FARMING SYSTEM AND TRADITIONAL GRASSLAND MANAGEMENT PRACTICES: THE CASE OF KOFELE DISTRICT, WESTERN ARSI ZONE, ETHIOPIA

MSc THESIS

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HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA

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APPROVAL SHEET

ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled "**Farming System and Traditional Grassland Management Practices: the Case of Kofele District Western Arsi Zone, Ethiopia**" submitted in partial fulfillment of the requirements for the degree of Master's with Specialization of Animal Production, Graduate Program in the School of Animal and Range Sciences and it was carried out by Hussein Abduku Id.No SGS/025/08, under our supervision. Therefore, we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the school.

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Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Council (SGC) of the candidate's major department.

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DECLARATION

I hereby declare that this MSc thesis is my original work and submitted to Hawassa university college of agriculture, school of animal and range science in partial fulfillment of the requirements for the degree of the master in animal production with the title "**Farming System and Traditional Grassland Management Practices: the Case of Kofele District Western Arsi Zone, Ethiopia".** Hence, I declare that it has not submitted to any other institution elsewhere for the award of any degree.

____________________	____________________	____________________
Name of the Author	Signature	Submission Date

LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Insemination
BHU	Bule Hora University
CSA	Central Statistics Agency
DANRMO	District Agricultural and Natural Resource Management Office
ERSS	Ethiopia Rural Socio economic Survey
FAO	Food and Agricultural Organization
FEAST	Feed Assessment Tool
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic product
HU	Hawassa University
IAEA	International Atomic Energy Agency
IBC	Institute of Biodiversity and Conservation
IFAD	International Fund for Agriculture and Development
ILCA	International Livestock Center for Africa
ILRI	International Livestock Research Institute
MoA	Ministry of Agriculture
NGO	Non-Governmental Organization
ORS	Oromia Regional State
PRA	Participatory Rural Appraisal
SNNPRS	Southern Nation Nationality of People Regional State
TLU	Tropical Livestock Unit

TABLE OF CONTENT

Content **Page**

LIST OF TABLES

Table **Page**

LISTS OF FIGURES

Figure **Page**

LIST OF TABLES IN THE APPENDIX

Appendix table **Page**

LIST OF FIGURES IN THE APPENDIX

Appendix figure **Page**

Farming System and Traditional Grassland Management Practices: The Case of Kofele District, Western Arsi Zone of the Oromia Regional State, Ethiopia.

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ABSTRACT

This study was conducted in Kofele district, Western Arsi Zone of the Oromia Regional State, Ethiopia, with the objective of characterizing the farming system and traditional grassland management practices. The district was stratified in to two by altitude (high altitude and medium altitude). Proportionally four rural kebeles (Germama, Gurmicho, Guchi and Bitacha) from high altitude, and two (Tullo and Abbosa) from medium altitude were purposively selected. From high altitude 93 households (HH) and 57 from medium altitude were selected. Semi-structured questioner, focus group discussions and key informant interviews were used to collect qualitative and quantitative data, which were analyzed using descriptive statistics and regression model. The district is characterized as mixed crop-livestock farming system. Average land holding per HH was 2.24 hectares with 1.27 hectares allocated for crop cultivation and 0.92 hectares for natural pasture. The dominant crops grown in the study area were potato, barley, wheat and enset in their order of importance by farm HH. Twenty seven percent of the respondents are using small-scale irrigation to cultivate crops on 0.06-0.25 hectare of land. The average livestock holding per HH was 6.15 Tropical Livestock Unit. Natural pasture (56.5%), crop residue (29%), enset byproducts (9.5%), agro-industrial byproducts (2.2%) improved forage (1.1%) and other (1.7%) are among feed resources available in the study area. Feed shortage, low productivity and expansion of epidemic diseases such as anthrax, black-quarter and lumpy skin disease have been identified as livestock production constraints in the study area. Private enclosure, wet land drainage and fencing were found to be the traditional method of grassland management. Moreover, the traditional grassland management practice has become weak, contributing to the loss of productivity of grasslands. Land holding size, crop land and forest land (private forest plantation for commercial purpose) significantly influence the grazing land size ($p<0.01$). As conclusion appropriate land allocation, grassland management practices, like controlled grazing, cut and carry, proper straw conservation and empowering of traditional grassland management strategies should be considered.

Keywords*: Farming system, traditional grassland management, livestock production.*

1. INTRODUCTION

1.1. Background

In Ethiopia, agriculture is the main source of economy with more than 80% of the population being dependent on this practice in which livestock play a very important role (CSA, 2009; IBC, 2012). Agriculture contributes with approximately 50% to the overall Gross Domestic Product (GDP), generates 90% of export earnings and provides employment for 80% of the population (CSA, 2009). Livestock production is a part of the agriculture and the contribution of livestock and their products to the agriculture economy accounts for about 47% (IGAD, 2011). Ethiopia holds the largest cattle population from Africa with an estimated approximately, cattle 57.8 million, sheep 28.89 million, goat 29.7 million, horse 2.08 million, donkey 7.88 million and mule 0.41 million. From the total cattle population 98% are local breeds (CSA, 2016).

