the Borana zone, there are reportedly five big private ranches occupying a total of 33,805 hectares of better rangelands (Oba, 1998; Tache and Irwin, 2003; Eyasu, 2008). In Yabello district alone, the rangeland taken

by the ranches development is estimated to be 16,550 hectares (Ayana, 2007). According to Oba (1998), the semi-privatization of range enclosures is likely to increase 'land grabbing', a process that has already expanded in many areas of the Borana rangelands.

Overall, the land use pattern and land tenure structures have undergone major shifts. The shift to semi-private ownership structures and adoption of crop farming and private and cooperative rangeland enclosures, in the long-run, could endanger the viability of pastoral system by weakening the customary resource management institutions, disallowing mobility practice, snatching prime grazing lands, fragmenting (sub-dividing) and degrading the productivity of the rangelands, and increasing 'land grabbing' which causes inequality in getting access to the land among the users.

4.2.2. Perception of pastoralists on the rangeland condition

The ecological transformations such as land use and cover changes are a natural phenomenon; however, the major concern is how these dynamics are contributing to sustaining or degrading the rangelands' ecosystem. This study, therefore, investigates how the social process in adapting to profoundly changing SES sustained or degraded the rangeland ecosystem and the current status of rangeland degradation based on the pastoralists' perceptions and ecological knowledge. In order to assess rangeland conditions, 13 indicators of vegetation cover and soil conditions of rangelands were selected based on consultation of the related literature and thorough discussions with the key informants. Following Behmanesh et al. (2016), a qualitative Likert five-point scale was used for scoring rangeland degradation indicators. The score for each rangeland condition indicators based on the pastoralists perceptions is presented in Fig. 9 below.

During the survey, the Borana pastoralists were asked to rate the overall current rangeland conditions (as poor, fair and good) based on their observations as compared

to the past 30 years. The large majority (89%) of the respondents of the survey considered that the condition of the rangelands to become poor and poor, while 10% of the respondents identified the current status of rangeland condition as fair (Table 2). This shows that the rangeland ecosystem is unable to respond to the change-induced forces and losing its functionality, because the pastoral system is highly dependent on the availability of natural grazing pasture (Fig. 10). The decline in the rangeland productivity condition as perceived by the pastoralists was congruent with similar studies results (Abule et al., 2005; Ayana, 2007; Coppock et al., 2017). Similar to this, during the survey, the pastoral households were asked to identify the major constraints they were facing as the livestock keepers. All respondents (100%) mentioned the scarcity of feeds for their livestock which directly related to the rangeland condition.

Table 2 Opinion of Borana pastoral households on general rangelands conditions

Rangeland Condition	Frequency	Percent (%)
Poor	167	89
Fair	19	10
Good	2	1
Total	186	100

Source: Household survey, 2016

When asked the trends of rangeland degradation over the last 30 years, nearly all (91%) the respondents reported increasing trends.



Figure 10 Extent of Rangeland Degradation

Source: Taken by the researcher during the survey

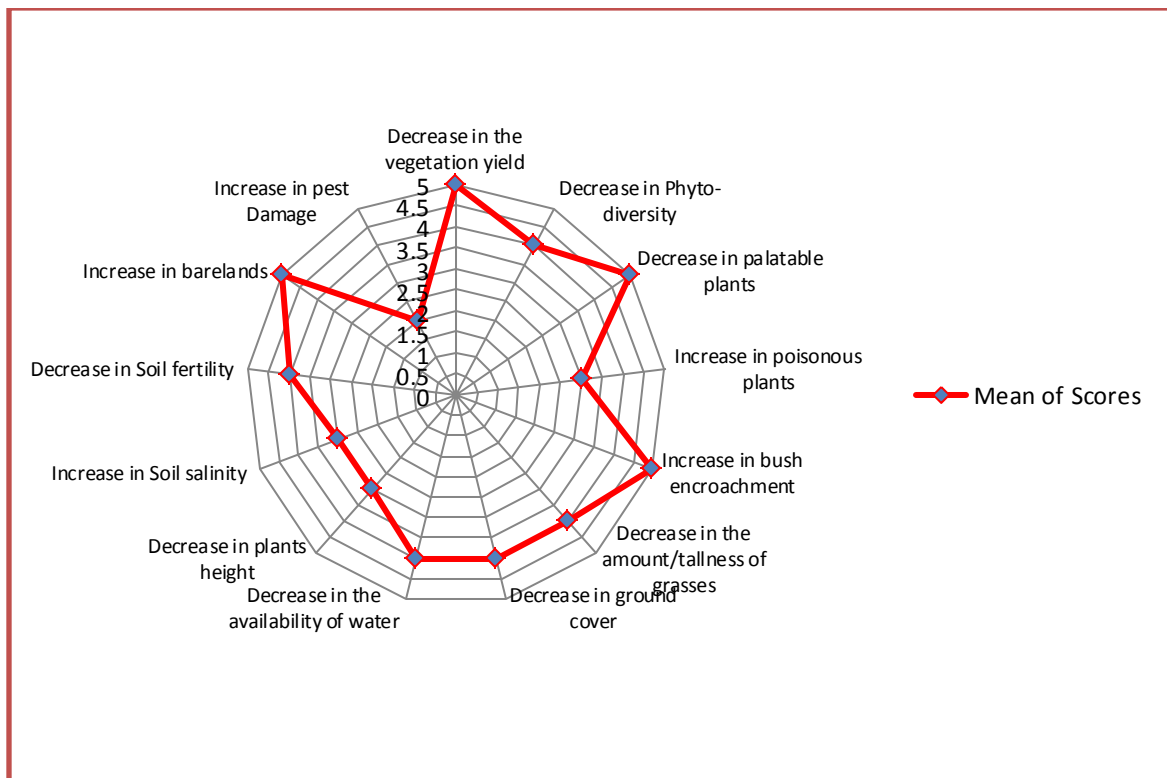


Figure 11 Perception of Borana pastoralists on the rangeland degradation indicators.

Source: Household Survey 2016

According to the assessment of the Borana pastoralists, over the last 30 years, there is a clear difference in all selected indicators of rangeland degradation. Among vegetation indicators, a decrease in vegetation yield, loss in palatable plants, extensive bush encroachment and an increase in bare grounds received high ratings (5) (Fig. 11). The findings of the present survey is in consistent with findings of many studies conducted across the country such as Ayana (2007) in the Borana, Abule et al. (2005) in the central Rift Valley and Tilahun et al. (2016) in the Afar region and Terefe et al. (2010) in Southern Ethiopia. During the survey, focused group discussants and key informants identified that bush encroachment was the major threats in the Borana rangelands causing rangeland degradation in suppressing the flourishing of the grasses and hence the productivity of the rangelands. In line with this, as the data obtained from Yabello district Pastoral Development Office (2017), the bush and shrub land covers an estimated area of 192,537 hectares in Yabello district alone. In consistent with this finding, Ayana (2007) reported that bush encroachment is threatening the productivity of grazing lands in Borana.

Similarly, pastoralists identified that the proportion of ground cover was significantly decreased indicating the loss of different herbaceous grasses or litter masses (Kgosikoma et al., 2012). Eminently, diversified grass species is better able to maintain rangeland productivity despite disturbances, for example drought, because some species will survive better than the other under the new condition (Reid et al., 2014). However, the pastoral assessment showed that the phyto-diversity of the rangeland has decreased in the last 30 years showing the deterioration of the rangeland ecosystem resilience. From edaphic (soil) indicators, a decrease in soil fertility on average scored 4 from five on the scale of the measurement. The pastoral households also indicated an increase in soil salinity in the communal rangelands. More importantly, the pastoralists

indicated that water or moisture availability was considerably decreased over the last 30 years (Fig. 11).

Overall, according to the assessment of the pastoralists, in all selected indicators, the productivity of the rangeland has showed a declined trend. The composition of the grass species had significantly changed in that palatable grass species were being replaced by unpalatable plants which can be explained by expansion of bush encroachment.

4.2.3. Perceived Causes of rangeland degradation

Regarding the cause of the rangeland degradation, the Borana pastoral households indicated that drought (91.4%), settlement (46.7%), expansion of expansion of cultivated lands (38.2%), private range enclosures (23.1%), blockage of mobility practice (20%), overgrazing (17.7%) and fire ban (15.6%) were the major factors causing the rangeland degradations (Table 3).

Table 3 Perceived Causes of rangeland degradation

Causes	Frequency	Percent
Drought and rainfall decline	170	91.4
Settlement Pattern	87	46.7
Expansion of crop cultivation	71	38.2
Private enclosures/ranches	43	23.1
Blockage of mobility	37	20
Overgrazing	33	17.7
Fire ban	29	15.6

Source: Household Survey, 2016

Drought or a decline in the amount of rainfall was the major factors perceived by pastoralists that contributed towards the changes in the rangelands ecosystem conditions. Increasing in drought occurrence and intensity caused the decline in the

vigor of different grasses and led to a high proportion of bare grounds. In agreement with this result, Abule *et al.* (2005), Bekele (2013), and Coppock *et al.* (2017) reported that moisture availability influenced the distribution of palatable grasses.

As reported by the respondents, next to drought, the expansion of crop farming was the main factor causing the decline in the rangeland productivity and putting new pressure on rangeland ecosystem. Stemming from the government policy that favors sedentarization and crop farming, the current expansion of private range enclosures and opportunistic crop farming led to the loss of prime rangelands, particularly the dry season grazing areas which causes the concentrations of the livestock at already degraded parts of the rangelands.

In particular, the spontaneous spread of private range enclosures resulted in the breakdown of effective customary resource management systems, constraining pastoral mobility practice and concentration of livestock at certain less productive areas which caused overgrazing, rangeland fragmentations and further degradation. Interestingly, the negative effects of the current expansion of water points came out during the FGDs. It was told that an increase in the number of water points associated with development intervention is contributing to the degradation of rangeland productivity by causing the concentration of the livestock at certain points particularly where water source exists. In supporting this result, studies (Napier and Solomon, 2011; Tache, 2013; Coppock *et al.*, 2017) showed that the privatization of communal rangelands threatened the sustainability of rangeland ecosystems and the livelihood of the Borana pastoralists.

Regarding the current infestations of unpalatable bush encroachment, culturally, the Borana pastoralists have used fire as a tool to reduce unpalatable bush encroachment, encourage regeneration of palatable grasses, remove cover used by predators and reduce the threats of tick-borne diseases (Ayana, 2007; Reid *et al.*, 2013). About 16% of

the pastoralists mentioned that the fire ban by the government causing rangeland degradation, particularly causing the expansion of the bush encroachment. As information generated from FGDs and key informants, the widespread of bush encroachment has been attributed to the banning of prescribed fire following the formulation of forest and land conservation policy by the *Derg* regime in 1974 which uniformly implemented throughout the country. Due to this policy, the use of fire as a management tool in rangelands is prohibited.

During the survey, it was tried to seek the opinions of experts and customary authorities towards the banning of fire as a rangeland management tool. All of the informants threw the sharpest criticism toward the banning of fire. For example, the opinion of one of the key informants from one of the local NGOs operating in the area runs like this:

The policy that blocked the use of fire was not based on understandings the Borana context. It may work for highlands. The use of fire has multiple functions for Borana pastoral system like facilitating the regeneration of the vegetation, avoids the infestations of unpalatable bush enouncement and reduces the spread of animal diseases. Now a day the Borana land is highly infested by bushes. As a result, many NGOs are investing a lot of money to reduce the infestation of the bush by cutting.

4.2.4. Conclusions

This part of the dissertation addressed the first research inquiry: how the rangelands ecosystems are changing and how severe is rangeland degradation as perceived by Borana pastoralists. In this regard, based on the above findings and discussions, two interrelated conclusions are to be made. First, the pastoralists' rangeland assessments based on their ecological knowledge showed that the Borana communal rangelands ecosystem undergone negative transformations over the last 30 years associated with

increasing occurrence and intensity of droughts, widespread of unpalatable bush encroachment, spontaneous expansion of private enclosures and settlement patterns, increasing alienation of grazing lands by opportunistic crop farming, increasing constraining of mobility practice, the banning of fire as a rangeland management tool, and overgrazing. Consequently, the productivity of rangelands has been deteriorated and the usefulness to pastoralists in providing ecosystem services has been reduced, indicating the erosion of SES resilience. The result of the study showed that the proportion of grass covers and palatable shrubs were in a declining trend. In contrast, the size of the bushlands was considerably increased in the last 30 years.

Second, the shift in resource regime or the land tenure arrangement towards private ownership has caused fragmentation and deterioration of rangelands by weakening of the customary institutions that effectively governed the sustainable use of scattered resources in drylands and increasing competitions and conflicts over the use of the rangeland resources.

Overall, the land use pattern and land tenure structures have undergone major shifts. The shift to semi-private ownership structures and adoption of crop farming and private and cooperative rangeland enclosures, in the long-run, could endanger the viability of pastoral system by weakening the customary resource management institutions, disallowing mobility practice, snatching prime grazing lands, fragmenting (sub-dividing) and degrading the productivity of the rangelands, and increasing 'land grabbing'. Hence, responding to such complex dynamics demands participation and networks of all actors in the rangeland governance and management system. Besides, customary institutions and natural resource management that stemmed from indigenous knowledge should be revitalized.

4.3. Customary Rangeland Governance System

4.3.1. Pasture Land Governance

Understanding customary natural resource governance requires thoughtful analysis of the property regimes as it determines access and management rights (Khan, 2011). An elderly person holding a customary authority substantiated the property regimes as follows:

"In the past, land was the property of all Borana." Galgalo Guyo Abba Reera (Father of reeraa, Age 63)

As well stated by Tache (2011) and confirmed through FGDs during the survey, being Borana is the only criteria to access and use grazing land at any part of the Borana homeland. The Land is the collective property of all Borana. Any members of the Borana society who abide by the Borana customary rules (*aada seera* Borana) have an equal right to access and use rangeland resources. This communal landholding and use systems were managed in a coordinated way for several centuries, through long-established and effective customary institutions making the Borana system among the most sustainable pastoral productions in East Africa (Cossins, 1988). It is important to note that all members have access and management rights but lack rights to alienate the lands.

The Borana rangelands are characterized by spatial and temporal variation and distribution of natural resources (Oba, 1998; Ayana, 2007). Evidence from the key informants indicate that based on understandings of the characteristics of rangelands they have developed clear communal land tenure arrangements mainly governed by mobility to adapt to variations of availability of rangeland resources in an opportunistic way. As elaborated by Ostrom (2011), an establishment of effective institutional

arrangements essentially requires clear understanding of the resource system. The Borana pastoralists uniquely crafted their own common customs and laws (*Aada fi Seeraa*), arise from their values, actions, and interactions, to effectively and collectively regulate the use and management of rangeland resources (Oba, 1998; Tache and Irwin, 2003). These customs and laws are fundamentally derived from their strong social and cultural institutions known as *Gada* system (Ayana, 2007; Tache, 2008; Debsu, 2013). The *Gada* indigenous governance system has a set of laws and provisions, customs, norms and values that govern the action of society in all spheres of life (*aada seera* Borana). It is the supreme political structure that determines the relationship between society, natural resources and supernatural power (God) (Legesse, 1973; Oba, 1998; Watson, 2003). Overall, *Gada* institutions play a central role in shaping the cosmology of the Borana pastoralists towards the use and management of natural resources.

Longstanding indigenous *Gada* institutions mold the access and use rights, right to exclude others and rules for managing rangelands resources mainly water and pastures. It is reasonable to deduce that customary rangeland governance institutions are built on understanding of the rangeland resource systems. To illustrate a bit how the *Gada* system works, at both macro and micro levels, headed by *Abba Gada* (Father of *Gada*) at the top, the *Gada* governing councils are legitimate entities to protect and enforce the customary laws and code of conducts as well as provision of amendments (for detail explanation see Legesse, 1973). The *Gada* has a council of a clan and age-grade representatives or classes across all administrative scales who enact rules into law and oversee their implementation for eight years, *Gada* period (Debsu, 2013; Kelemework, 2016; Chala, 2017).

The *Gada* council holds the pan-Borana Assembly (*Gumi Gayo*) at the *Gayo* wells every 8 years. This supreme institutions, *Gumi Gayo*, makes ‘proclamations’ on the rules that regulate the use of rangelands resources and is also responsible for helping the

community to adjust or revise customary rules and regulations based on the evolving environmental, social and cultural contexts (Watson, 2003; Tache, 2008). As information generated from elders, the leaders assume leadership position through the election on the bases of wisdom, bravery, ethical background, health, and physical fitness. In case the elected *Gada* officials fail to carry out their duties, the general assembly (*Gumi Gayo*) can replace them by another group from among the same *Gada* or age class which proves the accountability of the customary governance system.

One of the interesting features of the Borana customary rangeland resources management institutions is that they are well structured and organized along clan and territorial lines from the highest *Gada* institutions to further down to the lowest unit of social organization hierarchy, *warra* (household). The decision making and power sharing structures down the administrative levels are well established at various administration scales of resource management.

With regard to the power and duties of *Gada* council, field evidence reveal that the *Abba Gada* oversees the overall administrative issues and higher level decision-making process. Power and duties regarding planning, using and management of rangeland resources is mainly retained at grassroots level governance structures. These may include sanctions to establish and restrict access to parts of pasture for calf-reserves (*Kalo*). According to key informants, problems regarding resources use which could not be solved by these elders at low administrative levels would be handled by the higher *Gada* officials. Besides, higher authorities (next to *Abba Gada*) such as *Hayyu* (councilors) and *Jaleba* (messengers) involve in rangeland resources governance and decision-making process. These customary authorities are also responsible to resolve disputes and conflicts related to rangeland resources utilization.

On the bases of accumulated indigenous geographical and ecological knowledge, the Borana classify the entire rangelands to govern their resources, mainly water and pastures. As indicated above, within a defined boundary or encampment, the Borana pastoralists had developed well-structured administration levels or units. That is, the communal rangelands of each pastoral group are sub-divided into various highly networked administration levels to strategically utilize and govern their resources. These division and subdivisions of governance structures consider ecological factors like the availability of natural resources mainly water resources. Informants pointed out that the demarcation considers the availability of wet and dry season grazing areas, salt leaks, and water points.

This customary governance clusters or structures were also designed in the way that it is useful to cope with high climate variability and uncertainty (Oba, 1998). However, one should note that these customary territorial administrative units are neither mutually exclusive entity nor have clearly defined boundaries in contrast to formal administrative structures. Indeed, fluid mental borders do overlap and access to the key resources is constantly negotiated in both normal years and during environmental crisis such as droughts (Tache, 2010).

In connection with this, the data generated from FGDs and key informants show that all cluster of institutions of the Borana customary rangelands resource governance works collaboratively to ensure equitable use of resources. Similar studies conducted by Homann (2005) also reported that each specialized subdivision of institutions at various levels harmoniously works in a complex network to administer the allocation and management of rangeland resources.

From the smallest to the largest governance structure, the customary rangeland management institutions are territorially structured into warra (household), *olla*, *ardaa*,

reera, *madda* and *dheeda* administrative units (Fig. 12). Before making distinction between these administrative units and decision-making process within each unit, it is important to indicate the bases for demarcation of administrative boundaries. In Borana, customarily, the *Dawa* River is used as a reference to classify grazing zones and systems. The *Dawa* River is a perennial river that flow southeast through Borana rangelands and joins with the *Ganale* River at the border with Somalia to become the *Jubba*. All lands located to the east of the *Dawa* are known as *Liban* while the lands which extend to the west of *Dawa* are generally termed as *Dirree*. According to key informants, the *Liban* grazing system was mainly reserved for ritual celebrations and less significant for grazing.

The *Liban* grazing system further comprises two *dheedas* (largest grazing zone) namely, *Golba* and *Gubbaa*. The *Dirree* grazing zone is identified by the presence of *tuulaa salgani* (permanent water source). The *Dirree* grazing zone further categorized into five *dheedas* such as *Wayaama*, *Goomolee*, the *tuulaa* (deep wells) wells cluster (also known as *Dirree*), *Malbee* and *Golboo* (Tiki et al., 2011). *Dirree*, the area representing the cluster of *tuula* wells, is used as a year-round grazing and settlement area for pastoral households. The remaining four grazing zones are used for wet season cattle grazing and small ruminants browsing.

Turning to the descriptions of administrative units, *dheedaa* administrative structure (equivalent to a district in a formal administration/political level) is the largest unit of indigenous rangeland governance level. As elaborated in Fig. 12, each *dheeda* further contains multiple *maddas*. At *dheeda* level, rangeland resource uses are overseen by council of elders pooled from different *madda*'s called *jarsa dheeda* (elders of *dheeda*). They play a leading role to regulate seasonal access to grazing and water. Information generated during the fieldwork confirms that a *dheeda* administrative unit contains both dry season and wet season grazing zones and hence, believed to be the most important

level for rangelands resource governance and management and is critical unit in managing strategic livestock mobility.

A *madda* is customary territorial administrative unit smaller than *dheeda* and subdivided into a number of *reeras*. *Madda* literally water source, is established around a permanent water source, usually a deep well. It is the water point surrounded by a grazing land which is used by all those who are entitled to use the water source. A *madda* unit is administered by the council of elders (*jarsa madda*) pooled from different clusters the *madda* under question.

As shown in Fig. 12, down the ladder, we find *reera* level customary administration unit which can be defined as the cluster of villages found in a specific location. It is the encampment settled at two or more close sites inhabited by people who can use water from the same sources and their herds can use on the same grazing sites (Dika, 2016). A *reera* administrative level is headed by *abbaa reeraa* (Father of *reera*).

Ardaa is the small unit that is inhabited by a group of a neighboring village (*olla*). It is a small grazing territory comprises a small group of *olla* and it usually two or three only, who may cooperate together in their grazing patterns based on *aadaa seera mara-bishaan* (Borana customary laws pasture and water).

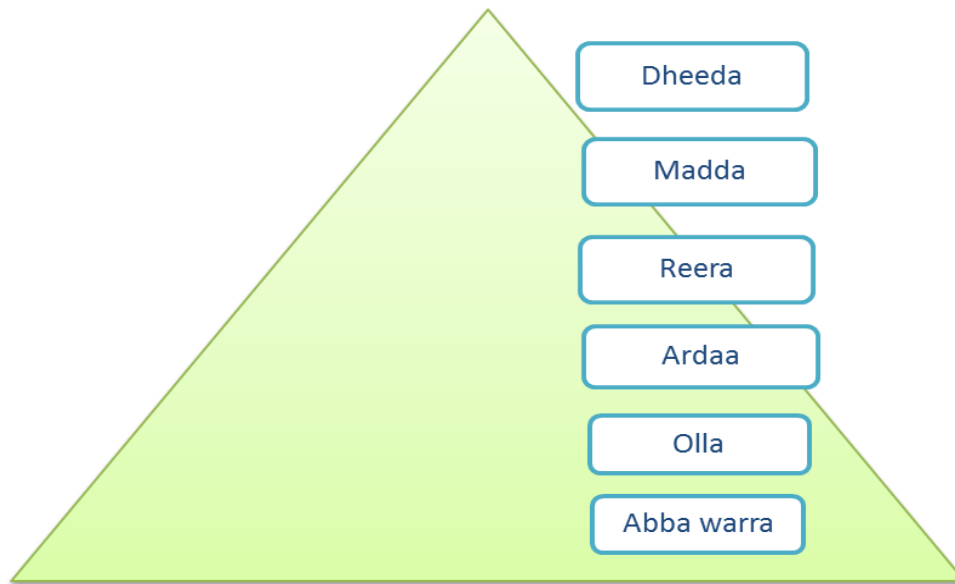


Figure 12 The territorial levels of the customary Natural resources governance

An *olla*, the smallest territorial administrative unit consists of about 30 to 100 *warras* (households). The head of the *olla* is known as *aba olla* (father of the *olla*), who is usually the first man to settle in that particular site. It can also be the senior descendant of the person who founded that particular village. The *aba olla* (*father of olla*) is responsible for the well-being of those all *warras* (households). The *aba olla* plays a major role in deciding the strategic movement of the livestock at the *olla* level to efficiently utilize pasture and water.

Regarding land use system, the Borana pastoralists have exceptionally developed clearly defined and well-planned land use system through classifying their grazing lands into the dry season and wet season grazing zones. At the center of each *dheedaa* there is a cluster of deep wells, called *tuulaa* (Homann, 2005; Tiki *et al.*, 2011). Surrounding the *tuulaa* wells zone is called *laaf seera dargula eelaa* (area allotted for water source). As already noted each *dheedaa* has well defined wet and dry season grazing zones, encampment or settlement zones and satellite grazing zones. As presented in Fig. 13, approximately about 8 Km surrounding (Tiki *et al.*, 2011) *tuulaa* well is reserved for

dry season grazing. Approximately, in between 8 to 15 Kms out of dry season grazing zones, we find *lafa seera ardaa*, meaning, encampment zone. The area beyond 15 Kms out of and opposite to encampment zone is utilized as *fooraa* herd management (*Seera fooraa*) i.e. satellite grazing zone.

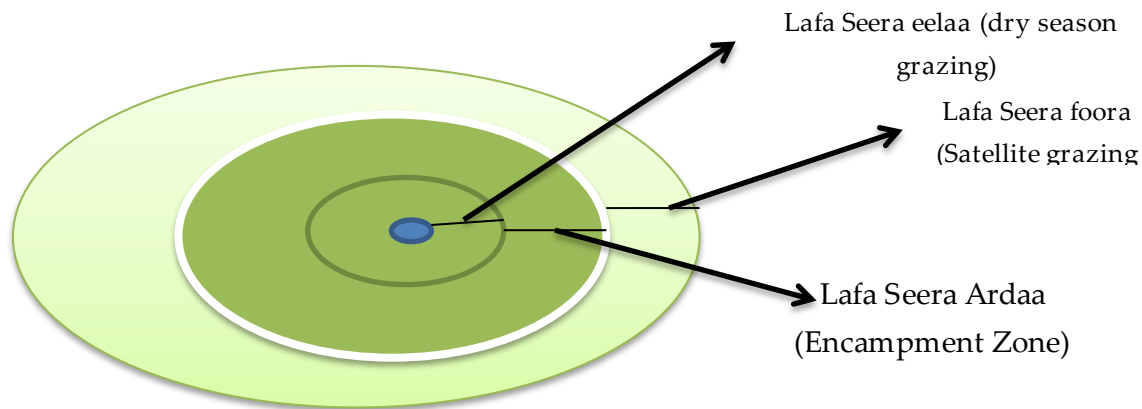


Figure 13 Schematic Representation of Land use system in Borana

Source: Own conceptualization

Similar to the data obtained from FGDs, studies (e.g Oba, 1998; Tache; 2008) argue that to adapt to the drylands environment, the Borana pastoral communities practice semi-sedentary lifestyle to make their livelihoods. Elders, children, women, weak and lactating animals are kept at *olla* encampment (*warra herds*). The remaining herds composed of males, non-milking females are kept at satellite grazing zone known as *fooraa* herds.

In discussing pasture land governance, it is also important to address informal institutions which coordinate mobility practices. As elsewhere in the world, the Borana pastoralists rely on mobility as a strategy for rangeland management. The pastoral mobility is driven by seasonal variations in rainfall, which results in spatial-temporal variation in forage and water (USAID, 2011). Informal institutions in rangeland

resource governance are structured in the way it facilitates mobility to adapt to such environmental variations.

The strategic decision where to and how to move is taken based on a critical investigation of the suitability of the destination in terms of carrying capacity of resources, disease prevalence, friendliness of host community and so on often conducted by a selected group of scouts locally known as *Aburu*. At *dheeda* level, though they overlap (Tache, 2000), settlement patterns and mobility routes or directions are controlled and coordinated by the *Jarsa dheedaa* (*dheedaa* council of elders). Through the participation of the community, *jarsa dheeda* make a decision concerning the seasonal mobility of livestock to use seasonal grazing. At the same time, as the Borana culture is characterized by resource sharing (Oba, 1998; Tari and Pattison, 2014), the mobility of livestock between different *dheedaas* must be pre-arranged or negotiated with the respective *jarsa dheedaas* to avoid associated conflicts.

4.3.2. Water Resource Governance

Access to water is critical, especially in the dry season in arid and semi-arid Borana rangelands. A scarcity of water is currently the major problem hampering the livelihood of people compounded with an adverse climatic condition. Throughout history, Borana people sustainably dealt the scarce resource use through their customary management laws and property rights arrangements at various levels that determine access right to and management. As noted somewhere else in this paper, these norms are known as *seera marra bisaanii*, literally the law of water and pasture embedded in the *Gada* system.

In Borana, water sources could be categorized into two major types: the permanent and the seasonal sources. The permanent water sources include rivers, wells (*eelaa*) and man-made ponds (*Haro*) while temporary or seasonal water sources include temporary ponds and surface water. Wells and ponds are the primary sources of water for both

human being and livestock. Hence, the availability of water wells greatly affects grazing and mobility patterns of the pastoralists. Water wells (*eelaa*) are the permanent water sources for the pastoral group and have a central position in the social, economic and politics of the Borana. Water wells are categorized into two types, *adadi* and *tuulaa*. *Adadi* wells are shallow, while *tuulaa* wells are very deep (reach a depth of 30 m), dependable and demands maximum labour to construct and maintain (Oba, 1998; Tache and Irwin, 2003). Throughout the Borana, there are nine *tuulaas* and they are known as *tuullan saglan* Borana (the nine wells of Borana).

The excavation of a well is initiated and led by a clan representative or an individual called *aba eelaa* (father of well) and recruits or participate other clan members. This head of the clan is called father of the water (*Konfi*). This leadership position is inherited to children, grandchildren, and so on. It is the responsibility of the clan to represent water manager called *abba Herreegaa*. *Abba herreegaa* is an officer who is responsible for scheduling water use order and following up of the day-to-day activities of water points. Unlike *Konfi* structure, the nomination of *abbaa herreegaa* is based on the merit of management capacity. In case *abbaa herreegaa* fails to play his duties, he is removed from the position and replaced by another person. The well council composed of six to seven elders pooled from the clan group including *hayus* (the clan councilors) headed by *konfi* oversees the proper utilization and maintenance of the wells. Disputes over water source use which could not be solved by the well council (elders) and *abbaa herreegaa* would be resolved by the higher *Gada* officials.

Property right of a water point is a bit different from property rights of grazing lands. Various sources of water are subject to different forms of governance. The *konfi*, literally the ownership right, of a *tuulaa* well belongs to a distinct clan (tribe) though it is not exclusive for members of another clan. Any household or clan who abide by Borana customary laws have a right to access the nearest water points for free after making a

formal request to the well council beforehand for proper arrangements. However, the fact that its construction and maintenance demand high labour force, a high restriction is vested on access by clan members. As the data obtained from key respondents (*abba herreegaa*) *abba herreegaa* assigns first access rights to water for the clan members. However, other associated clan members (Tache and Irwin, 2003) can request if there is spare capacity exist, they can be given access, however, and they must still wait until the clan herds present. The major decision lies with *abba herreegaa*.

The temporary water sources, during the wet season are communally owned, used and managed by all pastoral groups regardless of clan relations. However, the access right of ponds and pools during the rainy season is mainly determined by the level of participation in the construction and maintenance of the ponds and catchment. Similarly, though access restriction is not tight as deep wells, *konfi* rights of the ponds belong to *dheeda* or *reeraa*, hence, the *abba herreegaa* is represented by *dheeda* or *reeraa* council. In similar custom, the decision regarding watering schedule is taken by *abba herreegaa*.

4.3.3. Contemporary Challenges of Commons Property Regimes in Borana

In recent decades, the roles of Borana customary institutions have been threatened due to changing and complex social, economic, political, and environmental dynamics. During the survey, the respondents were asked to report their view whether the adherence to customary rangelands governance institutions was weakening or improving. The data presented in Table 4 vividly corroborate that majority (79%) of respondents' view that the adherence to customary rules governing the access and use right and management of rangelands resources is generally weakening.

Table 4 Opinion of respondents towards the status of adherence to customary institutions

S/No	Opinions	No	%
1	Weakening	146	78.5
2	Improving	10	5.4
3	Same	14	7.5
4	No Response	16	8.6
Total		186	100

Source: Own survey result, 2016

The results of the survey also show that a very small proportion of the respondents (only 5%) perceive that the enforcement power of the customary rules and compliance of the society to rules is improving. This suggests that there is a general consensus among the respondents that the roles of customary institutions are declining. Similarly, respondents were asked to indicate that who decide herd movement directions and regulate overall access to rangeland resources. Accordingly, about 81% of the respondents reported that the authority lies with formal administrative structures, especially PAs. About 3% of the respondents perceived that issues related to rangeland resources access and utilizations were mostly decided by customary authorities.

Likewise, about 16% of the respondents indicated that the resource utilization and management related decisions were undertaken by both groups. From this, one can understand that the function of customary institutions is significantly decreasing and replaced by formal administrative structures. Plenty of studies conform to this finding. For instance, Homann (2005) reported that the roles of (*jarsa dheedaa*) for instance, for regulating the access to shared grazing areas were already hardly remembered by most of the respondents.

Efforts were also made to uncover the reasons behind the prevailing pressure on customary resource management through focused group discussions and key informant

interviews. Accordingly, the inseparably inter-connected internal and external factors underlying the weakening of customary institutions are discussed as follows.

4.3.3.1. Population Pressure

Local evidence revealed that rapid human population growth accompanied by increasing demand for environmental amenities is triggering a range of negative impacts on the performance of the Borana customary institutions. Commenting on the current internal challenges, one of the key informants stated:

“In these days, increasing human population highly contributed to the weakening of the enforcement of the customary institutions”

In all, population growth is one of the critical challenges facing sub-Saharan African countries as the livelihood of the people strongly tied to land resources. Population growth in pastoralist areas of Africa is estimated at 2.5 to 3.5 percent per year, which equates to a doubling of population every 25 to 35 years (AU, 2010). Based on CSA (2017) data, with the current growth rate (3.02%), Ethiopia’s population will double in the next 20 years. Similarly, the annual population growth in the pastoral lands of Ethiopia is estimated to be 2.8%, which will double the pastoral population every 25 years (Nori, 2007). With an annual growth rate of 2.3% (CSA, 2007), the Borana’s population size is estimated to reach 1,281,763 in 2018. Taking a closer look at the trends of human population during the last decades, it can be seen that the population density of Borana increased to 23.2 people/km² above normal range of 2-3 people/Km² (Coppock and Desta, 2004; Coppock et al., 2017) for pastoralists.

It is easy to apprehend that population growth puts pressure on natural resources and resource governance regimes. Mounting human population primarily based on natural resources imply increased resource exploitation, especially common property resources.

As indicated by FGDs participants, rapid growth in human population also contributes to increment in the livestock population and thus persistently lowering the productivity and carrying capacity of the rangelands. This may also cause customary common resource governance system to collapse if the customary institutions fail to respond in time (Heltberg, 2002). In Borana, the absence of another non-natural resource-based economic diversification options, and technological advancement, the rise in population density is deteriorating customary commons governance institutions. This can be explained by widely expanding fierce competition over resources which in turn causing rangeland fragmentation and degradation.

In connection with this, key informants have witnessed unplanned settlement expansion and increase in a number of *warra* (households) in olla and *reera* from time to time. The greatest challenge is that the new settlement pattern is random and contradicts the custom rules and regulations. For instance, the customary rules which restrict the settlement at grazing zones (*mata tika*, literally head of grazing) which is suitable for grazing have been already broken down. In summary, indigenous commons governance institutions have been inherently faded up in terms of adherence to rules and regulations among the society and brought a shift in property regimes.

4.3.3.2. Erosion of Social Capital and Escalating Poverty and Inequalities

The social capital is a vital ingredient for effective common governance regimes through generating trusts and reducing opportunistic behavior (Agrawal, 2003; Cleaver, 2005). It is claimed that social capital enables people to participate in effective local decision-making in common resource governance structures. As Cleaver (2007) noted, relational ties or social capital highly influence individuals' willingness to abide by collective decisions and to comply with unwritten norms of resource use and management.

Reciprocity and sharing are the indicators of social capital that reduce household risk exposure and promote cohesion, trust, and cooperation that support the resilience of SES (Zwiebel and King, 2014). In Borana, reciprocity is a known feature of pastoral community in which recovery assistance is given for individual who suffers loss and below a certain level of poverty. This clan-based social security institution is known as '*buusa gonofaa*'. It has played a crucial role in building trust and facilitating cooperation and collective actions in the customary governance of rangeland resources and ensuring social security.

As Debsu (2013) noted, the Borana pastoral communities were also known for their social bond through different forms of livestock sharing and transfers. During the survey, efforts were made to assess the trends of livestock sharing through gifts and lending as a proxy of social capital (Zwiebel and King, 2014) based on the perception of the respondents. Respondents were asked to report their opinion about the trends of livestock sharing both on gift and lending bases. As displayed in the Fig. 14, about 81% of the respondents reported that the traditions of long and short terms livestock sharing are considerably declining. The remaining 7% and 12% of the respondents believe that the trend of livestock sharing is increasing and the same respectively.

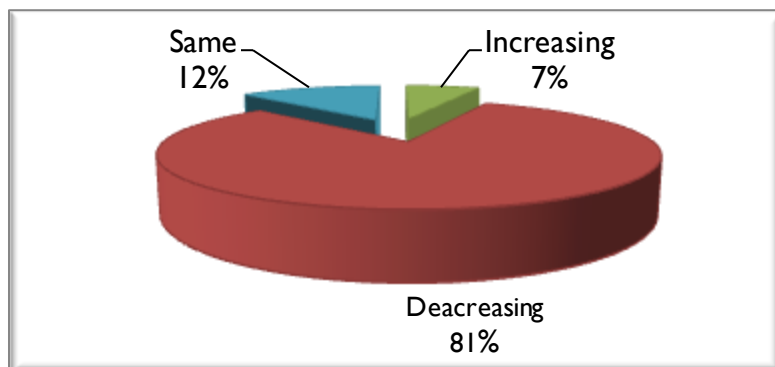


Figure 14 Perception of respondents on the trends of livestock sharing in Borana.

Source: Own Survey, 2016

The survey respondents were also asked whether they lent or received livestock for milk on short or long term bases, which is ruled by *dabaree* (temporary stock transfers) institution. As well stated by Tache (2008) the *dabaree* is an institution of stock transfer in which a family may receive milk animals from kinsmen, clan members or friends to respond to seasonal or long-term milk shortages. Accordingly, the survey result reveals that in the last five years, only 16.7% and 13% of households were lending and receiving livestock on *dabaree* basis respectively.

The result of this study clearly illuminates that long-established trust, reciprocity, and mutuality among the Borana pastoralists have been eroded. It is likely that absent of sufficient trust, reciprocity and mutuality result in destructive opportunism in collective actions in common governance process and further erode social capital (Huppé and Creech, 2012). The result of this study is compatible with other similar studies. Plenty of studies (e.g. Oba, 1998; Wassie, 2005; Tache, 2008; Debsu, 2013; Coppock et al., 2014) show that under current profound socio-ecological systems' dynamics and transformations, the role of *buusaa gonofaa* institution and traditions food and livestock sharing are continuously declining.

During the survey, FGDs participants were asked to describe their view why social networks are declining in Borana. Overall, the participants agreed that escalating poverty level and income inequalities are the major underlying factors contributing to the weakening of social capital. Currently, the livestock holding size is decreasing from time to time. It is so easy to comprehend that as the livelihood of pastoralists mainly depends on the size of livestock holding, declining in livestock holding size directly related to rising in the prevalence of poverty. An empirical study undertaken by Wassie (2005) indicates that the withering of indigenous support system is strongly associated with growing pastoralist destitution and the crumbling of local capacity to respond effectively to the demands of the poor. With the growing tendency of dependence on

external support from government and non-government organizations and increasing engagement in non-pastoral economic activities, the majorities started to drop *buusaa gonofaa* and other livestock transfer institutions.

Likewise, the FGDs participants noticeably indicated that economic stratification among pastoralists appears to be exacerbating the process of undermining resource sharing norms, customs, and behavior. Many studies (for e.g. Tache and Sjaastad, 2008; Debsu, 2013; Coppock et al., 2014) highlight that economic inequality or the gaps between haves and have-nots is widening in Borana as a result of underlying SES dynamics. Among the Borana, livestock holding is the primary indicators of wealth (Tache and Sjaastad, 2008), the consolidation of livestock into the hands of fewer wealth pastoralists is one of these transformations.

With this regard, for instance, a study by Flintan *et al.* (2011) showed that rich pastoralists can generate about four-fold the income of the poor. As diversity and inequality within the pastoral group are increasing, development interventions benefit only specific households, particularly the rich who have the connections and skills to take advantage of controlling over more rangeland resources which further result in increasing inequality and marginalization of majority of the pastoral population. This increasing income inequality or wealth level stratification contributed to the divergence of interests of the community, because, rich pastoralists behaved opportunistically and failed to abide by common resource use regulations.

4.3.3.3. Climate variability and rangeland degradation

In recent decades, Borana arid and semi-arid rangelands have experienced the effects of climate threats. Observed weather data and perception of pastoral households show that annual rainfall in Borana rangelands is persistently declining accompanied by frequent and severe droughts. According to informants, in the past, droughts lasting

several years occurred approximately once in 20 years. However, in recent years, the period between droughts has decreased to less than five years. For instance, since severe drought occurred during 1983 – 84, five severe droughts have occurred at the intervals of 6, 6, 4, 4 and 6 years.

This has led to the deterioration of the productivity of rangelands and subsequent degradation of rangelands. As noted by FGD participants, pastoral households have been forced to keep too many cattle on severely degraded rangelands which left grasslands at irreversible state. Rangeland degradation along with policy constraints on mobility and overall marginalization processes, expansion of farmlands and private enclosures and encroachment of drought-resistant invasive species have caused further fragmentation and shrinkage of communal grazing lands.

Consequently, resilient customary communal rangeland governance institutions and long-standing collective actions have been eroded as people seek to respond to these emerging challenges. According to informants, the shrinkage of rangeland resources also instigated conflict among the communities which in turn reduced the legitimacy of the traditional customs. People turn to formal institutions for justices when facing conflict over resource use. Ineffectiveness of formal institutional arrangements to deal with prevailing changes of SES further exacerbated the situation.

4.3.3.4. Policy Induced Pressure

A sizable body of evidence showed that in earlier days, Borana customary commons governance institutions, as elsewhere, were quite effective in ensuring SES resilience. However, today, these indigenous institutional arrangements of the commons and pastoral economy, in general, are under huge pressure though little progress has been made in recognizing the contribution of the pastoral economy in general and the role of customary governance structures. Since 1960s, Borana customary institutions have been

continuously weakened, mainly because of state policies and development approaches which on the one hand encourage sedentarization and restriction of herd mobility and which on the other hand promote alternative forms of land use (crop farming and land alienation in the name of investment) (Oba, 1998; Helland, 1998; Homann, 2004; Ayana, 2007; PFE et al., 2010). Moreover, the establishment of formal administrative structures aimed at providing a uniform control system over pastoral areas similar to those in sedentary areas has proven to be largely incompatible with customary rangeland management institutions (Debsu, 2013).

In fact, there is growing interest and commitment (both with state and NGOs) to work with Borana customary institutions as a means of sustainable development. However, the interrelationship between statutory and customary institutions particularly, in rangeland resource governance, is still very poor. There is a general perception among professional and local customary authority key informants and FGDs participants that there exist contradiction among formal governance structures and customary authorities. Very few interviewed customary authorities have been involved in the decision-making process related to rangeland management. When involved, mostly in NGOs rangeland development-related interventions, they believe that few of their suggestions have been accepted.

It was also widely felt by key informants that the efforts to participate customary authorities in the state-led development interventions were highly motivated by political ends, mainly to control the pastoral communities. Moreover, according to key informants, young and inexperienced appointed officials in the formal administrative structures, especially at the kebele level, often fail to recognize the advice of elders who have rich experience in rangeland management. Tache and Irwin (2003) reported similar findings.

It seems that customary institutions having centuries of experience and knowledge in managing land and natural resources are normally disregarded by state policies and development practitioners. As noted by Abebe *et al.* (2015), though the formal government institutions succeeded in weakening the customary institutions, they haven't effectively replaced them in resource management. Rather than building synergy between customary resource governance leadership and state policies, efforts by state mainly tend to focus on dismantling commons governance institutions from governance processes. In other words, new institutional structures were constructed without due consideration of well-adapted customary institutions and effectively replacing them. As a result, the conflicts and competition between local authorities and state policies became increasingly acute.

This further result in weakening of customary institutions in such a way that some members of the community, especially the rich, increasingly likely to turn to either of the two governance systems or both to claim the use of the resources in an opportunistic way. In such a situation, the enforcement of commons management rules is very problematic. In sum, state policy persistent attachment to misconceptions about pastoralists' ways of life has been degraded customary laws that govern access right, rules of entry to social groupings, collaborative process and settlement patterns.

4.3.4. The need for revitalizing customary institutions in the Borana context

Drawing on the resilient SES governance perspectives, this thesis argues the importance of revitalizing the Borana customary rangeland management institutions grounded in the indigenous knowledge system that emerged through adaptive process and transmitted over generations is critical to understanding the pathways to resilience and adaptation because of their long history of resilience to environmental variability. If it is intended to establish effective governance that can respond to changes and dealing with

uncertainty, the governance process should address the complexity and interconnectedness of SES, components such as species, landscape types, knowledge systems, actors, cultural groups or institutions (Ostrom, 2011; Kittinger *et al.*, 2012; Kittinger *et al.*, 2013; Cosens *et al.*, 2014; Reid *et al.*, 2014; Leslie *et al.*, 2015).

Theory of complex adaptive systems portrays that in SES human and ecological systems inseparably, complexly and co-evolutionary interconnected (Adger, 2000; Ostrom, 2011; Kittinger *et al.*, 2012; Boyd and Folke, 2012). Both social and ecological systems further encompass elements or units that interact intricately, and each may contain interconnected subsystems (Folke, 2006). An ecological system contains self-regulating communities of organisms interacting with one another and with their environment (Berkes *et al.*, 2003). A social system includes economy, actors and institutions (Kittinger *et al.*, 2012). As stated, institutions incorporate formal governance structures or law and modes of socialized behaviors that structures human dependence on natural resources. Indigenous institutions of natural resource governance embedded in the local culture and societal values (Agarwal, 2008; Berkes *et al.*, 2009) are one of the subsystems of the social systems.

These coevolving interrelationships between social and ecological subsystems involve two primary reciprocal interactions (Olsson *et al.*, 2004; Kittinger *et al.*, 2012). These reciprocal interactions can be explained by the community, individually or communally, depend on rangelands by using pasture, water, spiritual and cultural services (Walker *et al.*, 2006). Pastoral communities derive ecosystem services and benefits from rangelands systems. Likewise, humans alter the structures and functions of natural systems of the rangelands through efforts of maximizing their benefits (Kittinger *et al.*, 2012; Reid *et al.*, 2014).

Worth to note is that these interactions between and within the social and ecological systems are complex and dynamic (Kittinger *et al.*, 2012). This implies several connections exist at a time on different system levels or scales (Armitage *et al.*, 2012). Recognizing the complexity of interactions in the SES means dealing with unpredictable and uncertain environmental dynamics and acknowledging a multitude of perspectives (Cosens *et al.*, 2014).