Grazing ruminants are the largest contributors to livestock output in tropical regions. The production performance of grazing ruminants, within their genetic boundaries, depends on the level of nutrient intake (Tolera *et al*., 2012). Natural pasture and crop residue is dominant feed source in the highlands of Ethiopia (Mengistu, 2016). The contribution of feed resources depends up on the agro-ecology, the type of crop produced, accessibility and farming system (Ahmed *et al*., 2010). Grazing land shortages and poor quality of available feed are the major constraints of livestock production in Ethiopia (Melkamu, 2013). Grazing conditions are only favorable for four to five months per year. Additionally there is a shortage of forage availability especially during dry season (Mengestu *et al*., 2016 b).

Traditionally livestock owners have their own grazing land management system, to use grassland resource properly. However, the current trends observed in the highlands of Ethiopia, pasture land is deteriorating due to manmade and natural factors which include expansion of cropland at the expanse of pasture land and land degradation, climate change (mainly due to rainfall variability and loss of diversity (Alemayehu, 2006; Dejene, 2003).

In order to promote the survival and the sustainability of pastures at sustainably, the sustainable grazing land management involve the implementation of proper strategic management plans (Otte and Chilonda, 2002). Participation of local users is very important, because local users have an intimate knowledge about their local environment and traditional experiences in tackling problems (Angassa *et al*., 2012). The major feeding management practice in highlands of Ethiopia includes, natural grazing and browsing, provision of crop residues and cut and carry system (Dejene, 2003).

Ethiopia is known by having different environmental condition, soil type and agro ecology, social and cultural diversity. This variation make difficult to describe farming system of one area easily. However, different researchers classify farming systems based on various classification criteria. Generally classifications are based on integration of crop and livestock and agro ecology (IBC, 2012).

The Ethiopian highland areas are found in >2000 meters above sea level (m.a.s.l.) which cover 37 percent of the total area and inhabit about 77 percent of the population (IBC, 2012). In the highlands of Ethiopia crop production is the major agricultural commodity, hence more crop residues are used as livestock feeds particularly during dry seasons. Thus, crop cultivation and livestock production integrate strongly (Tilahun and Kirkby, 2004). By adopting strategies, which integrate livestock and cropping systems, there is considerable potential not only to increase crop yields but also increase the quantity and quality of forage for ruminant livestock.

1.2. Statement of the Problem

Despite its potential in terms of livestock population, Ethiopia categorized among leading world countries in terms of high number of cattle heads but one of the lowest livestock productivity even when compared to most sub-Saharan African countries (Tolera *et al*., 2012), and this is mainly due to feed shortage constrains coupled with poor management systems (Nina *et al.*, 2012). In most highland areas of the country, the grazing land productivity become declining due to inadequate technical support and lack of appropriate management and sufficient input supply particularly forage seed production (Alemayehu, 2004). The effective use of grassland resources often depend on the management strategy that govern the resources and it affect the contribution of feed availability for livestock feeding (Reddy *et al.*, 2003), however this can be achieved only if based on reliable information gathered through well-designed study.

In one way, currently, Ethiopian populations are growing at a rate of 2.5% per annum (CSA, 2014), resulted declining in land holding size per capita as well as per household (Menberu, 2014; Mengistu, 2011). This might be a result for the problems stated above but not proved by well-designed study in the study area.

In another way, some scholars reported as, in most highland areas of Ethiopia, farming system shifted to being dominated by crop cultivation as farmers gradually being attracted by cultivation of crops than livestock production, which resulted steadily shrinking of grazing land (Mengestu, 2016; Mekoya *et al*., 2008); it mean that the largest share of the arable land goes to crop cultivation with a shrinking size of grazing land (Alemayehu, 2004).

Specifically, numerous studies that has been done so far here in central highlands of Ethiopia were focus only in evaluating the contribution of natural pasture to livestock feeding and livestock productivity which reported as declining from time to time (Ahmed *et al.*, 2010; Mengistu, 2016; Mekoya *et al*., 2008). However, no any study attempt to investigate on why its contribution decline, on characteristics of local farming system and its effects on grassland resource availability and traditional management practices in the study area so far. Hence, this study was designed in order to fill this information gap intending mainly on characterization of farming system, factors that affect grassland availability and on traditional grassland management practices in the study area.

1.3. Significance of the Study

Farming system characterization is a pre-requisite for developmental intervention and it helps to design appropriate feeding and management strategy to achieve target productions without adverse environmental effects. Finally, the document uses as a resource material for organization or policy makers to undertake developmental interventions targeted to improve the livelihood of the farmer. In addition, this thesis paper can assist other researcher's as a starting point for those who want to conduct further research on this topic.

1.4. Objective of the Study

1.4.1. General objective

- The general objective of this study was to characterize the farming system and traditional grassland management practices in Kofele district.

1.4.2. Specific objectives

- To characterize the farming systems of the area.
- To describe the traditional grassland management practices.
- To identify the factors that affect grassland size in study area.

1.5. Research Questions

The main intent of this thesis was to investigate and answer the following questions.

1. What are the major farming systems farmer's practices in the study area?
2. Is there difference in farming system between households?
3. What are the major traditional grassland management practices?
4. What are the factors that affect grassland size in study area?

1.6. The Scope of the Study

This study was conducted in western Arsi zone Kofele district rural *kebeles* smallholder farmers of male and female rural households. The study was focused on crop cultivation, land allocation, livestock production system and traditional grassland management practices of the respondent households found in highland and mid-highland of the district.

2. LITERATURE REVIEW

2.1. Overview of Farming Systems in Ethiopia

Agricultural practice is also known as "farming". Ethiopian is characterized by a wide range of agro-climatic conditions with diverse cultural practices and farming system. In the country, smallholder farming accounts for about 75 percent of agricultural production (Salami *et al.*, 2010). Agricultural practices are characterized by subsistence and traditional mostly relying on rain-fed agriculture as well as most of the animal products come from traditional livestock production systems (Herrero *et al*., 2009).

Ethiopia is one of the countries in sub-Saharan Africa which is seriously affected by land degradation; the minimum estimated annual costs of land degradation in Ethiopia range from 2 to 3 percent of agricultural GDP (FDRE, 2014). Land degradation is the highest in the highlands of Ethiopia, mainly a function of heavy reliance by a rapidly growing population on unsustainable subsistence agricultural practices (Hurni *et al*., 2010).

Characterization of the farming system provides a useful framework within which to examine agricultural development strategies and interventions. The characterizations need a detailed understanding of the interactions between various production systems within a given unit of land. Generally the following criteria are used as the basis for classification, land allocation, water availability, altitude, dominant pattern of farm activities and household livelihoods, including crops and livestock. In addition, account is taken of the main technologies used, as they determine the intensity of production and integration of crops and livestock (IBC, 2012).

Based on integration of crop cultivation and livestock production and agro ecology farming system can be classified broadly as, mixed crop-livestock farming, agro pastoral farming and pastoral production system (IBC, 2012). The study done by Azage *et al*. (2003) noted that the urban and peri-urban agricultural system is the farming system practiced in urban and peri urban areas, further more based on technology used and purpose of production; urban and peri urban farming classified in to subsistence and commercial.

2.1.1. Mixed crop-livestock farming system

Mixed crop-livestock farming system is agricultural production system in which livestock husbandry and cropping are practiced together complementing each other (Solomon, 2004). Thus, the system provides a safeguard in spreading income and reducing risks arising either from crop or livestock. Livestock sector contribute draft power and manure for cropping. While, livestock production is benefited by using crop residues as animal feed resources. Therefore, livestock husbandry and crop production have much interaction (IBC, 2004), but the degrees of integration vary considerably. The variation should be on the importance of crop residues provide as a source of livestock feed. In this system there is greatest human population pressure where land holdings are extremely small and communal grazing lands almost all converted to private land. So that, on-farm production of forage is an increasingly important source of livestock feed (Ahmed *et al*., 2010).

Livestock production objectives include milk production (for sale or for butter), breeding females for surplus, male animals for sale and keeping oxen provide draught power and cattle provide manure for cropping. Grazing management systems and sources of livestock feed are often changing quite rapidly. In areas close to the larger urban centers grazing land size decreases due to urbanization and in favorable locations along the main livestock trade routes there is increasing specialization of livestock production. In and around the major urban centers dairying is becoming increasingly important (Azage *et al*., 2003).

Land degradation is more common in this farming due to frequent cultivation without fallowing, free grazing and deforestation (FDRE, 2014). In mixed crop-livestock farming system, disease was one constraint which makes the sector non-productive. Diseases have numerous negative impacts on productivity of herds i.e. death of animals, loss of weights, slow growth rate, poor fertility performance, decrease oxen draft power performance and the likes. There are many ways of fighting against diseases and among these, vaccinations (preventive measures) and treatments (curative measures) are the major ones. There is a serious feed shortage problem in this farming system and indigenous livestock breeds are dominant than the improved breeds (Solomon, 2004).

2.1.2. Agro-pastoral farming system

Agro-pastoral farming system practiced in mid agro-ecological zones of Ethiopia on which farmers grow crops and raise livestock (ORS, 2001). These systems are defined as where subsistence requirements derived from cropping exceed 50 percent, where a tendency for crop production has shown besides livestock production. Agro-pastoralists are entirely sedentary, whilst other families are semi-transhumant. In this farming system extensive livestock rearing technology is used and contribute as, draft power/oxen, savings and milk production. Specially, livestock sector are characterized by subsistence type of milk and meat production. The average herd size is generally low, herd sizes range widely from 10-

50 cattle, 0-10 goats and 0-10 camels. Cattle and small ruminants play a critical role in the household economy. Retain female stock to produce milk and to maintain the reproductive potential of the herd. As a result of this young males and females of optimum reproductive age are marketed. Herd management practices are herd splitting occurs into wet and dry groups, and into grazers and browsers to take advantage of the dispersed and varied nature of water and grassland resources (Alemayehu, 2004).