For centuries, the Borana common pool resources institutions, as elsewhere, have helped sustainable management of rangelands resources through oiling the coevolving interactions in the SES. Therefore, rangeland governance and management requires understanding of the interactions and relationship complexities between SES (Chaffin *et al.*, 2014). Governance practices fail to consider both human and ecological components often leads to a failure of management, because development interventions in one component without addressing the interaction between the components may result in a disturbance in the other components let alone dealing with disturbances posed by SES dynamics.

In such evolving complexity and unpredictability of interactions between social and ecological systems, rangelands governance and management policies and institutional designs need to turn away from dismantling human and ecological systems as if they are independent. If it is intended to put the pastoralists towards the path of sustainability, it is essential to start with recognition of the complex interconnections between local values and institutions and rangelands ecosystems (Ostrom, 2011). However, what we observed in the Borana rangeland governance system is the opposite of what existing studies on SES have routinely recommended, particularly understanding of the interactions between human and ecological subsystems is the primary step in enhancing adaptive capacity of SES. Customary institutions governing

human activity were treated as being external to ecosystem resulting in socio-ecological misfits.

A polycentric governance structures in which multiple actors interact across administrative scales to make and enforce rules is considered to be one of the best ways to deal with environmental complexity in an adaptive manner (Pahl-Wostl, 2009). Studies show that multilayered institutional arrangements provide several benefits over mono-centric (conventional) governance approaches in which the role of customary institutions are overlooked.

First, polycentric institutional arrangements involving customary institutions and local value systems improve knowledge sharing and learning across various cultures and scales, and achieve collective action in the face of changes (Armitage *et al.*, 2012). Second, multi-level interactions expose actors to a greater diversity of solutions that may be used to respond to complex common problems (Koontz *et al.*, 2015). Thirdly, multilayered governance system helps increase rule compliance and reduces conflicts that might arise from competing jurisdictions, as it creates opportunities for decision makers discuss and discover common understanding (Pahl-Wostl, 2009; Koontz *et al.* 2015).

Customary resource management institutions are based on understanding the interconnectedness between social and ecological systems (McMillen *et al.*, 2014). Participation of the pastoral community at large is, thus, useful to get knowledge and valuable insights into the dynamics and complexity between and within SES (Cinner and Aswani, 2007). This clearly shows that conventional governance processes which fail to recognize the complex interconnections between customary institutions (society) and the natural environment cannot deliver SES resilience assets.

From policy perspectives, it has long been recognized that crafting a new institutional arrangement must start with carefully looking at customary institutions, indigenous knowledge and value system if it is meant for sustainable development (Ostrom, 2009; Koontz *et al.*, 2015). It is important to consult firmly rooted customary institutions in local society especially, where an intended intervention affects the ways in which resources will be used and managed (Ostrom, 2009). Pastoral communities, particularly in Borana, have managed their rangeland resources for centuries to secure their livelihoods in the context of historically absent or little state support (Oba, 1998; PFE *et al.*, 2010). Nevertheless, as the survey data confirm, the efforts by the state to establish administrative structures undermined the role of trusted customary institutions. The efforts in designing governance institutions focused on solely establishing formal institutions rather than creating a platform in which multiple institutions can operate and respond to diverse situations.

Community-based and participatory approaches also facilitate the institution of legitimate and effective natural resource governance and management by incorporating local perspectives and worldviews (McMillen *et al.*, 2014). The same source remarkably stated that participation of local institutions and community, rather than standing away and blaming the community, helps to understand their limitations and capacitate them in enhancing SES resilience. In fact, it is not to mean that all local institutions are always effectively dealing with prevailing SES change-induced perturbations. However, building on positive attributes of customary institutions that support the culture of collective behavior is paramount importance in building SES resilience.

Equally important, the success of rangeland resources governance depends on the strong participation of customary authorities, as they are respected by communities (Agrawal, 2010). With this regard, the survey results confirm that in all people had a positive attitude towards the role of elders and customary authorities.

The issues of human dignity may also arise. Disregarding the customary institutions directly related to ignoring the cultural value systems of the community, as the customary institutions are embedded in the culture, values, and norms of the society. For instance, the respondents were asked whether they would prefer subdividing and privatizing their grazing lands or communal grazing lands, the majority (84%) of respondents indicated that communal grazing system better suits to their condition. As confirmed by FGDs, this view is dictated by the complexity in subdividing the communal system due to temporal and spatial variability in rangelands resources. Similar studies, for instance, Pavanello and Levine (2011) present that subdividing the rangelands complicate the livelihoods of the pastoralists as in fragile environment like drylands of the Borana, unpredictable rainfall situation poses uncertainty on the location of productive and productive sections of the rangelands. This is because; the drylands are characterized by a greater degree of spatial and temporal rainfall variability. Therefore, it is more suitable to use and manage the entire rangelands commonly than parceling or fragmenting it (AU, 2010; Pavanello and Levine, 2011).

Similarly, during the survey, the sample respondents were asked about their future strategies whether they would like to totally exit pastoralism way of life or not. The result was very impressive. Although they want to diversify their economic opportunities, almost all (87%) did not want to exit from pastoralism mode of production. This clearly shows that there is a common understanding that pastoralism works for them. Nevertheless, pastoral communities and their customary institutions and local knowledge have been overlooked by top-down approaches. Development interventions in pastoral areas mainly focus on changing the basic lifestyle and altering pastoralism to sedentary life (PFE *et al.*, 2010).

It is understandable that it is difficult to transform the life of pastoralists as intended without respecting pastoralists' values and knowledge system. Governance processes

that fail to respect and protect knowledge and value systems, rights and tenure arrangements of local people cannot effectively deliver SES resilience assets (Koontz *et al.*, 2015). Unfortunately, clearly marginalizing policies have been adopted resulting in continuous dilution of customary rangeland management institutions.

4.3.5. Conclusions

Based on their indigenous knowledge of the rangeland resources dynamics, Borana pastoralists have over the years developed a set of rules and regulations on how to use their rangeland resources and evolved robust customary institutions which helped them well in systematic exploitation and sustainable management of these resources under prevailing harsh environment. These customary rangeland governance institutions are also contributing much in management of conflicts over the use of resources. Nowadays, however, the customary commons governance institutions are weakening due to multiple pressures. However, they are still playing considerable roles especially in the areas of water resource use and management.

The weakening of pastoral commons customary governance institutions is attributed to increased internal pressures such as population pressure and erosion of social capital, and persistent development policies that fail to carefully understand the pastoral context. As a result, today, the Borana communal rangeland systems are characterized by a lack of enforceable rules for collective resource access and management which in turn eroding SES resilience. It can be argued that if it is intended to put the pastoralists towards the path of sustainability, it is essential to start with recognition of complex interconnections between local values or institutions and rangelands ecosystems. Customary institutions can still provide insights into understanding the SES resilience in the face of increasing environmental variability and uncertainty.

Recognizing customary institutions can also provide an opportunity to learn from their limitations. Equally important, the success of rangelands resources governance and management depends on the strong participation of customary authorities, as they are respected by communities. It is also very difficult to transform the life of pastoralists without respecting pastoralists' values and knowledge system, as disregarding their values systems equate to eroding human dignity. Above all, this paper emphasizes that dominant thinking of building centralized regimes that have marginalized customary institutions leads us nowhere. Rather, the existence of multi-level institutions or polycentric governance systems in which multiple actors involved is critical to coping with complexity in SES.

Chapter Five: Pastoral System Vulnerability Dynamics and Adaptive Responses

5.1. Introduction

This chapter aimed to understand pastoral SES transformations and how the SES transformations reduced the resilience of the Borana pastoral system and how the pastoral system is responding to the adverse effects of these transformations. In studying pastoralists' vulnerability dynamics, earlier studies focused on climate related hazards putting aside the socio-political changes related risks and their interactions with environmental related drivers of vulnerability. This thesis therefore, attempted to address how the interactions of multiple (both environmental and socio-political) stressors co-produce new pastoral system vulnerability pathways. As such, this study contributes in taking vulnerability assessment a step forward the existing pastoral system vulnerability assessment by looking into the interactions of environmental and socio-political dynamics and how the pastoral system is double exposed to both simultaneously occurring changes. To this end, the study discusses evolving policy environments and underlining root causes of pastoral system's vulnerability to contemporary climate and sociopolitical variations. In investigating SES adaptive responses, this study limited its discussion on human system adaptive responses (including technical, behavioral, and institutional responses that people make) to deal with changes SES.

This chapter composed of four major sections. Section 5.2 deals with the evolving pastoral development policy environment in the modern Ethiopian history. Section 5.3 examines the vulnerability of pastoral households to climate variability/changes using integrated vulnerability assessment. Section 5.4 explores the underlying root causes of vulnerability of the pastoral system to climate changes drawing on double exposure

frameworks. Section 5.5 provides some conclusions on the sources vulnerability of pastoral system to SES dynamics. Section 5.6 explores technical, behavioral and institutional adjustments of pastoral households in dealing with risks associated with SES transformations. Finally, section 5.6 gives some critical conclusions related to pastoral households' adaptive responses.

5.2. Evolving Land use and pastoral development policies: *Marginalization process*

Government policies play a paramount role in maintaining the adaptability and thereby the resilience of SES in any setting, being rural or urban. Policies shape institutional arrangements that determine the interactions of various actors and hence structure risks and sensitivity to climate and socio-political stresses, facilitate or impede individual and collective responses, and shape the outcomes of such responses (Agrawal, 2008). Over the changing political regimes, the formulation of new policy or change in existing policy may result in benefit and challenges on different segments of the society. In fact, no public policy can automatically bring equal benefit to every segment of the population (Scoones, 1995). It is important to look again and again the impact of the implemented policies and strategies and attention should be given to consider special policies to help the more vulnerable population, like pastoralists (Kreutzmann et al., 2011). Thus, review of past and existing policies and how it resulted in the marginalization of certain community members, pastoralists, in this case, is critical to formulating new enabling policies for the future.

To this end, based on extensive review of pastoral development policies, laws and development interventions, this section sheds light on formal rangeland governance systems, pastoral development policies, and marginalization process throughout modern Ethiopian history based on insight towards its implication for erosion of

adaptation capacities of pastoral communities in responding to prevailing climate variability and change, specifically Borana pastoralists.

Imperial Regime (pre-1974)

Generally speaking, during this period, pastoralism received very little attention from the policymakers. As a result, there were no clear policies and strategies specifically dealing with pastoral development issues. However, as noted by many scholars (Oba, 1998; Ayalew, 2004; Helland, 2006), during this regime, pastoralist communities were exposed to prime rangelands encroachment upon by other activities such as the expansion of state and private owned large-scale commercial farms and establishment of national parks and sugar factories. Land use laws and policies were being implemented in the way that marginalizes the pastoral system as they were founded on the general premises that picture pastoralism as economically not viable and environmentally destructive (PFE et al., 2010). Pastoralists were totally denied their land rights.

To provide an overview of historical backgrounds of the land tenure system and associated marginalization process, in Ethiopia, the evolution of land tenure arrangements can clearly be seen by separating the country into two distinct categories, north and the south (PFE et al., 2010). In the North, center for state formation, land tenure system was characterized by *rist* (kinship) landholding system. The *rist* system can be explained as the communal holding (descent group) system or collective rights distributed through heritance to the descendants, both male, and female (Tache, 2008). However, the owner of the land would neither sell nor mortgage the land (Helland, 2006). The right to land was not exclusive but shared among individuals who could establish a direct line of descent with original settlers (Hagos et al., 2008). The other major form of tenure system was *gult*, ownership right acquired from the monarch or

from provincial rulers. The *gult* owners, feudal landlords, collected tribute from the users of the land. The *gult* rights were used as compensation for officials (Hussein, 2004). The church land, also known as *semon* land, was owned by the church (Helland, 2006).

In the South, following the expansion of state from the North in the late 19th century, land ownership patterns were developed. After the conquest, by Minilik II, feudal elites divided the land and the majority of the farming households became sharecropping tenants (Kebede, 2008). With regard to tenure security, the situation in the North is different from the South. Many pieces of literature argue that the *rist* system, descent-based and landholding security is guaranteed by the system of taxation (Ayana, 2008). On the contrary, in the South, however, tenants or sharecroppers had no security of landholding. Thus, the meaning and concepts of tenancy in the North is different from the South. Peasants in the North were known as '*gabbar*' (those who pay tax), the tenants of the South were known as '*chisegna*' (those whose rights were like '*chis*' – smoke) (Helland, 2006).

Due to fear of harsh environment and malaria incidence, the lowland periphery, the pastoral land remained undisturbed until World War II (Helland, 1997). However, evidence shows that the expansion of the state from the central highlands particularly, during Emperor Haile Selassie- I put the communal lands under the ownership and control of the state (Abdulahi, 2007). Starting from the early 1930s, there were a series of legislation and proclamations that ruled out the pastoralists from the game. This was followed by alienation and expropriation of land for non-pastoral use by the feudal lords. For instance, proclamation No.1 of July 1964 grants a *gasha* of land for the patriot who fought Italians (Ayalew, 2004). During these Imperial regimes, above all, Article 130(d) of the revised 1955 constitution was the major formal declaration that totally

marginalized the pastoral communities from their land and denied them basic human right (Abdulahi, 2007). This article stipulates

All property not held and possessed in the name of any person natural or legal, including all land in escheat, and all abandoned properties, whether real or personal as well as all products of the sub-soil, all forests and grazing lands, water courses, lakes and territorial waters, are state domain.

This provision misunderstood group or collective user rights to the land and considered the pastoral communal grazing lands as nobody's land. Likewise, Civil Code Article 1168 declares that *"the processor who had paid for 15 consecutive years the taxes relating to the ownership of immovable property shall become the owner of such property."* This legal framework also overlooked the existence of a pastoral economy. The fact they did not pay tax, they could not qualify for the land ownership. Furthermore, this 1960 Civil Code in its Art 1194 provided that *"immovable property situated in Ethiopia which is vacant and without master shall be the property of the state."* This provision further demolished the pastoral communal landholding right and hence, the state could distribute the land to other potential users. As indicated by Abdulahi (2007), this encouraged the proliferation of private holdings and expropriation of the pastoral communal lands.

Generally speaking, during imperial regimes, although the introduction of large scale commercialization displaced pastoralists at some parts of the country, the majority of pastoral areas of Ethiopia in general and Borana pastoralists in particular, were relatively remained undisturbed and unexploited (Helland, 2006). This was mainly due to limited state capability to control and prevailing less favorable environmental situation in pastoral areas.

Despite severe limitations in addressing the interest of the pastoral communities, it is logical to recognize that it was during this imperial regime that the design and

implementation of pastoral development projects emerged mainly supported by United States Agency for International Development (USAID) and World Bank. The pastoral development initiatives implemented under this regime fundamentally excluded human dimensions and focuses on the commercialization of livestock production and to some extent on infrastructural development and natural resource conservation (Coppock, 1994; Desta, 2006; Lemmessa, 2015). Lemmessa (2015) further argues that the main intention of the government was to extract livestock for central and international market.

Derg Regime (1974-1991)

The overthrow of the imperial regime in 1975 by military junta known as *Derg* brought about radical land tenure reform in history of Ethiopia. The *Derg* introduced Proclamation No. 31, 1975, which made all lands and its resources the collective property of the Ethiopian people and under the custody of state (Kebede, 2008). One of the interesting features of this proclamation was that it recognized pastoral communities of long-standing land insecurity. As noted by Crewett et al. (2008), the reform gave usufruct rights to both pastoralists and subsistence farmers. However, it prohibited land transfer rights through mortgages, leases, sales, or bequests, as well as the hiring of labour on the farm. In this regard, Article 24 of the proclamation declares that *“as of the effective date of this proclamation, nomadic people shall have possessory rights over the lands they customarily use for grazing and other purposes related to agriculture.”*

However, the ‘possessory right’ title rendered to pastoralists by proclamation declared in Art 24 did not protect the alienation of their communal grazing land for mechanized state farms (Workneh, 2006). In spite of the fact that *Derg* and Imperial regimes were contradictory in worldviews, Marxist and Imperialist respectively, nothing changed in land tenure arrangements. Under both regimes, the ownership of the communal

pastoral lands vested to the state. It is important to note that there was no fundamental difference in development initiatives and interventions in both regimes. As a development strategy, both regimes embarked on the introduction of large commercial irrigated farms. This resulted in the expropriation of pastoral lands. For instance, state-backed agro-industrial projects such as the Metehara sugar factory and the establishment of the Awash National Park in the Awash Valley are exemplary of the exploitive policies carried out by Monarchial and *Derg* regimes (Eyasu and Feyera, 2010). As noted by Desta (2006), the encroachment of pastoral land was worse than the former regime. Productive rangelands were taken and enclosed for National Parks, state control ranches, and forests. In summary, sad to say, pastoralist's communities have been given little attention in the development plan of the country during this regime similar to the previous one.

The development interventions were solely focusing on the natural resources and the livestock not on improving the pastoral livelihood (Desta, 2006). This wrong assumption emanated from failures in understanding that both social and ecological system intricately linked and co-evolved. Focusing only on one element and dismantling the other from the system could not bring the desired change, even worse, may distract the whole system. This is what one can observe in pastoral development policies and intervention in the country all over the regimes in modern Ethiopian history.

At this point, it is relevant to note that the establishment of new administrative structures without consulting customary institutions greatly influenced the adaptation strategies of the pastoralist communities to spatial and temporal variability of rainfall through halting mobility of livestock, even worse, at some areas it results in conflicts among resource users (Oba, 1998; Abdulahi, 2007). Similarly, although it was not fully implemented, villagization and resettlement programmes used as rural development

strategies during the *Derg* regime eroded trust between state and pastoral communities (Workneh, 2006).

Contemporary Regime (1991 to the Present)

In Ethiopian history, it is a significant progress in pastoral policy as pastoralists' interests were somehow recognized by the supreme legal document of the country, the Constitution since Ethiopian People's Revolutionary Democratic Front (EPRDF) came to power. The EPRDF government drafted new Federal Democratic Republic of Ethiopia (FDRE) Constitution in which it addressed the marginalized communities like pastoralists. The FDRE Constitution enforced since 1995, and basically, replicates the previous regimes stand regarding the ownership of the land (Kebede, 2008). Article 40(3) of the FDRE Constitution provides that land is the common property of the nations, nationalities, and peoples of Ethiopia and shall not be subject to sale or other means of exchange.

The Constitution further stipulates that the ownership of rural and urban land, as well as of all natural resources, is exclusively vested "*in the state and in the people of Ethiopia.*" One of the typical features of this FDRE Constitution, while compared with its predecessors, is that in the first place, it is characterized by decentralization of government power based mostly on ethnic federalism (Abdulahi, 2007). Secondly, FDRE Constitution Article 40 clearly spelled out that Ethiopian pastoralists have the right to free land for grazing and the right not to be displaced from their own lands without their wish. Article 40 says that

Ethiopian pastoralists have a right to free land for grazing and cultivation as well as the right not to be displaced from their own lands.

Similarly, the FDRE Constitution recognized and guaranteed the indigenous communal landholdings of the pastoral communities and provides as they should get fair prices for their products (Abdulahi, 2007; Desta, 2006). Furthermore, as Abdlahi (2007) noted FDRE Constitution Art 40(5) is based on a clear understanding of collective ownership rights of pastoral communities and overall pastoral ways of life. However, tenure security of pastoralists still remains weak while compared with farmers. Pavanello and Levine (2011) deeply analyzed that the notion of 'free land' in the article shows the moment the land is taken by the state for another purpose, as the ownership right of the land is totally vested in the state, pastoralists lose their grazing land, as there is no free land. Similarly, Dessalegn (2007) states formal land tenure structure in Ethiopia dismantles the ownership rights of pastoralists and provides only the use rights.

More problems arise when one further looks at other land use proclamations and pastoral development policy statements. Before directly go to discussing other pastoral policies, it is pertinent to start with the FDRE Rural Land Administration Proclamation No.89/97 to understand the marginalization process of pastoralists. This proclamation was enacted in 1997 and later on replaced by FDRE Rural Land Administration and Use Proclamation No. 456/2005. It seems that the Land law enacted in 2005 stands only to ensure the tenure security of private property rights. Contradicting to the FDRE Constitution, it dismisses the pastoral communal landholding systems and concerns majorly for attractions of investment on pastoral lands. In its preamble, it states that the legislation is enacted to *"encourage private investors in pastoral areas having tribe-based communal landholding systems."*

This clearly indicates that the 2005 land use Proclamation provides more power to state which opens the door for the government to easily appropriate communal grazing lands and transfer for investors (Abdulahi, 2007). The proclamation provides

power to the government to privatize the communal land as deemed necessary. Despite progress in recognition of pastoral communities by the Constitution of the land not to be displaced from their land, yet there are many unsettled issues and conflicting policies regarding the pastoral land tenure arrangements. Overlying putting pastoralists' issues on development agendas, there is a hidden idea that pastoralists' mode of life should be eradicated and replaced by other economic activities.

Since EPRDF seized power, the Ethiopian government has put in place a number of laws, policies, and strategies that are designed to support sustainable development. To understand how these policies and strategies marginalized the pastoral communities, the following section of the paper looks into the major development policies and strategies.

To start with Environmental Policy, the Environmental Policy of Ethiopia was approved in 1997 and is the first key document that captured sustainable development principles. It recognizes the customary rights of access to and use of land and natural resources in line with the constitution. It directs the development of both medium and large scale irrigation projects and develops rangelands which can be used for grazing and crop production based on cost-benefit analysis. It is strongly argued that pastoralists in Ethiopia contribute to environmental sustainability and economic development through managing large areas of rangelands (62% of land coverage) they customarily possess (McGahey et al., 2014). Nonetheless, Ethiopian Environmental policy overlooked these huge roles and did not give any direction towards rangelands management and development to ensure green development in the country.

Since EPRDF seized power, there are various successive multi-sectoral national development plans adopted to eradicate poverty and ensure equitable growth that recognize the pastoral issues including Sustainable Development and Poverty Reduction Program (SDPRP) (2000 – 2004), Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005 – 2010) and Growth and Transformation (GTP) I and II (2015 – 2020). Likewise, though a large portion of the document deals with the issues of crop production, the EPRDF Rural Development Policies and Strategies (RDPS) formulated in 2002, appreciates the role of pastoralists in the country economic development and clearly recommends that any development endeavor should start with pastoralism upon which the livelihood of the society depends.

However, while one closely examine all national development plans and strategies including undergoing GTP II, in their long term strategies they focus on voluntary sedentarization and promotion of agriculture based on the development of irrigation infrastructures. At the onset, the settlement policy endorsed by the government mainly justified by the provision of socio-economic services. However, when one closely looks at the policy statement and strategy, it is predominantly guided by core values of pulling the pastoralists from ‘backward’ mobile ways of life.

It is also worth noting that one of the remarkable moves under the EPRDF government regarding pastoral development is that unlike its predecessors, it has formulated specific pastoral development policy. The comprehensive pastoral development policy was developed by the Ministry of Federal Affairs in 2002 (MoFA, 2002). Although this policy statement acknowledges the role of customary institutions and indigenous knowledge of the communities, in the long run, it essentially seems the government is committed to settling all pastoralists. Among many issues identified to be addressed, such as rangelands conservation, water

development, infrastructure and social services the major policy premise lies on the settlement of the pastoralists. A close look at this policy document further reveals that there are unrefined and contradicting issues. On one hand, the policy tries to recognize the customary rangeland management systems. On the other hand, it recommends a sustainable settlement. Similarly, many studies (Desta, 2006; Helland, 2006; Tache, 2008; Lemmessa, 2015) argue that pastoral policy still remains unclear.

During the previous regimes, there was no permanent government structure with a clear mandate to plan and implement development interventions in addressing pastoral communities. As recognition of pastoral communities in the arena of national development policies is growing, the FDRE government established the Ministry of Federal Affairs (MoFA) to coordinate pastoral development activities alongside other sectoral issues. As a step forward, the Pastoral Affairs Standing Committee (PASC) is also being organized at the House of Representatives level, mandated to oversee the pastoral development activities. Nevertheless, many argue that it is mainly driven by political agendas, controlling the pastoral areas, as they are in peripheral and strategic regions, that they could be the means for political and military infiltration (Mohammed, 2004).

Currently, various pastoral departments, units, teams, and task forces were structured within the concerned federal ministries like the department of pastoral development within the Ministry of Federal Affairs (MoFA), and departments within the Ethiopian Agricultural Research Institutes (EARI), Ministry of Agriculture (MoA), and Ministry of Water Resources. There are also task forces in the Ministry of Education (MoE) and the Disaster Prevention and Preparedness Commission (DPPC) to address pastoral issues. Correspondingly, pastoral development offices were structured down the hierarchy at regional, zonal and district levels in Oromia, Afar,

Somali and Southern Nations and Nationalities (SNNP) where the pastoral mode of production exists.

Summarizing, despite positive moves in the incumbent regime, especially in recognizing the role of the pastoral economy and customary institutions, the notion behind various policies and laws still dictate that the pastoral lands are underutilized. In other words, it is conceived by government policymakers that the pastoral lands are viewed as free space to be used. This wrong assumption resulted in the appropriation of pastoral communal lands for private investors for modern ranch development and other non-pastoral activities. Besides, persistent marginalization process and unfavorable pastoral development policies have left the pastoral communities with no alternative livelihood options that fit the pastoral system.

5.3. Exposure to climate stressors

5.3.1. Climate trends of the study area

Temperature trends

Climate data obtained (1980 – 2014) from Ethiopian Meteorological Service Agency, Yabello station showed that the mean annual daily temperatures was $19.8^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$ SD. The maximum and minimum temperatures were $25.6 \pm 2.3^{\circ}\text{C}$ SD and $14.013 \pm 1.3^{\circ}\text{C}$ SD, respectively. The data in Fig. 15 (a) corroborate that the mean monthly minimum temperature showed fluctuating trend during 1980 to 2011, while the maximum temperature showed slight increase during 2000 to 2011 from the mean temperature.

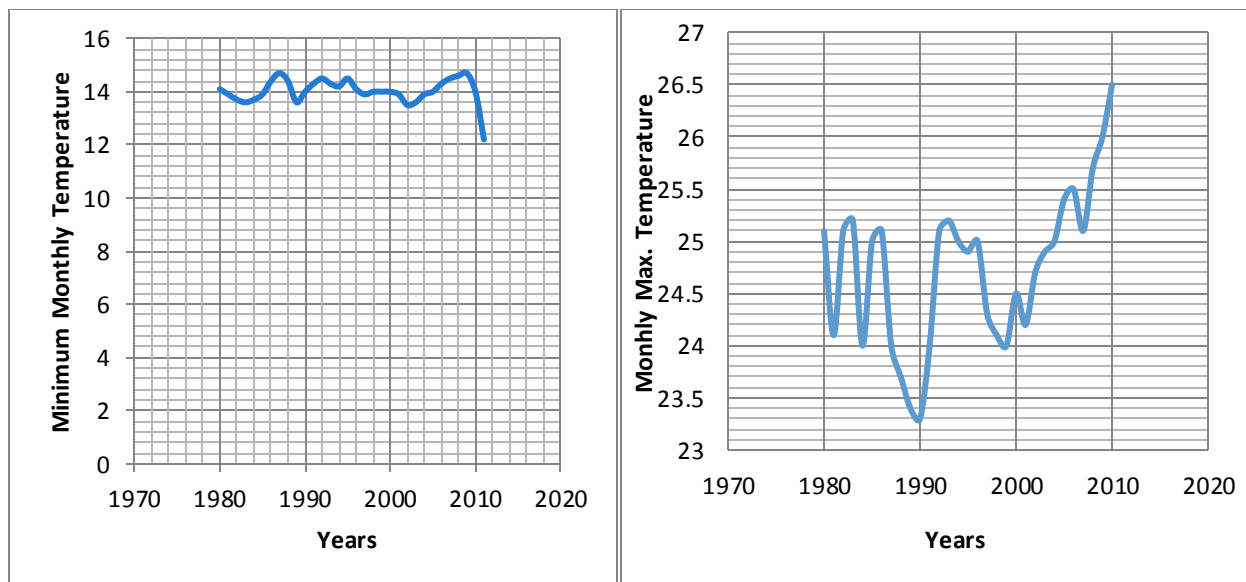


Figure 15 (a) Minimum Monthly Temperatures, (b) Maximum Monthly Temperature of the study area

Source: Created based on the unpublished raw data of Ethiopian Meteorological Service Agency

Annual Rainfall Trends

Records indicate that the study area has a mean annual rainfall of 579.4 ± 171.24 mm with 29.8% coefficient of variation (C.V). However, the average annual rainfall shows slight decrease from 1980 – 2010 (Fig. 16). This trend agreed with the perceptions of herders as presented in the subsequent section. Likewise, studies conducted in Sub Saharan Africa (e.g. Bekele, 2013; Viste *et al.*, 2013) reported that the annual rainfall has decreased for three decades since the early 1980s. This situation results in vulnerability of pastoralists' livelihood by reducing forage productivity and the availability of water resources (Desta and Coppock, 2004).

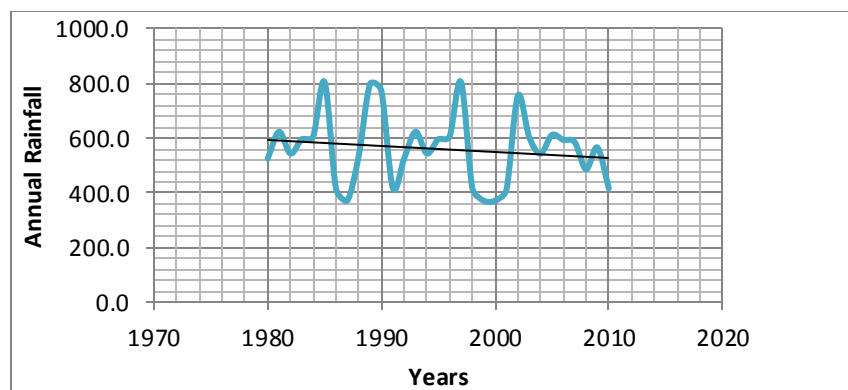


Figure 16 Annual rainfall of the study area

5.3.2. Perceptions of herders towards climate variability and change

The perceptions of herders are based on temperature and rainfall variation experienced over the last twenty years. During the survey, the respondents were asked to indicate the trends of temperature and rainfall, whether increasing or decreasing. Table 5 shows that nearly 83% of the respondents perceived an increase in temperature. The finding also revealed that 12 % of the respondents reported that the temperature in the area is fluctuating (Table 5).

Table 5 Perception of Borana pastoralists on temperature and rainfall (N=186)

Temperature	Frequency	Percent (%)
Increased	154	83
Decreased	8	4
Fluctuating	23	12
Same	1	1
Rainfall		
Increased	11	6
Decreased	151	81
Erratic	22	12
Same	2	1
Frequency of Drought		
Increased	169	91
Decreased	7	4
Same	10	5

Source: Computed from HH survey of 2016

Similarly, the result of the survey showed the decreased and erratic rainfall trend over the last 20 years. Over 81% of the respondents reported that the rainfall trend in the area is decreasing from time to time and about 12% perceived the trend as erratic. Only 6% of the respondents observed the increase in rainfall trends. Moreover, the majority (77%) of the respondents reported late onset of the rainy season. Overall, the majority of interviewed pastoralists felt that climate conditions have changed over the last 20 years.

The data generated from FGDs and key informant interviews reveal that 20 to 30 years ago, Borana land received sufficient rain during the wet season termed as '*gana*' (February to April). In these days, however, the amount of rain has significantly decreased and became uneven. Similarly, 30 years ago, rainfalls were regular and predictable in seasons but, now a day, this situation became history. The majority of respondents (91%) reported increased frequency of drought in Borana. FGDs participants perceived that drought occurrence and cycle was reduced from 10 to 20 years to five or less. In line with this, one key informant from Yabello Pastoral and Drylands Agricultural Research Center commented: *Before, droughts used to occur after 10 years, but these days, droughts have become very common.* Our findings are consistent with the previous studies, such as Debasu (2013) who reported that after the '*Gada*' of Boru Guyyo (1985–1992), wet season rainfall decreased and became much more erratic.

5.3.3. Hazards reported by pastoral households

The respondents reported that drought, floods and livestock disease outbreaks are the main hazards they frequently experienced over the last 10 years as a result of climate variability or changes (Table 6). Among these, drought was the major hazard they experienced. About 86 % of the interviewed household heads indicated that drought events were increasing from time to time in the area and increasing the vulnerability of the pastoral households in the area. According to key informants, increasing frequency

and severity of drought is intensifying pre-existing scarcity of pasture and water and hence causing massive cattle losses through mortalities and forced off-takes. For example, recent drought of 2015 caused massive deaths of livestock in Borana.

Table 6 Hazards reported by Borana pastoral households (N=186)

S/No	Hazards	Frequency	Percent (%)
1	Drought	161	86
2	Livestock disease Outbreaks	18	10
3	Floods	6	3
Total		186	100

Source: Computed from HH Survey, 2016

The results also display that 10% of household heads reported that they were experiencing livestock disease outbreaks. The remaining 3% stated that they experienced flood as the main hazards. During the survey, participants of FGDs confirmed that the intensity of drought has been increased. In consistent with our findings, many studies (Desta and Coppock, 2002; Angasa, 2007; Skinner, 2010; Bekele, 2013; Debasu, 2013) reported that drought is the main climate-related hazard severely constraining the livelihood of pastoral communities in drylands. These studies demonstrate that in the past, droughts lasting several years occurred approximately once in 20 years. However, in recent years, the period between droughts has decreased to less than 5 years. Since severe drought occurred during 1983 – 84, 5 severe droughts have been occurred at the intervals of 6, 6, 4, 4 and 6 years. In these days, it is very difficult to predict drought cycle as before. Summing up, Borana pastoralists were suffering from loss of livestock, which is considered as an asset in pastoralists' context due to unpredictable and recurring droughts.

5.3.4. Socio-economic and Bio-physical Vulnerability Indicators

As it can be seen from data displayed in Table 8, in terms of the indicators chosen to reflect adaptive capacity such as availability and access to various infrastructures and institutional support services, key assets ownership and literacy rates, Borana pastoral households were found at poor profile which in turn negatively affect the robustness of their adaptation strategies. In human capital front, findings of the survey reveal that majority (70%) of the respondents indicated as they were not able to read and write which reduces the household's ability to use climate related and other useful production and market information.

Regarding economic indicators, noticeably, the livestock possession has shown a declining trend. As shown in Table 9 over 76% of the respondents owned less than 4TLU during the survey period. Likewise, about 41% of the respondents indicated as they owned less than two milking herds due to prolonged breeding time resulting from adverse environmental change effect. Moreover, the productivity of milking cow has significantly fallen with increasing feed shortage. This clearly indicates high vulnerability to climate induced shocks.

More importantly, the participation of pastoral households in non-climatic sensitive livelihood diversification is found to be very low. As it can be seen from the Table 8 large majority 78% of the respondents indicated they have no alternative income sources clearly indicating high vulnerability to climate induced shocks. While we look at dependency ratio, noticeably, 65.1% respondents reported more than four dependents in the households. This indicates that households' with higher dependency ratio are easily susceptible to losses induced by climate related shocks.

Obviously, institutional supports such as credit facilities, market accessibility, extension services, livestock and human health infrastructures and water availability enables

pastoralists to adapt to arid and changing environment in pastoralists situation. One of the noticeable finding of this analysis was that majority of households travel long distance (2hr walking distance for a single trip) to access market services, human and livestock clinical services and water sources.

With regard to credit facilities, the data presented in Table 9 clearly depict that the credit use in the study area is almost nil. It was found that from sampled households only 3.8% respondents reported that they had accessed credit services. Likewise, access to extension services is found to be limited in its coverage. As it can be seen from Table 9, 84.4% of the survey participants indicated that they did not access extension services.

Similarly, from biophysical factors, increasing frequency and intensity of drought, increasing temperature and declining rainfall have highly contributed to the vulnerability of pastoral households in Borana. Nearly all of the respondents (98%) had noticed the deviation of climate variations/changes (Table 7).

Table 7 Selected indicators of vulnerability and their effect on vulnerability level

Variable Indicators	Percentage (%)	Expected Relation
Adaptive Capacity Indicators		
Age of HH heads: 50+ years	37.1	+
Education Level of HH heads: illiterate	69.9	-
HH family size: More than five persons	89.8	-
Economically active members: dependency of 4 person & more	65.1	+
Total Livestock Units: Having less than 4 TLUs	76.3	-
Camel Ownership: Have no camel	82.8	-
Livestock diversity: less than 2 livestock species	41.4	-
Availability of milking herds: less than 2 milking herd	78.5	-
Own private land: Have no private land	19.4	-
Crop Farm income: No income from crop farming	30.7	-
Herd mobility practice: No mobility practice	76.9	-
Non-farm income: No non-farm income	78	-
Members of household employed: no member employed	90.9	-
Access to Credit services: No credit access	96.2	-
Radio Ownership and listening: Having no radio	74.7	-
Mobile Ownership: Having no mobile	40.3	-
Livestock market distance: More than 2hrs walking distance	59.1	+

Membership in Cooperatives: No membership	81.7	-
Social Network(Linkage): Have no social networks	11.3	-
Training participation: No training received	82.3	-
Extension Contact: No extension advise	84.4	-
Early warning information: received no information	94.1	-
HH coping strategies: more than 2 coping strategies	37.1	-
Family Health condition: affected by at least one disease	69.4	+
Distance from Livestock Clinic: More than 2hrs walking dist.	50	+
Distance from Water source: More than 2hrs walking distance	32.3	+
Distance from Health center: More than 2hrs walking distance	50	+
Disease prevention: at least use one prevention mechanism	23.7	-
Sensitivity and Exposure Indictors		-
Climate change: experiencing change	97.8	+
Temperature variation: Experiencing above average	82.8	+
Rainfall variability: Receiving below average	81.2	+
Drought: Noticed increased drought frequency	91	+
Drought: Experience drought in the last five years	86.6	+
Flood: Experience flood in the last five years	3.2	+

Positive sign indicates that the variable increases vulnerability, while negative sign means it reduces vulnerability. *TLU*: Tropical Livestock Units (1TLU 250 kg live weight)

Source: Computed from household survey, 2016

5.3.5. Vulnerability at Household Level

Eleven principal components were retained in PCA from twenty eight selected indicators of adaptive capacity. These principal components explained 71.2% of the total variation in the original 28 variables included in the analysis. The results of the PCA also show that the first factor explained 12.7% of the total variation in the data while the second factor explains only 9.3% of the variance. The component loadings or weights for each variable obtained from the first component of PCA analysis is given in Table 8.

Table 8 Component scores of coefficient for first PCA for adaptive capacity indicators

Vulnerability variables	
Adaptive Capacity Indicators	Loadings
Distance From livestock clinic	0.962
Distance Livestock market	0.958
Distance from health center	0.855
Distance from water source during dry season	0.615
Crop Farm income	0.927
Own private land	0.925
Number of Adaptation Strategies	0.516
Livestock diversity	0.747
Availability of milking herds	0.686
Total Livestock Units	0.660
Members of household employment status	0.861
Off-farm and non-farm income	0.810
Household head illiteracy level	0.734
Mobile ownership	0.649
Household head age	0.463
Economically active members	0.805
Household size	0.654
Membership in formal cooperatives	0.840
Disease prevention methods	0.683
Climate information services	0.814
Herd mobility practice	0.552
Access to credit services	0.811
Radio ownership and listening	0.531
Social linkage status	0.732
Extension Contact	0.484
Family health condition	0.745
Training participation	0.624
Sensitivity and Exposure Indictors	
Climate change perception: Perceive change	0.898
Temperature variation: Experiencing above average	0.886
Rainfall variability: Receiving below average	0.883
Drought frequency: Noticed increased drought frequency	0.469
Drought hazards: Experience drought in the last five years	-0.788
Flood hazards: Experience flood in the last five years	0.847

Extraction method: principal component analysis, rotation method: varimax with Kaiser Normalization, and rotation converged in eight iterations. Source: Computed from Household Survey, 2016

As hypothesized, the loadings of all indicators of adaptive capacity show positive sign indicating positive correlations among the variables. It is very important to notice that walking distance to the nearest livestock clinic, human health center, livestock market, and water source received higher weights and negatively impact the adaptive capacity as hypothesized. The higher the weight of the indicators implies the higher the impact of indicators in adaptive capacity. Therefore, it can be seen that all indicators were found to increase the adaptive capacity as shown by the positive sign of the weight.

Income diversification, private land ownership, total livestock holding, livestock diversification and availability of milking animal increased adaptive capacity as expected. Equally important, it was found that dependency ratio and household family size decreases the adaptive capacity of the household. Institutional support services indicators such as credit access, climate related early warning information, extension services and training participation were found to increase the adaptive capacity. Likewise, illiteracy level also found to influence adaptive capacity positively.

Regarding the exposure and sensitivity indices, the weights for the indicators of exposure and sensitivity were all positive as hypothesized except for drought hazard. This clearly shows that temperature trend, rainfall trend and perception of climate change contribute positively to the sensitivity index. In similar vein, while flood hazard and frequency of drought contribute positively to the exposure index, drought hazard contributes in the opposite direction. Overall, the loading of each variable for the retained principal components for all selected indicators were detailed in Table 8.

One of the main purposes of this paper was to categorize individual household based on vulnerability index. Therefore, in this particular study, the vulnerability index was calculated by assigning arithmetic relation i.e. subtraction of the sum of exposure and sensitivity index from adaptive capacity index. As shown in Table 9, based on

calculated vulnerability index, the sampled households during the survey were classified into three categories as less vulnerable (+1 to +9.65), vulnerable (-0.99 to +0.99) and highly vulnerable (-8.45 to -1). It should be noted that vulnerability index is not absolute measurement of household vulnerability level, however it provides comparative figure to compare individual households.

Table 9 Classification of households based on calculated Vulnerability index

Vulnerability Level	Vulnerability Index	Frequency	Percent
Highly Vulnerable	-8.45 to -1	78	41.9
Vulnerable	-0.99 to +0.99	40	21.5
Less Vulnerable	+1 to +9.65	68	36.6
Total		186	100

Source: Computed from Household Survey, 2016

Overall, the results of the survey summarized in Table 9 display that majority, about 63% of the respondents, found in high and moderately vulnerability levels. A further look at the finding of the survey strikingly reveals that 54.3% of the respondents had negative values implying that their adaptive capacity index is less than the sum of exposure and sensitivity indices. In other words, these proportions of the respondents were characterized by low illiteracy rates, low total livestock unit holding, low income diversification, limited access to institutional and social services and extension services. Summarizing, this finding shows that the adaptive capacity of Borana pastoralist demonstrated throughout history has been already eroded.

5.4. Drivers of pastoralism vulnerability to climate variability/change

Today, the Borana pastoral system is facing interlinked changing climate and socio-political conditions. These simultaneously occurring climate and socio-political transformations said to create double exposure that co-produce new pastoralism vulnerability pathways. This section highlights the complex interactions between socio-political and climate stressors and how the interactions of those stressors are producing

new pastoral system vulnerability, particularly focusing on how contextual socio-political change drives pastoral system vulnerability to climate change-induced stressors.

Property regime shifts and land tenure insecurity

For centuries, in Borana, communally owned rangelands have been governed by sophisticated customary institutional arrangements that ensured equitable access rights to grazing and water and sustainable management of these resources (Oba, 1998; Helland, 2006; Ayana, 2007). The customary tenure arrangements primarily based on *Gada* system allowed the Borana community to exploit patchy resources and adapt to environmental risks. However, evidence shows that throughout the history of modern Ethiopia, successive governments denied the customary land tenure arrangements (**section 5.2**) and these processes drastically affected the capacity of the system to adaptively respond to shocks associated with environmental changes. Formal land tenure structures and land use policies persistently worked to dismantle the social dimension of the rangelands from land use patterns. In terms of land tenure and use systems, despite limited interference to the pastoral system prior to Hailesilasie regime (not because of due concern for pastoral communities, but due to remoteness and fragility of the area), generally, history shows that there was no harmonious relationship between the state and pastoral communities (Tache and Irwin, 2003; Ayalew, 2004; Helland, 2006; Tache, 2008).

Indeed, land reforms in this country, in any case, cannot be free from the influence of existing theories and postulates on institutions and natural resources governance as policy makers, planners and experts were western trained (Desta, 2006). As persuasively elaborated by Scoones (1995), there are three major theories said to have influenced the direction and process of land reforms across the globe. These are: (1) The

tragedy of the commons which recommends privatization and nationalization to sustainably manage the land resources, (2) The property rights school, which has largely recommended private property; and (3) the “assurance problem” approach, which defends that over-exploitation of resources does not arise from free-riding behavior but rather stems from a coordination problem among resource users.

Most probably informed by the ‘Tragedy of the commons’ postulate formal written denial of property rights of pastoralists in the form of constitution started during Emperor Haile Selassie regime. As discussed above, the 1955 Constitution formally removed the pastoralists’ land tenure security through stipulating the ‘nomads’ lands as no body’s land’. Apart from the nature of the governance system, it is partly due to ill-understanding of the pastoral mode of life that based on extensive rangeland use based on mobility which is used as a strategy to adapt to environmental changes.

Although, land reform during the *Derg* regime is considered to be radical and abolished landlordism, the process of pastoral land alienation continued. The land reform proclamation in its Article 26 provides pastoralists only possessory rights, with ultimate right vested in the state. It took away their land but gave them permission to use it (Dessalegn, 2007). This was followed by the extensive appropriation of pastoral lands by the state in promoting large commercial agriculture. For instance, evidence showed that more than 150,000 hectares of key dry season grazing lands were taken by the state for the development of commercial agriculture without compensation which highly compromised the adaptation strategies of pastoralists to highly variable rainfall (Ayele, 2004; Helland, 2006).

At present, although the pastoral land right is recognized in the Constitution of the land than in any of its predecessors, in terms of ensuring security tenure structures, it has not brought significant change. Moreover, land use policies and strategies set by the Federal

Government of Ethiopia contradicts the Constitution in that the formulated land use proclamation stands in favoring of attracting investors to the pastoral lands. As discussed above, the land use law declares that the government can transfer communal pastoral lands to private holdings if it deems necessary. As one can easily understand, security of tenure arrangements remains vague and poor. It directly depends on the interests of the state in that the state can displace the pastoralists for alternative pastoral land use for other economic activities (Helland, 2006; Dessalegn, 2007; Tache; 2008).

The land use policy, thus, allows the continuation of alienation of pastoral lands. For example, in Borana zone, there are reportedly five big private ranches occupying a total of 33,805 hectares of rangelands. The rangelands given for the ranch development were the better lands of the rangelands (Oba, 1998; Tache and Irwin, 2003; Eyasu, 2008). As noted by Tache (2008), it was during EPRDF government that for the first time privatization of the grazing lands was actually implemented in Borana. This process interfered and challenged the local adaptation mechanisms of the communities through loss of dry season grazing lands. This could also result in further degradation of the communal grazing lands through concentration of livestock at a certain place. Ultimately, the erosion of productive rangelands further exacerbates the vulnerability of the community to environmental stress.

According to the survey results, almost all (97%) respondents indicated that poorly defined land tenure system and associated encroachment upon relatively better rangelands are the major threats posing a huge problem on the livelihoods of pastoralists and common property rangeland resources by undermining local adaptation pathways. In this regard, one of the key informants convincingly explained that the dispossession of lands resulted in reduced productivity of livestock production and total loss of livestock asset. He said that *“In the past, there were enough pasture lands for all households, today, however, productive rangeland is taken away by private enclosures*

supported by government". In sum, continued pastoral land encroachment and land tenure insecurity exacerbate the negative impacts of increasing droughts induced by the environmental process posed challenges to the resilience of the pastoral system.