In this system crop cultivation contributes for crop foods and cropping component is subsistence. Crop production comprises mainly sorghum with some maize and teff. The main cropping season is from March-June. The actual proportion of crops for subsistence needs changes between families in one group in a season, or even for the same family in different years and is dependent on a household's personal livestock holding at any one point in time (ORS, 2001).

The environmental condition of agro-pastoral farming systems are the areas that are found below 1,500 m.a.s.l. Mean annual rainfall varies from 600-900mm, variability is high, from 20 to 40 percent of the annual mean. There is a relatively close correlation between rainfall and altitude between 1,000 and 1,700m.a.s.l with mean annual rainfall increasing 64 mm for each 100m increase in altitude. The rainfall pattern is bi-modal with 60% of rainfall between March-May and 30 percent between September-November. Temperature varies inversely with altitude, decreasing 1°C with each 200m increase in altitude. Mean annual temperatures vary between 20°C to 24°C (Alemayehu, 2004).

2.1.3. Pastoral production system

Pastoral production system practiced in lowland areas of Ethiopia by small family units and livestock are kept to provide mainly for milk. The environmental conditions of this farming system are with an altitude of below 1,500m.a.s.l. The system is mainly operating in the range lands where the peoples involved follow animal-based life styles. Herds and flocks are raised that vary considerably in size, from a few sheep and goats in the poorest families to many hundreds of cattle and camels in the wealthiest. The size of the herd/flock determines the share of feed resources obtained from pastures grazed communally under an open access or common property tenure (IBC, 2004).

Extensive livestock rearing system is followed and used as the main subsistence component. The actual proportion of crops for a family’s subsistence requirements changes between families in one group in a season, or even for the same family in different years. It is thus dependent on a household's personal livestock holding at any one point in time. Livestock do not provide inputs for crop production but are the very backbone of life for their owners, providing all of the consumable saleable outputs and, in addition, representing a living bank account and form of insurance against adversity (ORS, 2001).

Livestock management practice in resource utilization in this area are seasonal mobility (nomadic or transhumance) as a survival strategy, move from place to place seasonally based on feed and water availability. The climate in these areas is characterized by low, unreliable and unevenly distributed rainfall and by year round high temperatures. Not only the unfavorable weather conditions but also uneven water point distribution and further the lack of proper management of the rangelands eventually leads tribal conflicts, introduction of new animal disease, low animal productivity and also trans-border issues. Even though, information on both absolute numbers and distribution vary, it is estimated that about 30 percent of the livestock population and about 15 percent of human population of the country are found in the pastoral areas (ORS, 2001).

Table 1: Summary of farming systems in Ethiopia

Farming system	Population density	Ecology	Crop-livestock integration	Crop cultivation	Livestock contribution	Livestock breed	Land management
Mixed crop-livestock	High	Mid-land High land(>2000 m.a.s.l)	Interdependent	Wheat, teff and barely	Income source, draft power and manure	Indigenous	-Change to crop land[1] -land degradation is common
Pastoral	Low (15 %)	Lowland (< 1500 m.a.s.l)	Small family unit	Maize are dominant	Mainly for milk. As an insurance, prestige.	Indigenous	-Land management is poor. -communal grazing system. - mobility
Agro pastoral	Medium	Mid-agro ecology (1500-2000)	Medium	Crop dominant (>50%) Sorghum, maize, teff	Draught power, saving and milk, small herd size	Indigenous	-Free grazing -mobility

Source: (Alemayehu, 2004; IBC, 2012; ORS, 2001).

1 Cropland refers to areas of land ploughed and/or prepared for growing crops. This category includes most flat areas and also some steeps lopes where various crops were grown, either on a rain-fed basis or using irrigation.

2.1.4. Urban and peri-urban farming system

Urban and peri-urban farming plays an important role in the economic life of urban peoples concerning the supply of livestock products and fuel wood. Dairy farming is the kind of farming practiced in the larger cities and further classified into two commercial and subsistence farming systems, which produces milk mainly for market and subsistence farming, which produce milk mainly to meet household needs (Azage *et al*., 2003). The commercial system generally operates in urban and peri-urban areas without holdings of land for feed production.

Urban and per-urban dairy farming system is concentrated in and around larger cities, and towns, characterized by a high demand for milk. This system has been developed in response to the fast growing demand for milk and milk products around urban centers (Asaminew and Eyassu, 2013).

Peri-urban dairy farming system is developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities like Addis Ababa. It possesses animal types ranging from 50% crosses to high grade Friesian in small to medium-sized farms, includes smallholder and commercial dairy farmers in the proximity of Addis Ababa and other regional towns. This sector owns most of the country’s improved dairy stock. The system is estimated to consist of 5,167 small, medium and large milk farms, with about 71% of the producers selling milk directly to consumers (Tsehay, 2001).

In urban and per-urban dairy farming system, the main feed resources are crop residues agro-industrial by-products (CSA, 2014), of the total urban milk production, 73% is sold, 10% is left for household consumption, 9.4% goes to calves and 7.6% is processed into butter and cheese terms of marketing, 71% of the producers sell milk directly to consumers (Tsehay 2001).