Apart from the alienation of key rangelands, there is also increasing demonstration that the state land use policies and strategies have led to rangeland fragmentation through weakening customary communal tenure regimes (Tache, 2008; Flintan, 2011; Napier and Solomon, 2011). As the land tenure system regulates the rights of use and access to land, hence, play an important role in sustainable rangeland management (Mwangi, 2005). Well-structured and adapted land tenure rules can promote sustainable land use and management. In contrast, studies show, insecure land tenure is linked to poor land use which in turn leads to rangeland fragmentation and degradation (Napier and Solomon, 2011).

As the results of the survey show, the state-imposed land laws, on one hand, fail to protect tenure security of the Borana society, on the other hand, succeeded in disarming the effective communal tenure system which, in turn, has led to reduced attachment of the society to customary institutions and over-exploitation of rangeland resources. These persistent processes further weaken the collective institutions and eventually left a vacuum in the rangeland governance system. In other study conducted by Kamara et al. (2004), it was reported that the state land institutions are challenging the viability and resilience of customary land tenure and management institutions which relied on collective arrangements.

This vulnerability pathway is combined with the notion of free market system, increasing human population growth, and the resulting competition for survival among pastoralists which brought about open access system in Borana rangelands which directly contributed to the deterioration of pasture lands signifying the postulate of the

‘Tragedy of the Commons’. Many studies also confirm that the land tenure policies intended to nationalize ecosystem properties through taking land as state property in order to prevent degradation instead of managing it as the common property has often failed (Ostrom, 1990; Mwangi, 2005; Ostrom et al., 2012; Tahmasebi, 2012).

The other potential threats associated with a shift in land tenure system and poor land use planning largely due to misguided external intervention is fragmentation of rangelands through expansion of private enclosures. In responding to severe and recurrent droughts and non-climate stressors, it was observed that private enclosures are spreading (**section 5.6**). The rangeland enclosures partly stimulated by the expansion of opportunistic crop farming (Napier and Solomon, 2011). In the efforts to use the land for crop production, individuals fence certain parts of the rangelands and they cultivate as much as they can and leave the remaining for pasture. However, the main driver of the emergence of rangeland enclosures was severe and recurrent droughts. Before the mid1980s, communal enclosures were used as fodder banks (*kalo*) were exclusively governed by customary institutions and played significant roles in adapting to ever-changing environmental conditions.

However, the expansion of private enclosures attributed to the weakening of customary rangeland governance systems (Flintan et al., 2011; Napier and Solomon, 2011; Tache, 213; Coppock et al., 2017). Despite it is being promoted by government and non-government organizations as a best practice in responding to changing the climate, uncontrolled expansion of private enclosures is endangering the traditional adaptation strategies of the pastoral system in the Borana. With this regard, one of the key informants put the extent of the problem as the following:

“The situation we are facing is terrifying. Individuals who have large herds or economically powerful and have link with government structures are enclosing the lands

without any permission from the community as it was before. Borana elders lack authority to protect as before they used to."

Evidences generated from FGDs revealed that as consequence of expansion of private enclosures, new facet of competition over the resources has appeared. The resulting fierce competition for resources further broken-down the customary institutions and posing emerging challenges on existing property right regimes through fragmentation of the rangelands. This fragmentation is, in turn, affecting communities' adaptation capacities in many ways. Firstly, it has blocked the traditional livestock mobility routes which complicated the adaptation strategies to changing environmental risks. As the data generated from FGDs, as a consequence of rangeland enclosure by individuals, mobility has already been constrained.

Secondly, it has led to restrictions of access right especially of those poor and powerless households. Due to collapse in customary enforcement mechanisms, wealthy members of the community have appropriated the rangelands. Consequently, the poorer households remained with marginal and less productive communal rangelands although they are also attempting to appropriate. This means the spread of unplanned private enclosures have benefited small proportions of the society while the majority of the community members have been pushed to food insecurity and poverty which limited their adaptive capacity in responding to environmental change.

Thirdly, as FGDs participants stated, contrary to customary reciprocal resource use in Borana, expanding spontaneous private enclosures ultimately ended up with internal conflicts over the enclosed lands. In consistent with the finding of this paper, Tache (2011) reported that cases such as contrary to pastoralists tradition, cruel way of killing animals were happening as a result of violent internal conflicts over enclosed lands.

Finally, the private enclosure has been ended with the degradation of the rangeland resources as additional pressures have been placed on the now smaller and fragmented pool of resources.

Moreover, Pavanello and Levine (2011) persuasively argue that in fragile environment, like drylands of Borana, unpredictable rainfall situation poses uncertainty on location of productive and productive sections of the rangelands. This is because; the drylands are characterized by greater degree of spatial and temporal rainfall variability. Therefore, it is more suitable to use and manage the entire rangelands commonly than parceling or fragmenting it (AU, 2010; Pavanello and Levine, 2011; Coppock et al., 2017). In connection with this, Ostrom (1990) postulated that structuring effective and sustainable natural resource governance needs understanding of attributes of both natural and human systems. However, from the above discussion, one can easily understand that most of the state led policies and interventions put in practice lacked this vital ground. Experiences all over the world show that neither state control nor privatization can offer the creativity and flexibility required for the sustainable management of the rangeland resources under increasing patchiness of the resource distributions associated an increasing aridity derived by climate change (Coppock et al., 2017).

There is a wide agreement among studies undertaken in Borana that spontaneous expansion of private enclosures in the communal grazing has resulted in further breaking-down of the customary rangeland governance system thereby increasing the vulnerability of the majority of the members of the communities to environmental changes by deteriorating already limited adaptive capacities of the pastoral system (Oba, 1998, Homann, 2005; Tache, 2010; Tache, 2011; Flintan et al., 2011; Filntan, 2011; Tache, 2013). In sum, in Borana, the interactions of environmental change and the shift

in land tenure structures has created conditions that limit adaptive response to SES dynamics.

Sedentarization policy pressure

Mobility is one of the peculiar characteristics of the pastoral production system which is used to optimally utilize highly scarce and variable rangeland resources. With expected increasing aridity associated with climate variability and changes, more mobility of herds is required (Coppock et al., 2017). However, settlement policy was followed by the government. Following the down fall of Imperial regime, the sedentarization policy came into the fore. During the *Derg* regime, mobility practice and associated customary institutions have been drastically influenced by the process of villagization or the new settlement process and establishment of new governance structures without giving due consideration for the existing customary governance structures.

Despite some improvement in recognizing the rationality of pastoral mobility practice, still to date, the pastoral development policies and strategies are fundamentally founded on the conviction that pastoral lands are poorly utilized and pastoralists' lifestyle based on mobility is considered to be culturally 'backward' and obstacle to development (Abebe et al., 2015). This has led to erroneous policy frameworks and interventions that mainly focused on sedentarization and discontinuation of custom of pastoral mobility.

This would largely stem from poor understanding of ecological and social conditions of rangeland management (Abebe et al., 2015; Lemmessa, 2015). Drylands on which pastoralists livelihoods depend on are characterized by highly variable resources and rainfall availability in time and space and low productivity (Nori, 2007; Upton, 2012; Reid et al., 214). The practice of pastoral mobility is derived from these forces. Pastoralists are forced to move from place to place in search for scattered resources over

time and space and avoidance of seasonal stresses such as shortage of pasture and livestock diseases. It also reduces rangelands degradations through decreasing pressure on rangelands (Oba, 1998; Cosens et al., 2014). Mobility, therefore, reduces the vulnerabilities of pastoralists to climate variability (Upton, 2012).

During the survey, respondents were asked whether they practice mobility or not. Accordingly, only 23% reported as they practice mobility. The remaining majority (about 87%) have already abandoned mobility practice. As a follow up, while the respondents were asked the reason why they stopped mobility practice, they indicated that they have no adequate land rights to move. Information captured through the FGDs and key informant interviews also confirmed that long practiced mobility has been constrained by settlement programs sponsored by government and expansion of crop cultivation. Besides an increasing rangeland fragmentations is a critical challenge in maintaining mobility which allows flexible use of resources (Coppock et al., 2017). This drastically increased the vulnerability of the community to climate hazards through constraining access to productive rangelands and breaking opportunistic use of variable resources over space and time frame.

Change in production systems

In connection with land use policy and strategy, the government has been promoting rain-fed agriculture throughout variable agro-ecological condition of Borana which caused competition between pastoralism and crop production over the land use. Besides, in response to socio-political and environmental stresses the Borana pastoralists are readily adopting crop cultivation on small scale basis to diversify their income sources. Although widely expanded after land proclamation in 1975 during the *Derg* regime, crop farming is said to be started in early 1960s in response to drought induced famine (Oba, 1998; Ayana, 2007) (**sections 5.6.2 and 5.6.3**).

The present survey reveals that about 79 % of the sample households have already started farming. Similarly, Ayana (2007) reported that from sampled households 87% engaged in crop farming. The data gathered during this survey shows that on average, the sample households' land holding for farm land was about 1.3 hectare, to some extent greater than the result of the study conducted by Coppock (1994) reported as one hectare. This possibly shows that the land put under crop cultivation is increasing over the last decades. Overall, in the Borana zone, the communal grazing land converted to crop land is estimated to be about 1,332,900 ha (Pavanello, 2009). Similarly, as the data generated from the key informants interview with Borana Zone Agricultural and Rural Development experts during the survey reveals that on annual basis, additional hectares of land is prepared to expand crop cultivation through agricultural extension programs.

However, the expansion of crop farming has brought about new challenges on the pastoral system. As key informants persuasively presented, rain-fed cropping is difficult to sustainably practice in arid and semi-arid lands characterized by unpredictable rainfall seasonality. On one hand, the productivity of crop farming is too low. On the other hand, pastoral households who depend on crop production are more at risk of losing their crop if rains do not come as crop production is more susceptible to shortage of rainfall.

Conforming to this finding, Eyasu (2008) pointed out that cropping is a risky business in drylands due to unreliable rainfall. The adoption of cropping as strategy often involves the disruption of well-established traditional seasonal grazing system and mobility. It poses negative impacts on livestock production through snatching prime grazing areas especially located in wetter areas. In consistent with this finding, Skinner (2010) reported that crop agriculture may cause irreversible damage to the rangeland and hence drives the pastoral system to vulnerability to climate variability.

Weakening of Customary Institutions

Vulnerability of any system or community is influenced not only by characteristics, magnitude and rate of change factors such as climate change and socio-political transformations but also by coping or adaptive capacity of the system itself (Tyler et al., 2007). Adaptive capacity is the ability of the system to adjust to change through learning and flexibility (Adger, 2006; Folke et al., 2006). Empirical studies all over the world demonstrate that customary institutions, as they are evolved through adaptation process, play key roles in building adaptive capacity of the system (e.g. Adger, 2000; Adger, 2006; Cosens et al., 2014; McMillen et al., 2014).

The adaptive capacity of the pastoral community is therefore determined by the customary resource management institutions embodied in the aboriginal knowledge and culture of the society (Tyler et al., 2007). As repeatedly demonstrated, in Borana, commons institutions based on their indigenous knowledge have played significant roles in building adaptive capacity of pastoralism systems (Homann, 2005). They have played indispensable roles in structuring sustainable use of rangeland and ensuring equitable distributions of resources or ensuring access right for all members of the community for generations.

However, as discussed under section 4.3.3, there is much evidence that due to both internal and external driving forces (internal factors are mainly stimulated by external driving forces) these long enduring institutions are deteriorating and failed to play their roles. As information captured through FGDs and key informant interviews, state motivated policies and interventions, especially efforts in designing formal governance structures have left the customary institutions half dead.

Although there is encouraging move towards recognizing customary institutions by government very recently, especially in participating customary authorities in conflict

resolution, customary institutions and practices continue to be marginalized by government administration structures. With this regard, key respondents during the survey threw the sharpest criticism toward the government efforts to participate customary leaders for it was mainly focusing on controlling pastoralists for political purposes rather than serving the interest of the pastoralists.

The evidences generated through key informant interviews and FGDs substantiate that customary authorities/leaders in the study area were losing credibility and legitimacy among the community members. As to some key informants, sometimes customary authorities are either paid by the government or NGOs to facilitate and coordinate any jobs with community. As a result, they started to work for their personal interests. Customary governance thereby became a lucrative activity for customary leaders who implement local government agendas in return for personal benefits. Study conducted by Hagmann (2006) also reported similar finding in customary conflict management.

In connection with this, one of the key informants articulated as follows:

“In these days, everything is done for political consumption, the customary authorities who are representing the communities were totally forgot the communities they represented. They only stand for their benefits due to formal administration influence at all levels to control the communities not for advantage of their communities they claim to represent. Consequently, the legitimacies of customary authorities were eroded.”

Setting up new formal institutions or revitalization of customary institutions may not pose a great challenge by itself. The problem arises and more complicated when the newly built institutions fail to respond to the needs of society towards sustainability. The importance of institutional reform in development has been long recognized and widely discussed. Institutions structure both incentives and disincentives to human activities in all aspects, being political, social or economic (Hodgson, 2006). Thus, in this

dynamic world, institutional reform is mandatory to effectively govern SES resilience by shaping the way societies act.

As a result of misguided external interference, however, the ability of customary institutions to adjust themselves to changes through inspiring community members to act in ways that maintain or improve to a desirable state through social learning has been interrupted in Borana. The ability of the pastoral community to respond to the environmental crisis mainly guided by '*Gada*' institutions have been already eroded. This situation, in turn, eroded the adaptive capacity and increased the vulnerability of majority herders in Borana. In addition, the newly established institutions were unable to deliver governance assets for SES resilience.

The vulnerability of pastoral community to environmental variability due to the erosion of customary institutions can be reflected in many ways. For example, as a result of the weakening of commons management institutions undermined collective action in resources governance which in turn increased degradation of resources. Moreover, the long legacy of equitable natural resource access has been broken down. This situation, consequently, results in hugging out of poorer resource dependent due to the encroachment of the rangelands.

Equally important, as a result of the weakening of indigenous institutions, the two dilemmas-difficulties in exclusion and substractability of the commons are arising in Borana rangelands resource management. Ostrom et al. (1999) describe that these two characteristics create a potential threat to the commons in achieving successful regimes of management. As internal challenges, effective rules limiting access and defining the rights and duties of resource users developed over the life of the pastoralists are ineffective today. Consequently, opposite to collective actions, pervasive rangelands encroachment is resulting. This ultimately results in the degradation of rangelands

resources. Today, as evidence demonstrates, the majority of the rangelands in Borana is suffering various forms of environmental degradation, such as desertification, loss of bio-diversity, woody species encroachment and soil erosion (Ayana, 2007). Even worse, the water resource is declining from time to time. These all are attributed to mismanagement of the rangeland resources due to the weakening of the customary institutions. Consequently, the rangeland resources degradation compromises the adaptive capacities of the communities to cope with the challenges of complex and dynamic environmental stress.

Another example could be to effectively deal with environmental change induced vulnerability, the Borana society developed indigenous social security institutions known as '*Buusaa gonofaa*' (Tache, 2008). The '*Buusaa gonofaa*' institutions, governed by '*Gada* system', deep-rooted in the common resource regimes and clan-based resource sharing in hard times. These institutions are meant to meet the long-term survival needs of Borana households through wealth transfer from the well-off to crisis victims (Wassie, 2005). In these days, however, a long legacy of mutual support and resource sharing has been deteriorated, ultimately resulted in declining of pastoral system adaptive response to environmental changes.

5.5. Conclusions

The aim of this section is to examine the vulnerability context of the Borana pastoral system, more specifically, demonstrate how the Borana pastoral system is vulnerable to socio-political and environmental changes and their combined impacts. This chapter draws on double exposure frameworks to examine the combined effects of socio-political and climate-related pressures on the vulnerability of pastoralists in Borana. The results of the study reveal that nowadays, the Borana pastoralists are facing severe pressures from both socio-political dynamics and climate variability and their combined

impact on their livelihoods and hence, putting the Borana pastoralists under increased vulnerability.

On the one hand, based on the data obtained from long term climate trends and perceptions of pastoralists, the Borana pastoralists are under increasing exposure to climate variability induced stresses, particularly extreme and frequent droughts and unpredictable rainfall seasons. On the other hand, political and socio-economic process such as poorly defined land tenure systems, increased marginalization, misguided sedentarization and settlement policies, rangeland fragmentation and degradation and undermining the roles of customary institutions are posing huge pressure on pastoralists' ways of life. Consequently, these processes resulted in the alienation of productive rangelands, rangelands degradation, and fragmentation, deteriorating quality and productivity of rangeland, poor management of resources and distributed overgrazing. Moreover, common property systems that allow flexible and reciprocal use of patchy resources through mobility and collective actions have already broken down and hence, putting severe pressure on both resource users and resource system. It seems that the impacts of political and socio-economic dynamics are more serious and visible than those of climate-related risks.

Overall, ill-informed persistent pastoral development policies and interventions along with multiple internal driving forces have weakened pastoralists' adaptive capacity to deal with the environmental crisis as usual and eroded the resilience of the pastoral SES. It can, therefore, be concluded that finding a way to reduce the vulnerability of pastoralists requires an understanding of the political and socio-economic process and environmental change and their combined effects on the pastoral system. This helps to design pastoral development policies based on a clear understanding of pastoral contexts. This, in turn, demands holistic and multi-disciplinary approaches. Customary institutions and practices that allowed flexible and opportunistic use and management

of rangeland in the past should also be reconsidered. In connection with this, clear land tenure system that can secure access and use rights of all groups of the pastoralists and restrict alienation should be put in place. Moreover, development approaches and policy reforms should consider and build on effective customary institutions.

This section has also attempted to examine the vulnerability profile of pastoral households to climate stresses and factors determining it in the study area. The results of the study highlight that climate variability manifested in the form of increased frequency and intensity of drought and rainfall variability is a major challenge Borana pastoralists are facing today. As evident from calculated households' vulnerability profiles, resilient Borana pastoral system in the past has been already eroded suggesting the need for quick and holistic interventions that understand the complex interactions between human and ecosystem in SES both in the short run risk mitigation strategies and long term resilience building.

Moreover, the findings of the present study reveal that Borana pastoral households' vulnerability to climate variability is largely associated with poor institutional and social support services. Hence, investing in various development infrastructures and institutional support services has strong implications in developing and building the adaptive capacity of pastoral systems to deal with anticipated severe perturbation induced by climate variability.

Worth noting, the negative effect of climate-induced hazards is unevenly distributed among pastoral communities and households depending on their adaptive capacity context. From a policy perspective, to prescribe effective interventions, vulnerability assessment at local and household levels is very essential as it helps to identify which segments of the society are more likely to be affected by the stresses.

Another important conclusion emerged from the present survey was that pastoral households' initiated strategies such as herd mobility and herd diversification appear to be important factors in determining the vulnerability suggesting the need of considering and supporting these indigenous strategies rather than exclusively focusing on sedentarization and crop farming that are at odds with complexity involved in the pastoral contexts. If these locally evolved strategies are overlooked, climate-induced risks will continue to increase the vulnerability of the Borana pastoral system. Equally important, employment opportunities and livelihood diversifications into less-climate sensitive economic activities that are congruent with the pastoral production system should be looked for.

5.6. Adaptation Strategies to climate variability/changes

5.6.1. Introduction

In understanding pastoral system dynamics, the scrutiny of adaptation strategies opted by pastoral household in the face of climate was one of the research questions. Apparently, to adapt to rapidly changing contexts of SES such as drought, the Borana pastoral communities has reoriented their livelihood strategies. The majority (83%) of the Borana pastoral households diversified their livelihood sources by engaging in pastoral related and non-pastoral activities particularly to respond to perceived impacts increasing intensity and frequency of the droughts. This section of the thesis looked into the adaptation options adopted by pastoral households and determinant factors that affected the choice of particular adaptation strategy.

5.6.2. Types of adaptation practices adopted by pastoral households

The survey revealed that Borana pastoral households have chosen adaptations including opportunistic crop farming (79%), adoption of drought resistant livestock

species such as camels (17%) and goats (93%), income source diversification (motor vehicle and house renting, petty trade, casual labour, charcoal making etc.) (22%), mobility practice (23%), private range enclosures (12%) and purchase of hay as a supplementary feed (31%). Some of the adaptation strategies (for instance, opportunistic crop cultivation and range enclosures) employed by pastoral households were partly supported by external interventions (Eyasu, 2008; Wassie and Fekadu, 2016).

Table 10 Pastoral household adaptation choices

No	Adaptation choice	Frequency	Percent
1	No adaptation strategy	31	17
2	Adoption of drought resistant livestock species		
	Camel	32	17
	Goats	174	93
3	Opportunistic crop cultivation	146	79
4	Income diversification	41	22
5	Herd mobility	43	23
6	Private Range enclosure (<i>Kalo</i>)	23	12
7	Hay purchase	58	31

Source: Household survey, 2016

Note: the percentage do not add up to 100 because of multiple responses

5.6.2.1. Herd diversification (adoption of drought resistant livestock species)

Herd composition diversification was one of the key adaptations by pastoral households (80%) in the face of changes. Keeping various livestock species has both economic and ecological benefits (Yohannes *et al.*, 2010). In addition to their economic benefits, the difference in the attributes of livestock species allows the pastoral households to exploit wider range of ecological niches, for instance, using both

grazing and browsing animals (Scoones, 1995). Historically, the Borana pastoral system was exclusively based on cattle. However, as FGDs discussants revealed, over the last 2 to 3 decades, driven by prevailing climate variability and other factors, they started to diversify livestock species. One of the key informants indicated that in earlier days, Borana kept large cattle herds to reduce natural risks related to drylands environment. In these days, however, it is impossible maximize cattle herds due to shrinkage and degradation of rangelands resources and it may result in total loss. Regarding the advantage of herd size maximization, Doti (2010) indicated that keeping large herd is rational and used as risk capital during natural hazards and livestock disease outbreaks.

As shown in Table 10, in response to the risks and uncertainty posed by recurrent droughts and systematic marginalization from their grazing lands, pastoral households are currently adopting drought resistant animal species such as camel (17%) and goats (93%). As camels and goats are browsers, keeping them enables the herders to take advantage of the increased availability of shrubs and trees caused by bush encroachment. In addition, the survey highlighted that adoption of camel and goat rearing has improved the economy of pastoral households. At first place, as demonstrated by FGDs, camel market price is high as compared to cattle indicating keeping camels would bring additional benefits to the household livelihoods. Similarly, according to elders, small ruminants in general and goats in particular allow for quick sales to meet household immediate cash needs. On the other hand, as space for grazing is gradually shrinking and hence keeping small ruminants is appropriate and justifiable as they demand less space.

Culturally, there is a thin ground in supporting camel production and consumption in Borana communities. However, climate variability derives the adoption of camel rearing as strategy because camels are more resistant and less vulnerable to drought

compared to cattle. As confirmed by survey result camel milk has also become important to household nutrition and income. One of the key informants of study stated that climate variability has affected Borana custom: He observed:

Recurrent drought has affected the Borana culture. Before, it used to be a taboo to rear camels and consume camel products, to date few elders resist, as it becomes an issue of life and death.

It is worth pointing out here that adoption of adaptation strategies are not simply a technical issue, rather they need wholesome transformations of customary institutions as it can be exemplified by the adoption of camel herding through flexibility and adjustment of institutions (Crane, 2013). However, as indicated by FGDs participants, wider adoption of camel may be constrained by the high market price of camel (Wassie and Fekadu, 2016).

Many studies (Megersa *et al.*, 2008; Watson *et al.*, 2016; Wassie and Fekadu, 2016; Galma *et al.*, 2017) have reported growing interest in camel and goat management in response to pressures from both environmental and socio-political changes. However, while keeping camels and goats by Borana have been welcomed as strategy and who adopted camel and goat production are better-off in their adaptive capacity, they are still not totally free from climate variability induced risks. In line with this, one of the key informant elders explained that these days, camels and goats are also suffering from recurrent droughts and increased dryness.

Moreover, adapting through adoption of camels and goats has brought various unexpected risks (Galma *et al.*, 2017). First, growing interest among the Borana to keep more camel and goat is challenged by the high level of risks due to endemic diseases given the poor veterinary services and limited experience of camel and goat management. In addition, there may also be new camel-related risks to human health

(Megersa *et al.*, 2008). According to respondents, goats were the most affected compared to camels. Nearly all our respondents who adopted goats reported that they experienced high death losses. Second, given the poor livestock marketing systems and facilities in the country, adoption of camel and goats, especially goats, by many pastoralists at the same time resulted in dramatic declines in goat price, which in turn undermined the effectiveness of the strategy. Third, shifting to camels and goats may also bring undesirable ecological consequences through degradation of vegetation, which in turn increases the vulnerability of pastoralists to environmental changes (Galma *et al.*, 2017).

5.6.2.2. Mobility practice

Although pastoral mobility concept is contested, it is widely recognized that mobility is one of the most successful strategies used by pastoralists to deal with uncertainty and risk prevailing in drylands ecosystem. As noted by Wassie and Fekadu (2016), mobility is not only a survival issue but also a resource management strategy to exploit spatial and temporal variation in rangeland resources distribution. Overall, pastoral mobility has multiple roles to play in pastoral system resilience building through reciprocal use of rangeland resources, sustainable rangeland management, biodiversity conservation, pest and disease control etc. (Yohannes *et al.*, 2010). Equally, scholars in rangeland management have boldly argued that blocking or limiting mobility practice increase the vulnerability of SES of the rangeland.

All participants of household survey generally appreciate the importance of mobility for livestock to cope with drylands environment. As identified by key informants, in Borana, governed by their customary institutions, the whole Borana land was categorized into 5 grazing system known as '*Dheeda*' depending on their ecological

contexts. These grazing systems further designated into wet and dry season grazing lands.

The designations of these wet and dry season grazing areas were meant to allow flexible and free movement of herds. As evident from the survey result, in response to increasing climate variability induced vulnerabilities, 23% of the survey respondents maintained traditional mobility practice as adaptive strategy despite many restrictive policy measures and internal factors such as population growth and spontaneous human settlements.

However, the livelihood diversification in response to negative effects of climate variability in turn has affected the effectiveness of mobility practice. The information generated from FGDs and key informants revealed that in these days, herd mobility is constrained by conversion of prime dry season grazing lands into crop lands and private range enclosures. Besides, as indicated by key informants, the overall reduction in rangeland productivity due to climate variability has challenged the herd mobility practice.

5.6.2.3. Opportunistic crop farming

To deal with undesirable effects of climate variability and socio-political stresses, pastoral households have already instigated crop farming. As it can be seen from Table 10, the majority (79%) of the survey respondents indicated that they have turned to crop farming as they faced difficulties in making their living from livestock production alone in the face of climate variability. When asked when they had started crop farming, majority of the respondents indicated that it is less than 10 years. This situation has pushed the pastoral system towards agro-pastoralism mode of production. The FGDs discussants indicated that participating in cropping has benefited pastoral households in supplementing household food needs and diversifying their means of subsistence.

Besides, pastoral households have been benefited from cropping as the crop residue can also be used to feed their animals.

However, the expansion of crop farming has brought about new challenges on pastoral system. As key informants persuasively presented, rain-fed cropping is difficult to sustainably practice in arid and semi-arid lands characterized by unpredictable rainfall seasonality. On one hand, the productivity of crop farming is too low. On the other hand, pastoral households who depend on crop production are more at risk of losing their crop if the rains do not come as crop production is more susceptible to shortage of rainfall.

Conforming to this finding, Eyasu (2008) pointed out that cropping is a risky business in drylands due to unreliable rainfall. The adoption of cropping as strategy often involves the disruption of well-established traditional seasonal grazing system and mobility. It poses negative impacts on livestock production through snatching prime grazing areas especially located in wetter areas. In consistent with this finding, Skinner (2010) reported that crop agriculture may cause irreversible damage to the rangeland.

5.6.2.4. Opportunistic rangeland enclosures for fodder banks

Historically, the emergence of rangeland enclosures dated back to 1950s following severe drought during *Gada* period of Guyo Boru (1945-1953). During this period, traditional enclosures (*Seeraa Yabbii*) nearby encampment meant for calf and relatively weak animals emerged out of flexible customary rangeland governance institutions. They were not physically fenced, rather protected by well-established customary institutions. Later on, after two '*gada*' periods, '*Gumi Gayo*' supreme '*gada*' institutions, highest governing body, approved the first fenced communal rangeland enclosures known as '*Kalo*' specifically during '*gada*' period of Goba Bule (1969-1977) (Napier and Desta, 2011).

One can easily understand from this historical background that the main driver of emergence of rangeland enclosures was severe and recurrent drought. Before the mid1980s, communal enclosures were used as fodder banks (*kalo*) were exclusively governed by customary institutions and played significant roles in adapting to ever changing environmental conditions. In connection with this, herd splitting is one of the effective adaptation strategies against natural calamity experienced in drylands environment. Borana pastoral households split their herds into smaller groups in order to use different grazing areas simultaneously. For instance, they separate weak and lactating herds from others and allow them to graze nearby encampment termed as '*kalo*'. This generally improves forage vigor and growth and ultimately reduces the degradation of rangeland resources (Doti, 2010).

After 1990s, local-level evidences pointed out that people, driven by economic needs, current SES dynamics pressure and drawing lesson from experience of communal fodder banks (*kalo*), have started to establish private enclosures. At present, both government and non-government organizations are promoting cooperative based enclosures as best practices.

As one key informant from Borana Zone Pastoral Development Office explained, currently, the government is facilitating the establishment of pastoral cooperatives to reclaim degraded rangelands through bringing cover to the bare lands and generate additional income from hay production and renting grazing lands. As noted by key informants, the use of purchased hay as adaptive practices has emerged from the private and cooperative enclosures. About 31% of the survey respondents have reportedly started to purchase hay in response to drought hazards (Table 10).

In Borana pastoral system, the expansion of opportunistic crop cultivation in turn has brought the expansion of private rangeland enclosures. In many places, as a

consequence, communal rangeland tenure systems are transformed into private ownership (Eyasu, 2008; Napier and Desta, 2011). During the survey, it was found that the majority of the respondents (71%) use private enclosures for double purpose, for both cereal cultivation and fodder production based on circumstances. Likewise, 12% survey respondents reported that they employed private enclosures used only for fodder banks as a strategy to adapt to both internal and external pressures. When asked the major driving factors to employ enclosures, it was stated that the major drivers of the use private enclosures were recurrent drought, erratic and unpredictability of rainfall seasonality, rangeland degradation and weakening of customary institutions.

It is worth to note that the expansion of private range enclosures as adaptive strategy endangers the sustainability and the resilience of pastoral system (Skinner, 2010; Napier and Desta, 2011; Tache, 2013). Under customary resources governance institutions, the right to alienation was forbidden. Recent trends, however, show that the role of customary institutions in protecting rangeland fragmentation has become constricted. As it is evident from present survey, land rush is intensively undergoing especially by relatively wealthy individuals. In connection to expropriation of communal lands, one of the survey key informant elders saying goes like this:

Which communal land you are talking about? Every morning we see new settlement and new fence.

This can have devastating effect on majority of pastoral households via limiting the scope of adaptive options available to them such as reciprocal use of resources and mobility (Crane, 2013). During the survey, it was observed that there were numerous meetings at *kebele* level discussing on the issues of illegal and spontaneous settlements and expropriation of rangelands.

5.6.2.4. Non-pastoral/non-farm income source diversifications

As repeatedly discussed, traditionally, livestock constitute the basis for Borana pastoralism. However, in recent years, mounting threat on livestock production caused by socio-ecological driving forces, Borana pastoral households have been engaged in non-pastoral/non-farm income generating activities as adaptive strategy to maintain their livelihoods though not totally detached from pastoral ways of living. As displayed in Table 10, 22% of the survey respondents reported that they have diversified their income sources through participating in non-farm/non-pastoral activities both to survive and accumulate wealth in the face of SES change induced pressures. As argued by Little (2013), income source diversifications can be categorized into survival (low return activities such as diversification including petty trade, charcoal making and selling and casual labour) and accumulation (high return and practiced by wealthier groups including trade, house and motor vehicle renting) types.

As confirmed by FGDs, both types of income source diversifications exist in Borana context. It was observed that better-off pastoral households have engaged in non-pastoral investments including trade, small nearby town based investment such as house and motor vehicle renting for the purpose of accumulation. In contrary, poor households have participated in low return income diversification activities such as petty trade, charcoal making and casual labor for survival purpose. Similarly, studies (Skinner, 2010; Berhanu, 2011; Wassie and Fekadu, 2016) attempted to address emerging pastoral system responses to climate and socio-political changes reported that many of pastoral households are choosing to increase the diversity of their income sources to cope with undesirable consequences.

5.6.3. Determinants of adaptation strategies choices

To identify determinant factors of selected adaptation choices, a binary logit model was applied using household reported adaptation strategies such as mobility practice, camel adoption, opportunistic cereal cultivation, exclusive private rangelands enclosure for fodder banks as response variables. Other reported pastoral household strategies including adoption of goats, purchase of hay, income sources diversification and enclosures used for both crop cultivation and fodder banks were excluded from the model estimation based on information generated through FGDs. For instance, goat rearing as adaptive response is becoming very common in the study area and over 93% of the survey respondents already engaged in rearing goats suggesting there is no need to analyze determinant factors. Income source diversification was also found to be complex process to estimate in *logit* model because pastoral households combine various income source diversification options or within the households, members of household may be engaged in different income generating activities.

5.6.3.1. Descriptive analysis

The socio-economic characteristics data of the survey respondents showed that the mean age of household heads was 45 years. The reported average family size was 9.13 persons, and the average number of household members who are economically active was 4.3 persons. An average of 13.5 (with standard deviation of 18) tropical livestock units was held by households in the study area during the survey period. Nearly all respondents (96%) reported that the herd size of cattle has decreased over the last three decades. The fact that pastoral households were marginalized from social and institutional support services, literacy levels of the household heads were found to be low (30%). The proportion of households who had accessed credit and extension services was very low, 4% and 16% respectively. Likewise, only 18% of household

heads reported that they participated in training related to livestock and crop production. On average, households travel about 1.70 hours (single trip) to access the nearest market services. These reveal limited access to markets across the study area. Of 186 respondents, only 18% claimed membership in community organizations. With regard to information devices, it was found that 60 % and 25% of the respondents own handset and radio respectively.

Table 11 Differences in household characteristics in the use of selected adaptation strategies

Variables	Mobility Practice			Camel			Cereal Cultivation			Private enclosure		
	Yes	No	Stat. sig.	Yes	No	Stat. sig.	Yes	No	Stat. sig.	Yes	No	Stat. sig.
Mean Age of HH	43.5	46.1	n.s	45.9	45.5	n.s	45.6	44.9	n.s	49.3	45	**
Mean of Family Size	9.9	8.9	n.s	11.7	8.59	**	9.4	8.1	n.s	8.5	9.2	n.s
Mean of Active labour	5.1	4.1	n.s	5.75	3.99	***	4.4	3.95	n.s	4.8	4.2	n.s
Mean of TLU	18	17.7	n.s	35.6	8.94	***	11.7	20.6	n.s	10.9	13.9	n.s
Mean market distance	1.5	1.7	n.s	1.6	1.71	n.s	1.8	1.4	**	1.9	1.7	n.s
HH who can read & write (%)	23.2	76.8	n.s	100	0	***	83.9	16.1	n.s	8.9	91.1	n.s
Received Credit loans (%)	28.6	71.4	n.s	0	100	n.s	100	0	n.s	14.3	85.7	n.s
Participate in CBOs (%)	29.4	70.6	n.s	14.7	85.3	n.s	76.5	23.5	n.s	11.8	88.2	n.s
Received extension services	17.2	82.8	n.s	6.9	93.1	n.s	93.1	6.9	**	24.1	75.9	n.s
Received Training (%)	30.3	69.7	n.s	15.2	84.8	n.s	87.9	12.1	n.s	9.1	90.9	n.s
Own Radio (%)	28.8	70.2	n.s	21.3	78.7	n.s	83	17	n.s	19.1	80.9	n.s
Own Mobile (%)	28.8	71.2	**	21.6	78.4	n.s	77.5	22.5	n.s	10.8	89.2	n.s
Received Early Warning info	58.3	41.7	n.s	25	75	n.s	58.3	41.7	n.s	12.4	87.6	n.s

Source: Computed from Household Survey, 2016, **Significant at $p = 0.05$; ***Significant at $P=0.01$; n.s stands for non-significant

Although the difference is not statistically significant for all adaptation strategies, the users of strategies tend to have higher age than non-users. It was found that the age difference between users and non-users of private range enclosure was statistically

significant at $P < 0.05$ level of probability. Likewise, the literacy level of household heads was ($P < 0.01$) higher for adopters of camel compared to non-adopters.

Livestock constitutes the main livelihood assets in the Borana pastoral system. Our analysis revealed that pastoral households' total livestock holdings correlated ($P < 0.01$) with the engagement in the opportunistic crop cultivation as adaptive responses (Table 11). This indicates the size of livestock ownership highly determines the households' choice of adaptation strategies (Temesgen *et al.*, 2014; Opiyo *et al.*, 2014; Wassie and Fekadu, 2016). While we look at household access to pastoral extension services, it was found that the difference between adopters and non-adopters of opportunistic cereal cultivation in terms of access to extension services was statistically significant at $P < 0.05$ level of probability. With regard to the ownership of information devices, handset, Chi-Square analysis indicates that the difference between adopters and non-adopters of mobility practice as adaptive responses is statistically significant at 5% probability level.

5.6.3.2. Empirical Results and Discussions

A total of 14 explanatory variables were used for model estimation. These includes: age of household head, household head literacy level, family size, active labour force, total livestock holding, distance from livestock market, radio and mobile ownership, access to credit schemes, access to pastoral extension services, access to early warning information, membership of households in community based organizations and household head participation in training. Before running the model, the existence of multicollinearity using Variance Inflation Factors (VIF) and contingency coefficients (CC) were checked. The results from VIF values have shown that variance inflation factors for all variables are less than 10, which indicate all the continuous explanatory variables have no serious multicollinearity problem. Similarly, values of the

contingency coefficients have shown that no multicollinearity problem among dummy variables.

In addition, various goodness of fit such as Pseudo R^2 and the value of Pearson Chi-square were checked and validated that the model fits the data. The model output explanation is based on the understanding of showing the impact of explanatory variables as increasing or decreasing the likelihood of a pastoral household adaptation choice is just enough and informative. Thus, the interpretations of the estimates are mainly based on the sign of the coefficients rather than absolute magnitude of the impact of the explanatory variables.

From logit model estimation, it was found that herd size, number of active labour force, access to extension services, literacy of household heads, family size and access to early warning have significant effects on the choice of strategies used by pastoral households. We hereby proceed with presentation and discussion of results.

Opposite to our prior hypothesis, the literacy level of pastoral household heads was negatively related with the decision of households to adopt camel rearing as adaptive strategy in response to climate variability induced stressors (Table 12). The negative relationship was probably explained by generally low level of literacy rate in the study area and relatively literate pastoral households choose to be engaged in other adaptation strategies which need less initial investment cost, as the market price of camel is high. Contrary to this finding, Madison (2006) argued that education diminishes the probability that no adaptation is taken.

The model outputs illuminate that there was positive association ($P < 0.05$) between household size and decision to adopt opportunistic crop farming in response to catastrophic climate variability induced shocks. The higher the number of household members, the more likely the pastoral household would involve in opportunistic cereal

cultivation (Table 12). This can probably be explained by pastoral households with relatively larger family size are initiated to participate in crop farming to feed themselves and ensure food security in the face of climate variability. In line with this finding, Wassie and Fekadu (2016) reported similar results.

Table 12 Parameter estimates of the logistic regression models on determinants of pastoral household adaptation choices

Explanatory Variables	Mobility	Camel	Cereal Cultivation	Private Enclosures
Age of HH	-0.013 (0.019)	-0.040 (0.030)	-0.007 (0.018)	0.020 (0.021)
Literacy	0.359 (0.487)	20.311(4.616E3)***	-0.706 (0.537)	0.889 (0.648)
Family Size	-0.114 (0.079)	0.054 (0.114)	0.211(0.093)**	-0.262 (0.119)
Active Labour	0.262 (0.121)**	0.120 (0.177)	0.173(0.127)	0.370 (0.165)**
TLU Holding	0.012 (0.010)**	0.142 (0.036)***	-0.015 (0.010)	-0.014 (0.023)
Market Dist.	0.299 (0.412)	1.129 (0.690)	-0.840 (0.638)	-0.110 (0.514)
Radio	-0.095 (0.485)	-0.966 (0.861)	-0.679 (0.532)	-1.328 (0.726)
Mobile	-0.657 (0.523)	0.111 (0.789)	0.465 (0.503)	0.599 (0.726)
Cooperative	-0.145 (0.486)	0.139 (0.859)	0.516 (0.526)	0.207 (0.689)
Early warning	-1.760 (0.675)**	-0.225 (1.337)	0.842 (0.715)	-0.138 (1.157)
Credit	-0.470 (1.018)	18.360 (1.286E4)	-19.124(1.438E4)	-0.556 (1.257)
Extension	0.589 (0.577)	2.095 (1.039)**	-1.353 (0.802)	-1.117 (0.573)**
Training	-0.846 (0.508)	-0.750 (0.888)	-0.840 (0.638)	0.143 (0.742)
Constant	1.315 (1.475)	-42.362(1.366E4)	21.093(1.438E4)	-0.763 (1.892)

Note: Numbers in parenthesis are standard errors; **Significant at $p = 0.05$; ***Significant at $P=0.01$. Source: Computed from Household Survey, 2016

There is strong evidence from the model that mobility practice as adaptation strategy in the face of recurrent climate hazards is positively influenced ($P<0.05$) by the number of active labour force. This implies that an increase in active labour ratio increases the likelihood of mobility practice. Similarly, availability of labour force was positively associated ($P<0.05$) with the pastoral households engagement in private range enclosures. The reason behind this result could be both mobility and private enclosures are labour- intensive practices.

In line with general expectation, the size of livestock holding substantially influenced the probability of pastoral household's involvement in mobile pastoralism and adoption of camel rearing in response to SES transformations induced vulnerabilities. While we look at the direction of their relationships, the size of livestock holdings increased the mobility practice and embracing camel herds. This suggests that as the size of livestock holding increases, the probability of continuing to use herd mobility practice and adoption of camel herd as adaptive response also increases.

Obviously, households who have large livestock holdings tend to move with their herds to escape drought-risks. With regard to camel herd adoption, this finding suggest that large size of livestock holdings allows households to enhance their economic wellbeing and, hence potential to buy camel. This finding signifies the consistent research discussions (Ayana, 2007; Tache, 2008; Bekele, 2013; Wassie and Fekadu, 2016) indicating that with declining size of livestock holdings combined with persistent policy pressure to sedentarize pastoral households, households with relatively less number of livestock tend to settle and turn to other livelihood sources such as opportunistic crop farming and other non-farming income generating activities.

Access to climate related information increased the pastoral households' mobility practice in response to contemporary variations (Table 12). This implies access to climate related information increases the likelihoods of continuing well-established pastoral mobility practice as adaptive responses. This would be explained by the fact that pastoral mobility is undertaken based on comprehensive and full-fledged information (information related to traveling route, availability of pasture and water, legal requirements, security issues, etc.) generated by scouts (Yohannes *et al.*, 2010), and hence increased the information seeking behavior of pastoral households who practice mobility.

The other related key findings of present study was in contrary to Wassie and Fekadu (2016) observation, pastoral extension services was found to be positively ($P < 0.05$) related with pastoral household's involvement in private range enclosures in response to minimize the current SES variation related risks. Seemingly, this can be explained by current pastoral extension services in Borana rangeland mainly focuses on sedentarization and expansion of private ranches, as can be observed from general pastoral development policy frameworks.

5.6.4. Conclusions

This section of the thesis examines how Borana pastoral households are responding to contemporary SES variations to minimize associated risks and identify determinant factors of households' adaptation patterns. The findings suggest that most of the Borana pastoral households have embraced diverse non-pastoral activities to sustain their life in the face of mounting internal and external pressures. Nevertheless, they are still less likely to totally abandon pastoral ways of life. In addition to aboriginal pastoral production system based on long-established herd mobility, they have already adopted various adaptation strategies including opportunistic crop farming, private range enclosures as fodder reserves, herd diversifications in favour of camels and goats, purchase of hay, and non-pastoral/non-farm income sources diversifications.

An econometric analysis revealed that the likelihood of pastoral households continuing to use mobility practice as an adaptive response is positively explained by availability of labour force, size of livestock holding and access to climate information. Likewise, engagement in opportunistic crop farming to minimize risks associated with climate variability was found to be positively influenced by family size. Similarly, the likelihood of pastoral households to be engaged in private range enclosures is positively affected by the availability of family active labour force and extension services. Proper

consideration of these determinant factors of pastoral households' adaptation choices is quite helpful in designing and implementing locally acceptable adaptation strategies.

Despite pastoralists' adaptive responses involved non-pastoral activities such as cropping, the findings of this study revealed, still to date, economic, social and cultural life of Borana pastoral communities is strongly tied to livestock production. However, state-initiated pastoral development policies mainly directed to sedentarization and promotion of private range enclosures for crop farming and fodder banks.

Pastoral extension services were also framed in line with these policy directions focusing majorly on the promotion of crop cultivation and range enclosures for fodder reserves. This study, therefore, suggests that pastoral extension services should encompass wider support of livestock production, communal rangeland management, and the wholesale adaptation patterns and capitalize on the existing local innovations and institutions. As it is understandable from their limited coverage, institutional support services were weak in Borana context.

Therefore, it is recommended that there is a need to develop and strengthen institutional support services such as comprehensive pastoral extension services, credit schemes, and well-integrated climate information delivery mechanisms to support pastoral households initiated adaptation strategies.

It is also quite important to note that despite pervasive internal and external driven restrictive pressures, Borana pastoral communities maintained centuries-old traditions of risk managing mechanism, mobility practice, as strategic decisions in response to SES variations. Persistent pressures, however, are reducing the effectiveness of mobility practice today by limiting pastoral households' freedom of actions. As always have been said, the present study suggests that there is a need to consider and support pastoral mobility practice to grasp advantages involved in it including flexibility,

dynamism, multi-functionality, and reciprocity in rangeland resource management and use. Overlooking the pastoral mobility practice may exacerbate the vulnerability of the pastoral system. Likewise, current rush in settlement, range enclosures and expansion of opportunistic crop cultivation further erode the resilience of pastoral SES. Thus, these current dynamics of livelihoods diversifications should be reframed and supported by well-structured institutions for sustainable future and equitable resource use rights for all groups.

Another important conclusion that can be drawn from this finding is evidently, Borana pastoral communities were turning towards keeping more diverse livestock species especially adopting drought resistant ones (camel and goat) to spread risks posed by climate variability and socio-political changes. Though in Borana culture, camel rearing and consuming its products were considered as taboo, recurrent drought and increased dying of cattle forced Borana pastoral households to adjust their institutions and accommodate camel rearing as an adaptive strategy.