2.2. Grassland Resources

In its narrow sense grassland[2] is a land covered with 90 percent herbaceous plants and 10 percent tree and shrubs (Hurni, 2015). Mostly grassland is used in its wider sense of "grazing land". The grassland region of Ethiopia, accounts about 30.5 percent of the area (Alemayehu, 2006). The grasslands are very diverse in species composition, with a range of dominant species dependent on rainfall, soil type and grazing system. Over 90 percent of the major cultivated forage grasses have their center of origin in Sub-Saharan Africa and are indigenous to the extensive grasslands (Hurni, 2015).

Extensive grasslands are mostly found in depressions and floodplains, which are commonly vegetated for longer periods of the year. Such grasslands are easily separable from croplands and were classified as un-drained or as wet (less-drained) grasslands. Un-drained grasslands, which are located between cropland plots, degraded hills, and on sloping but non-cultivated landscapes, were difficult to separate from cropped lands, resulting in lower mapping accuracy of these types of land features. The wetland landscape includes water bodies (natural and artificial lakes, ponds, reservoirs, dams, and rivers) and swamps (Hurni, 2015). On the more humid side, open grassland and grassland with some trees are common. The wide distribution and adaptability of many of these species across a

[2] *Grasslands refer to a land primarily covered by herbaceous plant species, and often existing as open fields that rarely show individual trees.*

In this study the term grassland and grazing land used interchangeably.

range of environments and management systems indicates the presence of considerable genetic diversity within the region. This diversity is exploited to select superior ecotypes for use in many other parts of the country (Settle *et al*., 2005).

In Sub-Saharan Africa, at present, livestock are fed almost entirely on natural pasture at pastoral production system. In mixed crop-livestock system natural pasture constitutes the main source of feed and the feed from natural pastures is estimated to covers 65.48 percent of the livestock feed (CSA, 2014). In highland it is complimented with crop residues and grazing occurs on permanent grazing areas, fallow land and on land following harvest. Due to grazing land shortage valley bottoms, fallow land and road side grazing became important source of livestock feed (Alemayehu, 2004).

Improved forage seed shortage in both quantity and quality and seedling production limits the vast expansion of improved forage development. The feed shortage is a major cause of the low productivity of livestock (Tolera *et al*., 2012). Even, available forage qualities vary from one agro-ecology to the other. Due to overgrazing the available feed resources become low in nutritional content, which is a serious problem which can causes low intake rates resulting in low levels of overall productivity (Tolera *et al*., 2012).

2.2.1. Traditional grassland management practices in the highlands of Ethiopia

According to Alemayehu (2006) grassland management is one of the key determinants of sustainability of the whole livestock farming in the long run. In all level of resource management local community participation starting up to the end is helpful for sustainability because farmer use indigenous knowledge for a long time. Traditionally the farmer has rules to manage the grazing land resources which provide an opportunity in resource utilization sustainably. Ethiopia's people have traditional laws which make the community to use grassland resource sustainably for many years. Grassland resources are managed by whether commercially or traditionally (Angassa *et al*., 2012) and resources are controlled by either private or common property. Land resources are under national laws but land use rights are granted by local communities (Alemayehu, 2006). Grassland management practices aim predominantly done to improve livestock productivity. The effectiveness of grassland management strategy differs from one area to other area; it is based on the type/strategy of the farmers that practiced for improvement. Sustainability and productivity of natural pasture management depends on the farmer ability to detect ecosystem changes. In the highlands of Ethiopia the traditional grassland management is weak; associated with land shortage which results to shortage of grazing land (Alemayehu, 2006).

Grassland resource is affected by climate, soil type and topography, in which they maintain grassland ecosystem. Intensity of grazing is taken as one factor which affect grassland environment. The effects of grazing on the ecosystems obviously depend on the number of herbivorous and their movement (Angassa *et al*., 2012).

Management system that have more influence on the plant response to grazing are; grazing time as to the opportunity of the plant to grow or re-grow, frequency of de-foliation of the plant and intensity of use or stocking rate. The degree of animal dispersion influence pastures availability, which in turn affects pasture conditions and animal production (Angassa *et al*., 2012). Management practices such as distribution of animals on specific sites, water point and mineral in strategic locations, dividing the herd in classes and ages and rotational grazing helps to improve grazing land (Funte *et al*., 2010).

Native pastures are extremely variable in terms of quantity and quality of forage species as a function of space and time. Spatial variability occurs from the parts of the plant itself to sub-regional level. Temporal variability may occur in several time scales, from seconds to several years. Variability may be natural (normal changes on physiology and plant growth associated to seasonal or even daily variations in environmental conditions), or induced by grazing (caused by animals) through the depression of available sources (O'Reagain, 2001).