However, adapting through the adoption of camel and goat is not totally free from unexpected risks such as declines in a market price, emerging endemic diseases and degradation of vegetation. Based on this fact, this study suggests that Borana herders' initiatives of diversifications should be well-supported by research in the areas of animal health, improved species, nutrition, value addition, and marketing to minimize associated risks and improve the resilience of Borana pastoral system. In addition, government and non-government stakeholders should support the promotion of camel production especially in addressing less privileged pastoral households linked to the high initial cost of investment.

Chapter Six: Analysis of Network Forms of Rangeland SES Governance

6.1. Introduction

With a growing understanding of complexity and uncertainty in a natural resource governance and management, the concept of the network governance came into the fore in scientific discussions. It is recognized that the ability to adaptively respond to complex environmental change and manage SES resilience resides in the actors' networks. Network forms of governance involving multiple state and non-state stakeholders enable various actors to collaborate and coordinate collective actions.

However, the structural pattern of the actors' collaborative linkages highly influences how actors actually behave and, hence, impact the deliverance of effective governance. Thus, in understanding the effectiveness of a governance networks, investigating the characteristics of network structures or relational patterns among actors is a primary step. In this context, this section presents the results of social network analysis. First, we present the whole network properties of the rangeland governance system. Subsequently, the actor (node)-specific characteristics of the network structures and their likely effects on the deliverance of governance assets were discussed.

6.2. The Whole Network Characteristics

As shown in Fig. 17, the rangeland governance involves a diverse set of actors both NGOs and GOs representing various scales, sectors, and divergent interests. It was identified that 53 network nodes or relevant actors in the rangeland governance system of which NGOs accounts for 28% (n=15), whereas government actors made up of 68% (n=36) and the remaining 4% (n=2) of actors belongs to community-based organizations, customary institutions and private company. As indicated by the key informants, the

most common activities that NGOs participate in Borana rangeland management are bush clearing and pond/well construction and maintenance.

Looking at the overall links, theoretically, a density of social network equal to one represents full connections of all nodes, in our case, however, the overall density of social network in rangeland management is very low ($D=0.076$) in that from 2760 possible links, actors only make 207 (7.6%) ties which is poor compared to what other studies for example, Sandström and Rova (2010) recommend. Closely looking at the network links, only about 32% of links were found to be reciprocated. It was also found that government actors exhibited strong hierarchical vertical links across formal governance tiers with very limited horizontal links at all governance scales.

Despite being on the same governance level, having interdependent goals and physically close to one another, there was little horizontal reported collaboration among actors operating at the same governance level. An examination of the network densities shows that the densities of all horizontal networks were low; 0.16 for district scale government actors, 0.056 for zone level, 0.014 for regional level and 0.14. Likewise, the density of networks among non-government organizations was 0.26. The density of the overall government actors ($D=0.25$) at all levels was found to be similar to that of NGOs (0.26). Worth noting, there existed no collaboration between community-based actors and indigenous *Gada* institutions and community-based organizations. Interestingly, it was observed that the tendency of collaborating with customary institutions is increased in these days.

Network governance views that governance for resilient SES demands collaboration among all actors (higher density) which improves the potential for joint actions through facilitating knowledge, resource and experience sharing, foster mutual trusts, solidify shared goals and help to manage potential conflicts (Bodin et al., 2006; Bodin and

Crona, 2009; Sandström and Rova, 2010). Network governance with higher density enables actors with differing knowledge, values, and interests to understand complex problems, agree on solutions and integrate their actions, and hence increase the adaptive capacity of SES (Alexander Steven et al., 2017). As it can be seen from the findings, there were very few overall and horizontal collaborations in the Borana rangeland governance and absence of such interactions potentially undermine the collective action, block communications of knowledge and experience, hinder resource sharing, trigger conflicts of interests and ultimately derives SES vulnerabilities which currently prevailing in the Borana pastoral system. In addition, a low-density network reflects the divergence and competition of perception, goals, and interests which lead to the absence of a common problem definition which hinders the potential to respond adaptively to uncertainties (Crona and Hubacek, 2010).

Sandström and Rova (2010) further elucidate that a well-connected network is assumed to increase the capacity of a co-management network to craft and maintain the rules of the game and the compliance of actors to the set rules. Contrary to the recommendations of existing literature on SES, the Borana rangeland governance system critically lacks sufficient collaborations among actors and hence lacks well-defined common priority process. Even worse, the low level of network cohesiveness appears to have hindered to have a common view on the future of the pastoral system, let alone setting common goals.

On the other hand, it is argued that cross-boundary connections (heterogeneity) increase the effectiveness of adaptive governance through mobilizing diversified resources (Alexander Steven et al., 2017). Effective governance, thus, requires multilevel coordination of actors' interactions across all administrative units involving both policies making bodies and policy implementing actors (Fliervoet et al., 2016). Such a cross-scale and vertical interactions potentially facilitate the sharing of diversified

resources. In our case, however, the network has low cross-boundary connections in that there was virtually no direct reported collaboration among stakeholders spanning two levels of governance; actors tend to collaborate with actors who share similar institutional mandate following formal institutional setup, to the nearest level up or down the formal governance hierarchy (Figure 17).

Unfortunately, multi-sectoral and multi-scalar interactions of actors were scarce in the Borana rangeland governance system. For instance, there was no direct collaboration between district and region level actors or between zone and federal level actors out of the formal institutional structures, and thus rangeland governance system failed to synchronize governance assets in responding to the dynamics in SES. In Ethiopia, for more than four decades, the issues of participation and collaboration have been widely discussed and narrated in the policy arena. However, evidently, the issue is practically absent on the ground. In line with this, one of the key informant interviews from the Yabello Drylands Pastoral and Agricultural Research Center saying goes like this:

“Now a day it is common to hear the issues of participation of stakeholders and collaboration here and there while designing development and research projects here and there. But I am not sure that we have the technical capacity to do so. We simply say it to attract the attention of donors to get funds.”

6.3. Actors’ connecting roles in the network and their importance

To examine the importance of each actor in decision-making related to rangeland management, degree centrality and betweenness centrality were assessed. Table 13 provides the top ten popular actors in the rangeland governance networks. The number of collaboration links reported by a given actor (outdegree) reflects the role of that particular actor in the governance network. In Borana rangeland governance networks, BZEPOAO (Borana Zone Environmental protection and land Administration Office)

(13) and SAVE (Save the Children) (13) listed the greatest number of actors to collaborate with (Table 13). Most of the actors who were playing a key role in the network were found to be government organizations. Non-government organizations such as SAVE and GDPI (Gayo Pastoralist Development Initiative) also reported a high level of collaborations indicating they are actively involving in the rangeland governance.

Looking at the *indegree* (popularity or visibility of an actor to others), YDPDO (Yabello District Pastoral Development office) (18) received the greatest number of nominations as a collaborator followed by BZPDO (Borana zone Pastoral Development office) (15) (Table 13). An *indegree* score indicates how much an actor is prominent or visible to other actors in the networks (Dkamela *et al.*, 2014). Accordingly, YDPDO was found to be the most powerful and influential of all actors in the network.

Table 13 Top ten actors' centrality scores in Borana rangeland governance network

Actor	OutDegree	InDegree	Betweenness
BZEPOAO	13	13	460
SAVE	13	7	351
YADELAO	11	12	353
BZPDO	10	15	373
YDPDO	10	18	429
GPDI	9	8	272
YDCPO	9	10	351
HUP	8	5	43
MEFC	7	4	170
SORDU	6	4	57
Mean of total links	3.96	3.96	102
Network Cent. index	17.7%	27.5%	13.8%

Source: Computed from the network survey, 2016

The perceived dominance of the YDPDO and BZPDO is because, the formal functions in controlling pastoral issues are mainly assumed by these government organizations.

Overall, almost all actors from the top ten popular actors belong to government organizations. To visualize each actor's connecting or bridging roles, we analyzed *betweenness* centrality scores for each actor. The *betweenness* centrality measures how frequently an actor is situated between two other actors, and high *betweenness* centrality scores reflect that an actor holds a favorable position for facilitating and controlling communication flows which in turn indicate a position of brokerage (Hannemann and Riddle, 2011). In our case, the *betweenness* centrality index was found to be 14% indicating poor network closure and hence, poor governance outcomes (Sandström and Rova, 2010).

Actors such as BZEPOAO, YDPDO, YADELAO, YDCPO and SAVE had higher *betweenness* centrality scores (Table 13), reflecting their role in brokering the connections of different actors who are themselves disconnected. Despite dominant roles of connecting different actors, SAVE, one of the non-government actors, holds a second rank in connecting different actors, indicating the organization is playing a considerable bridging role.

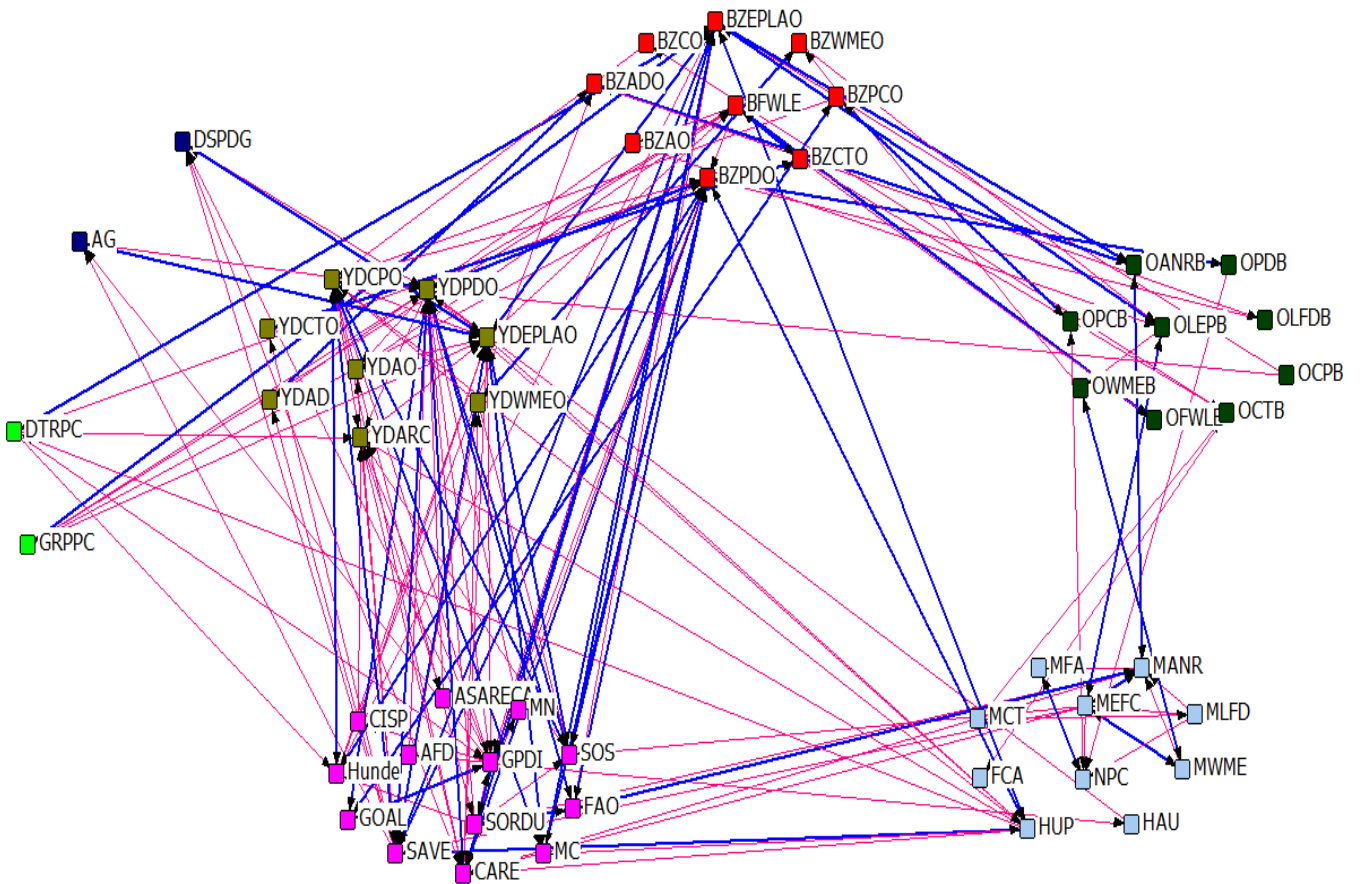


Figure 17 Social Network of Rangeland Governance in Borana, Yabello district

Note: The red arrow indicates non-reciprocated collaboration and blue arrows stand for reciprocated relationships. Pink Square: NGOs, Black Square regional: GOs, Red square: Zonal level GOs, Green Square: Private organizations, Blue Square: Local Organization, Gray Square: District Level GOs, Light Blue: Federal Level GOs.

6.4. Conclusions

This section made its departure from the assumption that collaborative governance involving various state and non-state actors is a venue to reverse the current deterioration of SES resilience of the Borana rangelands by addressing the complexity posed by climate and socio-political change. It has become clearer and clearer that as opposed to hierarchical and top-down forms of governance, network forms of governance facilitate both horizontal and vertical interconnection of actors, bring

different perspectives and sources of knowledge, develop shared values and develop innovative solutions to the wicked rangeland problems. In view of this, by analyzing social networks, it was attempted to identify the structural gaps that result in misfit in the Borana rangeland SES.

As evident from the low level of network density, there are very few horizontal and vertical interactions and linkages among actors in the Borana rangeland governance. Such a poor linkage considerably blocks flows of knowledge, experiences and other resources indicating inability of the governance system in facilitating the solidification of shared values and joint action. It has been argued that environmental problem is inherently complex issue demanding an integration of scattered resources and capacities distributed across scales, sectors and domains of governance system (Bodin and Crona, 2009).

More importantly, in countries like ours, where problems of limited human and other resources is very common, governance system that enables the integration of scattered fewer resources and coordination of action is essentially recommended. Unfortunately, rangeland governance system in Borana is hampered by absence of adequate network heterogeneity and closure which in turn blocks the building of collaborative visioning and an efficient use of available resources to address complex problem. Thus, this study suggests that policy environment that can create conditions for more collaboration, strength of actors ties, development of trust and social capital and enabling the design of effective collective efforts should be put in place.

The study was also attempted to identify the actors that were playing the most important roles in bridging actors who are not connected otherwise. In the network, one of the government actors, Yabello District Pastoral Development Office (YDODO) was nominated as the most important collaborative actor by other organizations (in-degree

value) followed by r followed by the Borana zone Pastoral Development office (BZPDO), reflecting these organizations are more responsible to deal with rangeland management issues and in attempts to enhance of the Borana SES will be more benefited from involving these key organizations. One of the limitations of this investigation was that it only focused on the general collaboration of actors. It failed to look into various relational patterns in the network such as information and other resources flows, policy influence, power relationship, and etc. Further research on the flows of these resources could inform a better design of joint action for adaptive governance of the rangeland SES.

Chapter Seven: General Conclusions and Ways Forward

Over the last half a century, a pastoral development issue has been a continuous theme of discussions. However, still to date, there are contradicting narratives and discourses over the viability of pastoralism in the country, as elsewhere in the world. Motivated by observing researches in the areas of pastoral development and government policy documents, this thesis research generally aimed to answer three major interrelated research questions, how the pastoral SES are transforming, how these transformations are affecting the resilience of pastoral system and how the rangeland governance system is contributing to the vulnerability/resilience of the pastoral system based on SES perspectives.

This study is one of the first to explore the pastoral system dynamics using SES perspective which helps to understand the complex nature of rangeland resources management system dynamics. Therefore, this study contributes to literature to have a better understanding of the complexity in pastoral system dynamics towards enhancing SES resilience. To this end, the conceptual frameworks used in this dissertation research may provide some useful tools and insights in investigating the dynamics of interactions between various components of complex natural resource management systems such as resource system and social systems rather than focusing solely on technical issues and viewing as if human and ecological systems operate independently.

As far as we know, this study is also the first attempt in examining the capacity of rangeland governance system in managing SES resilience in the Borana context by applying social network analysis. This could contribute to a better understanding of the social networks and institutional structures in the rangeland governance system towards managing the SES resilience in pastoral system in the country in general.

This research is also the first attempt to unpack how the Borana pastoral system is being double exposed to socio-political and climate change what is mostly missing in the pastoral system vulnerability research in the Ethiopian context which provides insight on multiple drivers of pastoral system vulnerability pathways. Besides, unlike previous studies, this investigation strives to relate the decline in the resilience of SES with poor adaptive governance which could move the conceptual advancement of rangeland governance system a step forward.

This section briefly summarizes the major findings of the study and provides the core conclusions came out from the findings of the study. Finally, the section provides some outlooks for further research.

To begin with SES dynamics, the findings of the study revealed that the Borana pastoral SES has undergone profound transformations attributed to both internal and external factors, and today they are at risk of a destabilized SES. These findings revealed that the Borana pastoral communities have experienced fundamental disturbances to their long established traditional functions which increasingly deriving pastoral system vulnerability pathways as they are exposed to both socio-political and environmental changes. The study found that the rangeland ecosystem has already degraded (**section 4.2**). Climate variability is also having an adverse effect related to increased frequency and intensity of droughts which caused increasing aridity and livestock loss (**section 5.3**). Drought has been adversely impacting the grazing system more frequently and severely in recent years and this trend has intensified existed scarcity of water and pasture resources.

Pressures on land use and tenure systems mainly stemmed from the government policies and pastoral communities' adaptation strategies resulted in marginalization of relatively poor pastoral households and ignited fierce competition and internal conflicts

over the resource use, in turn, causing open property regime system by reducing collective actions in commons management. The common property systems that allowed flexible and reciprocal use and sustainable management of patchy and scarce resources have already tattered. These land use regime shifts explained by the expansion of private enclosures accelerated the fragmentation and degradation of the rangelands. The Borana herders and their herds have become more sedentary and embraced diversified non-pastoral economic activities including crop cultivation following the government policy which undermined the strategic management of extremely scattered resources through mobility practice. Consequently, the productivity of rangeland has been deteriorated and the usefulness to pastoralists in providing ecosystem services has been significantly reduced and has already reached a critical stage (misfit between social and ecological systems).

Pastoralists' ways of life is under increasing threats-induced by the contemporary SES dynamics. Broadly, today, the entire Borana pastoral system has subject to an increasing combination of socio-political and ecological change stressors. In addition to climate variability/change, the Borana pastoralists as elsewhere have faced an exposure related to the unsupported policy environment along with internal dynamics such as growth population. Dating back to the imperial regimes and still now, intentionally or unintentionally, the pastoral system received little attention while compared with the farming communities. Even worse, limited government interventions were based on misinformed premises and often inconsistent with pastoral system realities (**section 5.2**). Eventually, in combination with internal deriving forces, these persistent unfavorable and marginalizing policies, produced pastoral system vulnerability to prevailing environmental and socio-political changes through weakening the customary institutions, prime grazing land encroachment and fragmentation, disallowing mobility, and, etc. The Borana customary institutions that were known for their flexibility and

adjustment to SES changes and balancing the interaction between nature and society have already weakened if not totally collapsed (**section 4.3**). On the other hand, despite it received little attention, the Borana pastoral system has double exposed to simultaneously occurring climate and non-climate change stressors and stresses (**section 5.4**). The combined effects of socio-political and climate-related factors have produced new pathways of pastoral system vulnerability. Socio-political changes explained in the forms of state-led interventions have made pastoralists adaptation strategies to environmental changes more complicated. Similarly, the prevailing climate changes/variability mainly manifested in the form drought has undermined the adaptive capacity of the pastoral system to respond to non-climate stressors.

In conclusion, the existence of multiple pathways of pastoral system vulnerability reflects that the design of successful adaptation or resilience building strategies strongly hinges on an understanding of interactions between various climate and non-climate factors and their combined effects on the co-production of pastoralism vulnerability pathways. This, in turn, requires multi-disciplinary approaches based on understanding of the interactions of coupled human and ecological elements in the pastoral system. Thus, we argue that, we need to expand our analyses of resilience or vulnerabilities of pastoral system or any natural resource dependent societies beyond one major dimension, by exploring how the relationships dynamics in their SES make them resilient or vulnerable along multiple dimensions.

In addressing the research question related to the vulnerability of pastoralists to prevailing SES changes, it was attempted to examine the vulnerability profile of pastoralists at household level. The calculated households' vulnerability profiles showed that the majority (above 63%) of the pastoral households were found to be vulnerable largely associated with poor institutional and social support services in the pastoral areas (**section 5.3.4**). Evidently, as just explained, attributed to interrelated

internal and external disturbances, today pure pastoralism is no longer a sustainable livelihood for the vast majority of the Borana pastoral households. Hence, investing in various development infrastructures and institutional support services including micro finance institutions and multiple diversification options that suit to the pastoral system contexts have strong implications in developing and building the adaptive capacity of pastoral systems to deal with present and anticipated severe perturbations.

How pastoral households are responding to prevailing SES dynamics? The results of the study pointed out that the Borana pastoral communities are modifying their ways of life to adapt to climate and non-climate transformations (*Section 5.6*). However, some of the adaptation strategies such as the current rush in settlement, range enclosures and expansion of opportunistic crop cultivation further brought the shifts in land tenure structures and created inequitable access to land resource among pastoral groups (sign of maladaptation process) reflecting such dynamics of livelihoods diversifications should be reframed and supported by well-structured institutions (including developing clear land use strategies) for sustainable future and equitable resource use rights for all groups. Equally important, there is a need to consider and support pastoral mobility practice to grasp the advantages involved in it including flexibility, dynamism, multi-functionality, and reciprocity in rangeland resource management and use. However, with an increasing rangeland fragmentations and shift in tenure structures, restoring and maintaining herd mobility is not an easy task.

In a related front, communal land tenure system that allowed flexible and reciprocal use of highly variable semiarid and arid rangelands has already been deteriorated due to increasing privatized grazing enclosures and division of commons into parcels of rangelands which caused severe rangeland degradation. The inability of formal land tenure policies in protecting pastoral land ownership rights further created a vacuum in

ensuring equitable access and use rights of the pastoral communities which, in turn, led to increased vulnerability of the pastoral system to environmental changes. Hence, it can be argued that appropriate land tenure systems that stem from a clear understanding of the rangeland resource system and can ensure equitable access and use rights and sustainable management of rangeland should emerge.

A center of this dissertation is how the rangeland governance process influenced the vulnerability or resilience of the pastoral system. The study found that the problem that the Borana pastoral system is facing today is essentially the governance failures rooted in lack of understanding the pastoral system and persistent efforts that worked to decouple human and ecological systems. This resulted in misguided and marginalizing policy and development interventions particularly related to land tenure arrangements. A state-led hierarchical governance structure, which is fragmented and sectoral based in nature, has been failed to respond to the complex problems the pastoral system has been facing. Rather, it succeeded in disintegrating well-adapted and flexible customary natural resource governance system that helped the Borana pastoralists to make their livelihoods under harsh environment maintaining the sustainability of the rangeland ecosystems.

One implication of the finding of this study is that a SES perspective which calls for a more holistic approach which is needed to clearly understand the nature of complex challenges in natural resource management and to establish effective rangeland governance. In complex problems similar to rangeland governance where it is impossible to design forward solutions, it is needed to expand our thinking beyond focusing on a single component by concentrating on the interactions in SES.

In line with this, the study attempted to analyze network forms of governance structures employing social network analysis to evaluate the capacity of the

contemporary governance system in responding to daunting complexity in rangeland resource governance (**Chapter 6**). The result showed that in any measurements of network structures such as network density and centrality, unfortunately, the current rangeland governance structures have limited capacity to develop a collaborative process in which various actors with differing knowledge, perspectives, capacities/resources, values, and interests can come together to understand complex problems, solidify shared goals, agreed upon the solutions and integrate their collective actions. Let alone having solidified common goals, divergent views exist among actors in the Borana rangeland governance system concerning the development path of pastoralists and rangeland management as it can be seen from persistent sedentarization policy pursued by the government while scientific communities, NGOs, pastoralists themselves and other actors oppose. The hierarchical, state-dominated, mono-centric and reductionist form of governance is still dominating the Borana rangeland governance system.