Three management systems were distinguished. Free grazing is the first management practice; the pasture can be accessed year round, by all animals' species and is open to everyone. This is the dominant type of management system and is assumed to be the main cause of land degradation (Benin and Pender, 2006). The next management system is a controlled grazing where the pasture can be accessed during selected months of the year and access is limited to certain users. This system can contribute to an efficient use of the feed resources, especially in the rainy season. The last management systems is a cut and carry system, where the pasture is completely closed year round and can only be accessed to cut the grass by hand to feed the cattle elsewhere. The open access grazing system, especially when combined with high stocking rates, leads to the depletion of feed resources through overgrazing, contribute to low productivity of livestock (Alemayehu, 2002; Gebremedhin *et al*., 2004).

Well managed grassland provides cost-effective, high quality feed for livestock. Good grassland management balances the amount of grass grazed with the amount of grass grown, increase infiltration, retention and improved nutrient reclining, associated with organic matter accumulation in the soil. In Ethiopia, there are numerous indigenous grassland management practices contributing to sustainability of ecosystem management. Good grassland management can help to improve the quality and quantity forage availability and optimize livestock productivity and improve financial returns. The ways people manage the private/communal pasture land influence the quality and the amount of feed, as well as its seasonal distribution (Miller and Tolina, 2008). These human responses to ecological processes are strongly influenced by economic, political and cultural processes (Kofinas and Chapin, 2009).

Institutions are a set of rules governing the access and use rights of communal grazing land. They are the rules and norms that determine the relationship of different groups of users to manage the resources (Berkes, 2007). Institutional aspects in the management of communal grasslands were poorly understood in the Ethiopia highlands (Watson, 2003). Livestock owners have their own indigenous knowledge how to use pasture land and establish responsible institutional committee for proper resource utilization. The role and responsibility of institutional arrangement are, such as restrictions of communal grazing lands for certain period of time, decide time of utilization depend on forage availability, equal utilization of resource (Miller and Tolina, 2008).

Local knowledge is the outcome of processes of learning and adaptation that evolved within a specific local environment. Local knowledge often includes important ecological knowledge, which is one of the most important factors for the sustainable management of ecosystems. Traditional mobility in pastoral production system is the ways of managing grazing land resource to utilize resources on a seasonal basis for the past years. Optimal use of natural resource is crucial to keep landscape environment and to use in an effective manner. Improved breed type of animal selection make better use of native pasture, and that are adaptable to the weather conditions of the area (Angassa *et al*., 2012).

2.2.2. Grassland improvement practices in the highlands of Ethiopia

In Ethiopia, for the last years in some areas grassland improvement is practiced. Forage development programmes are initially started through the introduction of improved forages species that enabled to achieve a significant increase in forage production (Alemayehu, 2006). Grassland improvement requires an understanding of interactions among environmental processes, socio-cultural components and local livelihood systems (Angassa *et al*., 2012). The knowledge on plant-animal interactions can be assessed by a set of techniques based on animals, such as assessment of spatial and temporal use of plant communities, intake determination, grazing behavior, and diet composition is essential to devise strategies for improvement of native pastures.

There are large potential areas for the production of diverse forage species seeds due to diverse altitude, climate, soil type and farming systems in our country. Despite the favorable soil and climatic condition, the progress in improved forage seed production is insignificant (Alemayehu, 2006). To improve forage availability introduces improved forage seed, over sowing, livestock exclusion and integration of improved forage with crop cultivation are some of the strategy.

1. Introducing improved forage seed

Introduce improved forage seed is helpful to improve grassland resource (Mengestu *et al*., 2016 a). Natural pastures in the country are mostly indigenous species of grass and native grasses are not able to provide necessary nutrient requirement for animals. In mixed crop-livestock farming system grazing land become shrinking resulting to overgrazing and decline of palatable forage species that has high nutritive value. So that, introduce improved forage seed is required to improve native grass species and to increase the livestock performance (Oba and Kotile, 2001).

2. Over sowing

Over sowing is the simplest and cost effective strategy to improve native pasture, it can be undertaken at very low cost, no need of cultivation. It involves broadcasting or sowing improved forage species into common or private grazing land and on degraded areas (Mengestu *et al*., 2016 b). So that this strategy is more preferable than others to improve native pasture, it does not require higher labor.

3. Livestock exclusion

Livestock exclusion from grazing land is an important means to make degraded land and overgrazed land. This type of strategy also provides an opportunity to develop forage banks to use during droughts or periods of seasonal feed shortage. Additionally, livestock exclusion are important for the conservation of feed but the system are only acceptable as grazing land management by farmers that have sufficient land size where they use for grazing after exclusion. In pastoral and agro pastoral areas livestock exclusion is mainly done for bare land rehabilitation and to control tick infestation (Alemayehu, 2002).

4. Integration of improved forage into crop cultivation

Under sowing and inter planting of improved forage species in an annual or perennial crop plantation helps to improve agricultural productivity of both crop and livestock feed source

(Mengestu *et al*., 2016 a). The use of this strategy contributes to improve soil fertility by legumes forage species cultivation and maintain cropping soils structure. The under sown forage protects the soil from erosive rains, can contribute nitrogen for the food crop, and balances the forage value of crop residues such as stover and straw to increase its intake and digestibility (Mesay *et al*., 2013). So that this strategy provides the most convenient approach for mixed crop-livestock farming system, in the highlands of Ethiopia food crop demand is increasing due to population pressure and grazing land shortage is a serious problem. Extension services delivery for the farmers on-farm trials on under sowing and inter planting contributes for the farmer to accept the strategy easily and to exercise the technology quickly on his/her farmland (Mengestu *et al*., 2016 a).