It is thus apparent that policy environment which promotes and cultivate the collaboration of multi-actors across scales should be emerged to make use of scattered knowledge and other resources and joint actions to effectively respond to the daunting complexity in the rangeland governance. The recognition of pastoral rights and their customary institutions should also be seen from polycentric governance perspectives. With this regard, the findings of this study strongly suggest that understanding and revitalizing the customary institutions and associated indigenous knowledge system can be of crucial importance in understanding how SES resilience can be enhanced as indigenous knowledge systems provide useful insights on the dynamics of ecological and human systems interactions.

It is also quite important to note that the major source of reduced resilience of the Borana pastoral system has primarily stemmed from failure of establishing adaptive rangeland governance system that can efficiently respond to complex interactions and uncertainties in the face of changes. The present study, therefore, suggests that there is a need to invest in establishing collaborative, flexible and learning based governance system that fully consider the interdependence and co-evolution of the social and ecological system and integrate the social and ecological aspects of rangeland development.

Despite the Borana pastoral system has received much attention from scientific communities; there exist unsettled issues regarding the pastoral SES resilience building still. Despite the rhetoric of collaborations, studies and interventions are mostly framed by the reductionist perspectives which decouple human and natural system as if they stand independently, with little or no emphasis on the interactions between the two. Therefore, future studies should focus on the reorientation of research perspectives from reductionist to a more holistic research approaches involving multi-disciplinary methodologies are needed to understand the rapidly changing Borana Pastoral SES, particularly, focusing on the interactions of the subsystems to design effective intervention points.

In studying network governance structure, one of the limitations of this study was its primary reliance on the interview of representatives of the actors under consideration, while the nature of the study demands the facilitation of workshops and meeting to create platforms for more interaction of actors on the issue. It was tried to fill this gap using methods such as document reviews and key interviews. The study also covered a limited geographical coverage. Hence, in-depth examinations of social network analysis are needed to understand the feature and the capacity of the rangeland governance

system in handling the resilience of SES, especially in making comparison with other pastoral system setting and wider environmental and natural resource governance system in Ethiopian context. Besides, future studies should also address various forms of the collaborative process such as resource sharing, knowledge sharing, power relationships, etc. to further understand the influence of each on the effectiveness of the governance regime.

As social processes put an enormous pressure on ecological processes and the distinction between human ecological systems is not easy to comprehend if not impossible, this study mainly concerned with the social processes and relies on perceptions of the pastoralists in understanding the ecological dynamics. Future studies will be benefited from integrating the perceptions of pastoral households and other analytical approaches and tools such as geographic information system and remote sensing to more clearly understand the SES dynamics.

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Appendixes

Appendix 1: Household Survey Interview Schedules

Addis Ababa University, College of Development Studies, Center for Environment and Development

Dear Participant:

I invite you to participate in a PhD research project entitled '*Socio-Ecological Dynamics and Rangelands Governance: the case of Borana Pastoral Communities, Southern Ethiopia*'. The purpose of the study is to investigate the dynamics of rangelands resources over the years and how networks among actors/stakeholders in rangelands governance regimes affect the resilience of the pastoral and agro-pastoral communities in the arena of climate and socio-political changes. We believe the results of the study will be value to all stakeholders such as communities, governmental and non-governmental organizations to strengthen the efforts in building socio-ecological resilience. Thus, your participation in responding to the questions or providing information as honestly as possible is critical to the success of this study. Participation is strictly voluntary and you may refuse to participate at any time. We recognize the value of your time, and sincerely appreciate your efforts on our behalf. Individual responses are anonymous and all individual level data will be held in confidence.

Thank you in advance for your time!

I. General Information

1. PAs/Village Name:		2. Date of Interview:	
3. Name of Enumerator:		4. Questionnaire No.	
5. Name of Household Head:		6. Time of Interview	HH Age

II. Household Characteristics

7. Age of HH (√)	15-24	25-34	35-44	45-54	55-64	65+	
8. Education Level of HH (√)	Illiterate	1-4 grade	5-8 grade	9-12 grade	Diploma	Degree	Religious
9. Marital Status (√)	Married	Single	Divorced	Widowed	10. HH Sex	Female(1)	Male(0)
11. How long have you lived in this village in years (√)	<5	5-10	Over 11	12. HH Size			
13. How many persons in each age category in years?	0-5	6-14	15-28	29-64	>64		

III. Economic Activities

14. What is your household's main source of income? (1) Livestock (0) Crop farming (2) off-farm 3) non-farm
 15. What is your average annual household income in ETB (last year)? -----

16. In your view, are your HH food secured? 1. Yes 0. No

17. If No, how many months you face food scarcity?-----

Farm based	Annual income in Birr	Off/Non- farm based	Annual income in birr
Livestock farming		Micro-business/small-scale	
Crop farming		Casual labor	
Others (specify)		Salaried/fixed employment	
		Charcoal burning	
		Remittance	

18. Types of house:

19. Do you own private land? 1. Yes 0. No

20. If yes, please fill the following.

A. Cultivated land----- (ha) B. Grazing land----- (ha) C. Homestead land..... (ha)

D. Forest land if any----- (ha) E. Others (specify)..... (ha).

21. What are the other sources of household's financial support? (0) none, (1) children, (2) relatives (3) friends CBOs and NGOs, (4) government

22. What is your household average expenditure per month? ----- ETB

23. Has any of your household member ever obtained credit facility in the last year? Yes (1) No (0)

24. If yes, what source?

1. Government (ETB)..... 2. Relatives and friends (ETB): 3. Micro-enterprise ETB.....

4. Non-governmental organizations (ETB)..... 4. Others (specify): ETB-----

25. Do you have any of your household members employed elsewhere? (1) Yes (0) No

26. If yes, type of employment; permanent (1), temporary (0)

27. Did your household receive any remittance during the last year? yes (1), no (0)

28. If yes, how much did you received? ETB

29. According to your own opinion do you think that your household enjoyed good social linkages with relatives? yes (1), no (0)

30. Do you own livestock? Yes (1), No (0)

Livestock	No. owned today?	No. born during last years?	No. sold during last years?	Average price per animal sold?	No. died last year	Main reason for death? 1= diseases 2= drought 3 = floods 4= conflicts 5= predation 6= slaughter	Trend in Livestock numbers? 1= increased 2= decreased 3= same
Cattle							
Goats							
Sheep							
Camels							
Donkey							
Others...							

31. Household income from livestock product annually? A. Milk (ETB)..... B. Butter (ETB)..... C. Skin & Hide (ETB)..... D. Others (specify).....

32. What is the approximate distance to the nearest livestock market? (0) Less than 1km, (1) 1 – 5km, (2) 6 – 10km, (3) >10 km

33. What are the possible reasons for selling your livestock for the last one year? (most to the least)

Reasons for	Rank	Reasons for	Rank
Drought		veterinary services,	
School fee		cultural festivals,	
Buy food		Shortage of feed	
Medication		Others (specify)	

34. What are the major challenges you are facing in livestock keeping? 1. Scarcity of feed 2. Scarcity of water
3. Livestock disease 4. Land alienation and insecurity of tenure 5. Others
(specify).....

35. Have you been visited by any livestock extension officer over the last one year? Yes 1. No 0

36. If yes, on average how many days did the development agents contacted (visited) you/visited him/her?
1. Once per month 2. Twice per month 3. Three times per month 4. Others (specify)

37. Do you have milking cow in your herd? Yes (1) No (0)

Animal	How many over the last 4 weeks?	Total amount of milk produced in litter	Total amount consumed	What is the total amount sold by Household?	What is the average price of milk per litter
Cattle					
Goats					
Camel					
Sheep					

38. Major crops and vegetable grown during the last cropping season.

Crop type	Plot size	Total output	Consumption	Sale	Total cash from crop sale
Maize					
Haricot bean					
Teff					
Sugar cane					

39. Lists of assets other than livestock and farms

Types of Assets	Tick	Types of Assets	Tick
Car		TV	
Motorcycle		Radio	
Solar		Mobile phone	
Others (specify)			

IV. Institutional Services

37. How long does it take to get from your house to the closest of the following facilities (one way) in hours?	Facility	On foot	Vehicle	On foot & vehicle
	Livestock Extension Services			
	Livestock clinic			
	Nearest school			
	Health Center			
	Water sources			
	Hospital			
	Nearest motor able road			
	Nearest shop			
	Market center			

	Credit service institutions			
	Bank			
	Post office			
	Nearest telephone facility			
	Kebele administrative			

41. What are your most important sources of farming information for the last two to three years? 1. Other farmer/pstoralist 2. Mass media 3. Extension agent's 4. Other (specify) -----

42. Have you been attending any livestock/agricultural training program? 1. Yes 0. No

Where? ----- For how long? -----

43. Do you own radio/television? 1. Yes=1 2. No=0

44. If yes, have you ever heard or listen radio/TV programs programmed on Livestock/agricultural matter? Yes=1 2. No=0

V. Social Network

45. In the past one month how many types of help did you provide or receive from others?(tick the appropriate box)	Various Helps	Help given	Help received
	Looking after livestock		
	Harvesting and threshing of crops		
	Attending to sick animals		
	Building/maintenance of house		
	During sickness		
	Borrowing money		
	Borrowing or providing seeds		
	During religious rites		
	During death		
	Buy items from markets		
	Writing and reading letters/applications		
	Mediating conflicts		
	During marriage		

46. In the last year have you received cattle as a gift or help? 1. Yes 0. No

47. In the last year have you lend cattle/caw as help for others? 1. Yes 0. No

48. How do you evaluate the trends of livestock sharing? 1. Increasing 2. Decreasing 3. Same

49. In the past one month did you borrow (get money from others on loan)? 1. Yes 2. No

50. If yes, how many times? -----

51. In the past one month did you lend money? 1. Yes 0. No

52. If yes, how many times? -----

53. Are you a member of any formal cooperative? 1. Yes 0. No

48. If your household wanted to borrow money, whom would you approach first? (tick the appropriate box)	Source	Tick
	Relatives	
	Friends	
	Village fund (community fund)	

49. How easy is to borrow money from?(tick the appropriate box)	Rural credit cooperative		
	Local/Private money lender		
	Source	Easy	Difficult
	Relatives		
	Friends		
	Village fund/Iddir		
	Credit cooperative		
	Local/Private money lender		

VI. Health, Sanitation and access to water resource

56. In the last 12 months, did your household members were ill that they had to miss work or school? 1. Yes

0. No

57. In the past one year did your HH members suffered from the following diseases?

A. Malaria B. Typhoid C. Diarrhoea D. Fever E. Other (specify).....

58. What is prevention methods used in your household?

<i>Disease prevention methods used?</i>	<i>Tick</i>	<i>NO</i>
Do you use water filter?		
Do you boil drinking water?		
Do you have mosquito nets?		
Do you use mosquito repellents?		
59. What is the main source of water supply to your drinking water?(tick the appropriate box)	<i>Means</i>	<i>Tick</i>
	Lake	
	River	
	Stream	
	Spring	
	Pond	
	Rain water	
	Underground water	
	Tap water	
60. Approximately how much time (in minutes) does it take a member of your household to collect water from the nearest facility?	<i>Seasons</i>	<i>Time in minutes</i>
	<i>During the rainy season</i>	
	<i>During the dry season</i>	
	<i>During most of the year</i>	
61. What do you feel about the volume of drinking water at the source?	<i>Increasing</i>	<i>Decreasing</i>
		<i>Same</i>
62. During the last 5 years what have you observed about the quality of drinking water sources for your household?	<i>Improving</i>	<i>Worsening</i>
		<i>Same</i>
63. How often are there conflicts over the use of water in your community for livestock?	<i>Never</i>	<i>Rarely</i>
		<i>Sometimes</i>
		<i>Often</i>
		<i>Always</i>

VII. Climate Change Issues

57. How do you perceive climate change/variability through? (Tick as appropriate)

Question items	Strongly Agree(5)	Agree (4)	Neither agree nor disagree(3)	Disagree (2)	Strongly disagreed (1)
Increasing rainfall in amount during main rain season					
Decrease the intensity of rainfall					
Shift in the timing of the onset of rain					
Rain starting later than normal					
Long rains than normal					
Rainfall became erratic					
Temperature of the area increasing					
Increase in recurrences of floods					
Increase in intensity of floods					
Decrease in recurrence of droughts					
Increase in intensity of droughts					

58. What has been the trend of temperature for the past 20 years to date according to your memory? 1. A.

Increasing B. Decreasing C. Fluctuating D. Constant E. Don't know

59. What has been the trend of rainfall for the past 20 years to date according to your memory? 1. A.

Increasing B. Decreasing C. Fluctuating D. Constant E. Don't know

60. Have you experienced any climate-related shocks over the past five years? 1. Yes 0. No

61. If yes, in what form? 1. Drought 2. Flood 3. Erratic rainfall 4. Hailstorms

62. How did the disaster /hazard affect your household?

A. Livestock Death

B. Livestock disease outbreaks

C. Decline in crop yield

D. Loss of income E. Food insecurity F. Others (specify).....

63. What are the short term coping strategies that your household used during the previous droughts? (multiple answer is possible)

(0) did nothing, (1) sold livestock, (2) borrowed from relatives, (3) waited for food aid, (4) participated in cash/food- for-work, (5) sought for non-farm employment, (7) sought for off farm employments (8) shift to crop cultivation

64. What are adaptation strategies that your household is using?

No	Adaptation Strategy	Tick
1	Change herd size and composition	
2	Wage labor migration	
3	Practice Mobility	
4	Income source diversification	
5	Shift to crop cultivation	
6	Shift to drought resistant crop varieties	
7	Intensify irrigation	
8	Diversify household income sources	
9	Change livestock types	
10	Change livestock breeds	
11	Purchasing supplementary feeds	
12	Herd splitting	
13	Constructing soil and water conservation structures	

15	Afforestation	
16	Use new high crop yielding varieties	
17	Producing cash crops	
18	Water harvesting	
19	Rotation of grazing land	
20	Intensification of irrigation	
21	Practicing agroforestry	
22	Fencing and reseeded the rangelands	
	Others(specify)	

65. Did you get any information/advice related to climate variability/change? 1. Yes 0. No

66. If yes, from where did you get the advices? (1) Development Agents (2) NGOs (3) Radio/TV (4)

Meteorological Agency (5) others (specify).....

67. What do you think you can do in the future to be able to adapt to the changes if they persist?

Future adaptation options	Tick
Abandon pastoralism life style at the expense of other economic activities	
Abandon the pastoralists way of life and move crop cultivation	
Emigrate from your village to other areas with better conditions	
Continue changing composition, herd size and breed changes to combat	
Ask for food aid	
Ask for government support like introduction of new and modern adaptation options	
Seek to obtain more information, knowledge and education on a adaptation to climate change	
Promote irrigation using underground water	
Promote conservation practices further	

VIII. Perception towards Rangelands Resources Dynamics

68. How do you evaluate the condition of the rangelands in your areas? 1. Good 2. Fair 0. Poor

69. Please tick one box for each statement below to show how much you agree or disagree.

Question Items	Strongly Agree(5)	Agree (4)	Neither agree nor disagree(3)	Disagree (2)	Strongly disagreed (1)
The vegetation of rangelands is decreasing					
During the last 10 years there is loss of bio-diversity					
Palatable plants are increasing					
poisonous plants are decreasing					
Shrubs are decreasing					
Compared to the past, bush encroachment is increasing					
The amount of grasses is increasing					
Annual plants are increasing					
Ground cover is decreasing					
The availability of water throughout the year is decreasing					
Plants height is decreasing					
Soil salinity is increasing					
Soil fertility is decreasing					
The risk of wildfires is increasing					
The risk of pest damage is increasing					
The proportion of bare land is increasing					

70. Would you please list the causes of rangeland degradation? Please tick.

Drought and rainfall decline	
Settlement Pattern	
Expansion of crop cultivation	
Private enclosures/ranches	
Blockage of mobility	
Overgrazing	
Fire ban	
Other, please specify	

IX. Rangeland Governance and Institution

71. What do the ownership grazing system look like in your surrounding? 1. Communal 2. Privately owned 3. Both
72. Do you have your own grazing land? 1. Yes 2. No
73. Do you practice mobility? 1. Yes 0. No
74. If yes, what are the advantages of that lifestyle?
75. What are/were the disadvantages?.....
76. What are the advantages of being settled?.....
77. What are the disadvantages of being settled?.....
78. Do you think the effectiveness of the customary institutions? 1. Increasing 2. Decreasing 3. Same
79. The communities are satisfied with the structure and functions of government structure. 1. Strongly Agree 2. Agree 3. Disagree 4. Strongly disagree 5. Do not know
80. Who decide the access to rangelands resources in communal grazing land? 1. Government administrative structures 2. Customary institutions 3. Both
81. What are the problems you or HH members face during using of rangeland resources?.....
82. How do you evaluate the effectiveness of formal government institutions compared to customary institutions? 1. Very Good 2. Good 3. Fair 4. Poor 5. Very poor
83. How involved are you in the governance process on your rangeland resources? 1. A great deal 2. Somewhat 3. Not much 4. Not at all
84. What level of trust exists between the community and the government institutions in rangelands management and governance? 1. A great deal 2. Sufficient 3. Not much 4. None at all 5. Don't know
85. In the last 5 years, did you contribute any resources for rangelands resource development? 1. Yes 0. No
86. If you were to rank the two categories of institutions (customary and non-customary) in terms of their contribution to sustainable development of rangelands resources, which category would you rank first? 1. Customary institution 2. Formal government structure 3. Do not know
87. Why?.....
-

88. How do you rate the quality of communication that takes place between stakeholders in rangeland governance? 1. Very good 2. Sufficient 3. Not very good 4. Not good at all 5. Don't know
89. How do you evaluate the government sedentarization policy? 1. Good 2. Bad 3. Fair 4. Do not know
90. If yes, what is the major reason for the mobility? 1. Shortage of feed 2. Shortage of water 3. Conflict 4. Other (Specify)
.....
91. If no, why you abandon? 1. No place to go 2. Alienation of land 3. Cultivation of crop 4. Expansion of private ranches 5. Others (specify).....
92. Are you able to move your livestock freely to the traditional grazing areas? Yes 1. No 0.
93. Have you started cultivation? 1. Yes 0. No if yes, when
94. In your view, do formal administrative structures recognize the customary institutions? 1. Yes 0. No

Thank You! We welcome additional comments:

Appendix II: Interview schedules used for Social Network data collection

Dear Participant:

I invite you to participate in a PhD research project entitled '*Socio-Ecological System Dynamics and Rangelands Governance: the case of Borana Pastoral System, Southern Ethiopia*'. The purpose of the study is to investigate the dynamics of rangelands resources over the years and how networks among actors/stakeholders in rangelands governance regimes affect the resilience of the pastoral and agro-pastoral communities in the arena of climate and socio-political changes. We believe the results of the study will better ascertain the networks among various actors in rangelands governance and management. Thus, your participation in responding to the questions or providing information as honestly as possible is critical to the success of this study. We recognize the value of your time, and sincerely appreciate your efforts on our behalf. Individual responses are anonymous and the data will be held in confidence.

Thank you in advance for your time!

1. Name of the organization:.....Name of the respondents:..... Position.....
2. Please list the five stakeholders who you believe are the most active in rangelands governance, management and development.
 - a.
 - b.
 - c.
 - d.
 - e.
3. Would you please identify organizations with whom your organization collaborated with on the issues of rangeland management within the last 2 years? How often? (Weekly, Monthly, every 3 months, 1–2 times=year)

Appendix III: Focused Discussion and key informant: Broad question on Climate change, and Institutional aspects in rangelands resource management

1. The state of the local climate in the past 30 years to-date b) Any changes so far (good/bad ones) c) Why those changes (if any)? d) The state of the climate to change further in the future?
2. Is there any change in land use system over the last 30 years or so? What are those changes?
3. How you would see the impacts of current private enclosure expansion along with crop farming?
4. How are collective-choice actions rules framed and implemented?
5. How do the local communities ensure monitoring of the commons?
6. What are the conflicts between local rules and national rules, as well as policy, in resource management?
7. What have been the historical changes in access to resources of local resource users?
8. How are issues of equity and distribution addressed by formal and informal institutions?
9. What are the local and national institutions involved in access, use and control over wetland resources?

10. How do rangelands policies facilitate marginalization of local resource users from their traditional usufruct rights to resources?
11. What are the property rights that exist in terms of access, use and control over resources by different stakeholders?
12. How the lockage of mobility by the government affected pastoralists?
13. What are the effects of missing property rights on access to resources by different resource user groups?
14. How are different resource user groups maintaining their access to resources under the present management systems?
15. What type of property rights needs to be re-established in rangeland resource management? Why? And how?
16. What are the practical ways to strengthen property rights for effective community-based resource management?
17. Who are the most advantaged groups and disadvantaged groups in accessing resources? Why?
18. How externals are protected from getting access to your rangelands?

Appendix IV: Actors included in the analysis of network governance

Governance level	Actor	Abbreviation
National Level	Ministry of Federal Affairs	MFA
	Ministry of Environment, Forest and Climate Change	MEFC
	Ministry of Agriculture and Natural Resources	MANR
	Ministry of Water, Minerals, and Energy	MWME
	Ministry of Livestock & Fishery Development	MLFD
	National Pastoral Commission	NPC
	Ministry Culture and Tourism	MCT
	Federal Cooperative agency	FCA
	Hawasa University	HAU
	Food and Agriculture Organization	FAO
	Merlin	MN
	CISP	CISP
	GOAL Ethiopia	GOAL
	ASARECA	ASARECA
	CARE-Ethiopia	CARE
	Save the Children-Ethiopia	SAVE
	SOS Sahel Ethiopia	SOS
	MercyCorps	MC
	Action for Development	AFD
	Haramaya University-Prime project	HU
Regional Level	Oromia pastoral development Bureau	OPB
	Oromia Forest and Wild Life Enterprise	OFWLE
	Oromia Pastoral commission	OPCB
	Oromia Land and Environmental Protection	OLEPB
	Oromia Agricultural and Natural Resource	OANRB
	Oromia Livestock & Fisheries Dev't Bureau	OLFDB
	Oromia Water, minerals, and Energy Bureau	OWMEB
	Oromia Culture and Tourism Bureau	OCTB
	Oromia Cooperative Promotion Bureau	OCPB
	Oromo grass root development initiative	Hunde
	Borana Zone Agricultural Desk	BZADO
	Forest and Wild Life Enterprise	BZFWLE
	Borana Zone Pastoral Development office	BZPDO
	Borana Zone Environmental protection & land Adm.	BZEPLAO

Zone Level	Office	
	Borana Zone water, mineral & Energy Office	BZWME0
	Borana Zone Cooperative Promotion Office	BZCPO
	Borana Zone Administration office	BZAO
	Borana Zone Culture and Tourism Office	BZCTO
	Southern Rangeland development Unit	SORDU
	Dida Tiyara Ranches	DTRPC
	Gums and Resins Production private company	GRPPC
	Gayo Pastoralist Development Initiative	GPDI
District Level	Yabello Pastoral and Dry Land Agriculture Research Center	YDARC
	Yabello District Pastoral Development office	YDPDO
	Yabello District Environmental protection & land Adm. office	YDEPLAO
	Yabello District Water, mineral and Energy Office	YDWME0
	Yabello District Culture and Tourism office	YDCTO
	Yabello District Agricultural Desk	YDAD
	Yabello District Cooperative Promotion Office	YDCPO
	Yabello District Administration Office	YDAO
	Yabello District Pastoral Development office	YDPDO
Local Level	Rabagada Gada institutions	AG
	Dembellsadeen Indigenous Development Group	DSPDG

Source: Own survey, 2016