2.2.3. Grassland management trend

The indigenous land management practices on grassland are not widely used due to increase in population pressure and livestock density. Some of the practices like grazing land fire application were practiced to control pest and to facilitate vegetation growth. The role of indigenous knowledge on grassland management is invisible compared with crop and forest land management (Angassa *et al*., 2012). The grasslands are used for livestock grazing for millennia. In the highlands plant growth is slow due to low temperature. Stocking density and intensity of cultivation determine the carrying capacity of land. In the lowlands, the short growing season suits only fast maturing plants; limited rainfall and recurrent drought, shrub invasion and overgrazing are major features of lowland grasslands. Overgrazing and seasonal feed shortage are evident in the country. In highlands of Ethiopia the grazing lands (except protected areas) are in poor to very poor condition and deteriorate further unless there is immediate action (Alemayehu, 2006).

2.3. Factors that Affects Grazing Land Size

2.3.1. Total land holding

Total land holding is the land size that is owned by individual farmers used for various activities like crop cultivation, livestock grazing and forest plantation. Generally land comprises all naturally occurring resources whose supply is inherently fixed and it is also referred to as primary input and factor of production which is not consumed but without which no production is possible. Additionally it is the most important economic and social asset for the households who have access to it. When the farm size is small that earning a living from it may be untenable, many are unwilling to give up land because it is the basis for a sense of belonging to a community and to a family. In Ethiopia, all land belongs to the state and user rights are controlled by the local administration, namely the *kebele* administrators. In order to allocate land by local authorities, an individual must be recognized and registered as a household head (Katherine, 2014). The land source in Ethiopia comes mainly from the family after married or *kebele* administrators allocates for young men land before they are married. Despite of this increasing human population coupled with diminishing land resources and increasing urbanization are creating a growing number of landless people (Yitaye *et al*., 2007). Additionally discriminatory allocation of land in the past and absence of land users' right discourage small holder farmers not to use proper grazing land improvement (Alemayehu, 2006).

2.3.2. Population growth

Household size contribution for development of one country is higher. This is true when the family size contributes or participates on developmental activities. In spite of this in highlands of Ethiopia the farmer is smallholders and they follow subsistence farming and population pressure is higher. High density resulted in fragmentation of agricultural lands. As a result, the land holding per household are declining significantly over time (IBC, 2012). Rapid increase of human population and increasing demand for food, grazing lands are steadily shrinking by being converted to arable lands and grazing areas are restricted to areas that have little value or farming potential such as hilltops, swampy areas, roadsides and other marginal land in turn affect smallholder agriculture and sustainability of rural livelihoods (Alemayehu, 2004). Increasing population density coupled with lack of alternative employment opportunities and traditional practices has posed a tremendous impact on the land resources in the highlands cause subsequent shrinking of individual land holdings, fragmentation of available holdings, and expansion into fragile and marginal areas (Mengistu, 2011). Consequently the farmer encroach very steep slopes and marginal lands in order to expand cultivated land (Menberu, 2014).

2.3.3. Climate

Climate change affect the agricultural productivity and food security of the people around the globe. Ethiopia is one of the countries experiencing the effects of climate change. An increase in average temperature and change in rainfall patterns are the direct effects of climate change. The quantity and quality of native pasture varies with altitude, rainfall, soil type and cropping intensity. Soil type of the area, deforestation, and land management practice determine agricultural productivity. Deforestation and poor land management result to soil erosion which contributes to low productivity and the problem is serious in the highlands of Ethiopia (FDRE, 2014). Climate variability is high in low land areas resulting in fluctuation of feed resource availability and cause droughts. Frequent drought result to substantial livestock herd size reduction and cause series scarcity of feed. Conversely, a fixed time lag after average rainfall years reflected an increase in livestock populations. Its effect threatens the livelihood security of pastoralist. The impact of climate change on livestock population is critical because of its direct implication for local livelihood systems. The evidence implied that slow herd recovery following droughts decrease the benefit expected from the system and it is a risk for the local households (Kitabe and Tamir, 2005). Due to climate variation the vegetation cover of the land reduces steep areas have become vulnerable to wind cause soil erosion. Soil erosion is taking place all over the country; about half of the highlands of Ethiopia are vulnerable to soil erosion (FDRE, 2014).

Rainfall is a dominant driver of ecosystem dynamics in Africa. There is a strong relationship between rainfall variability and livestock performance indicators, suggesting that management needs in order to protect the loss of livestock during drought periods. In Ethiopian lowland areas rain fall variability is higher, in such environments, livestock responses to climate variability would demand opportunistic herd management and flexibility such as herd mobility in response to effects of multiple droughts. Scarcity of feed resources influences livestock population dynamics. But in high land areas rainfall variability is less, plant to animal interaction can balance the grassland ecosystem (Angassa and Oba, 2007).

2.3.4. Livestock holding size and husbandry practice

In Ethiopia the livelihood dependency of the farmer with livestock is higher. Having large livestock population size gives more value and varies advantages. The trend of livestock population in Ethiopia shows it is increase time to time (Bezabih *et al*., 2015). The product and productivity that is expected from livestock maximized if and only if the livestock number and feed availability balance each other and properly managed. When numbers increase beyond the capacity of the grazing lands the area will become overgrazed. So that, the land cannot able to supply sufficient feed for livestock. Appropriate density of the stock on a specific area determines grassland species composition. Most of the time higher density results in a decline in palatable perennial species and an increase in less palatable species (Oba and Kotile, 2001).

Poor grassland management practice result in low productivity. In Ethiopia due to poor management and low attention the grassland productivity declining rapidly (Alemayehu, 2004). So that regulation of the stocking rate and managing the spatial and temporal distribution of livestock are the basis for grazing management. The amount of livestock that a particular area of grassland can carry is not dependent on its botanical composition alone, since it has to take into account the management objectives of the grazers and the availability of other grassland resources (Settle *et al*., 2005).

Watering point distance and livestock distribution affects the vegetation cover. Water point distributions are highly efficient in terms of regulating livestock density (Herrero *et al*., 2009). Overall, even though vegetation cover increases in relation to increased distance from water points. In some cases stock may tend to concentrate on the better grassland and ignore poorer sites and some pastures may be suited to grazing at certain seasons. Consequently increase grazing pressure nearby the water points, the cover of indigenous vegetation correspondingly decreases (Angassa *et al*., 2012). Stocking must be seen in the context of the whole area available and management decisions made in the sight of local knowledge, who knows his property well or the herding group with traditional knowledge of their grazing grounds (Angassa *et al*., 2012).

In Ethiopia traditional livestock production system is dominant but they are low in productivity (Tolera *et al*., 2012). The profitability of livestock production is lower as well as the output and input was not balanced. Furthermore, only herd size based production system is taken as the main reason for low profitability of the sector especially in pastoral farming system. Free grazing is the main feeding strategy in the country. Traditional production system when coupled with free grazing affect the livestock productivity and grassland ecosystem seriously. So that, destocking is one of the strategy used to improve grassland resources (Angassa *et al*., 2012). Additionally rearing improved cattle breed which have high productive performance and balance the herd size with the available feed resource contribute high in productivity of the sector and livelihood improvement of the farmers in the highlands of Ethiopia.

3. MATERIALS AND METHODS

3.1. Study Area

3.1.1. Location

The study was carried out in Kofele district, West Arsi Zone of the Oromia Regional State, Ethiopia. The district is located at 305 km form Addis Ababa towards south direction with latitude of $70^0$9'60.00''N and longitude of $38^0$49'59.99''E. It shares borders with Shashemene from north west, Kokosa from the south, SNNRS from the west, Gedeb Asassa from east, Kore from the north and Dodola district from south east (CSA, 2015). The district has 38 rural and 2 urban *Kebeles*[3], of which six rural *kebeles* (Gurmicho, Bitacha, Germama, Guchi, Abbosa and Tullo) were selected.

3.1.2. Climate and agro-ecology

The study area is found on altitude ranges of 2200-3200 m.a.s.l (DANRMO, 2017). Topographic feature is the main factors that determine the distribution of climate, land suitability, crop to be grown and natural vegetation types (Alemayehu, 2004). In Ethiopia agro ecology was classified in to highland, mid-highland, desert and lowland (MoA, 2000). Highland called *Badaa* in Afan Oromo ranges from 2500-3500 m.a.s.l; mid-highland called *Badadaree* ranges from 1500-2500 m.a.s.l. highlands comprises the majority (85%) of the study area. It receives an average rainfall of 1800 mm per annum with minimum 2300mm per annum and maximum 2700 mm per annum and has bi-modal rainfall distribution with small rains starting from March/April to May and the main rainy season

[3]*Kebele refers to the smallest administrative level in Ethiopian*

extending from June to September/October. The average daily temperature is 19.5°C with minimum of 5°C and maximum of 22°C.

3.1.3. Population and livelihood

The total population of the district was estimated, 194,531 from this male population accounts 49.68%. The population density of the district was 257.8 persons per km^2 (CSA, 2015). Potato, barley, wheat, maize, *enset*[4], kale and head cabbage are widely grown crop types in the district. The soil type is loam in the highland and sandy loam in the mid-highland (DANRMO, 2017). Livestock rearing and crop cultivation were practiced simultaneously as a means of the farmers' livelihoods.

3.1.4. Land use type and pattern

The total land area of the district was estimated, 70,229 hectare. The term land use implies the way the farmer allocates the land for their satisfaction of needs. It was classified as cultivable land, grazing land, irrigation land, swampy land, forest land and bush land. Cultivated land covers the largest share which accounts for about 58 percent of the total land, while grazing land was the second land use pattern that covers 31 percent of the total land (DANRMO, 2017).

[4] *Enset (Enset ventricosum)*

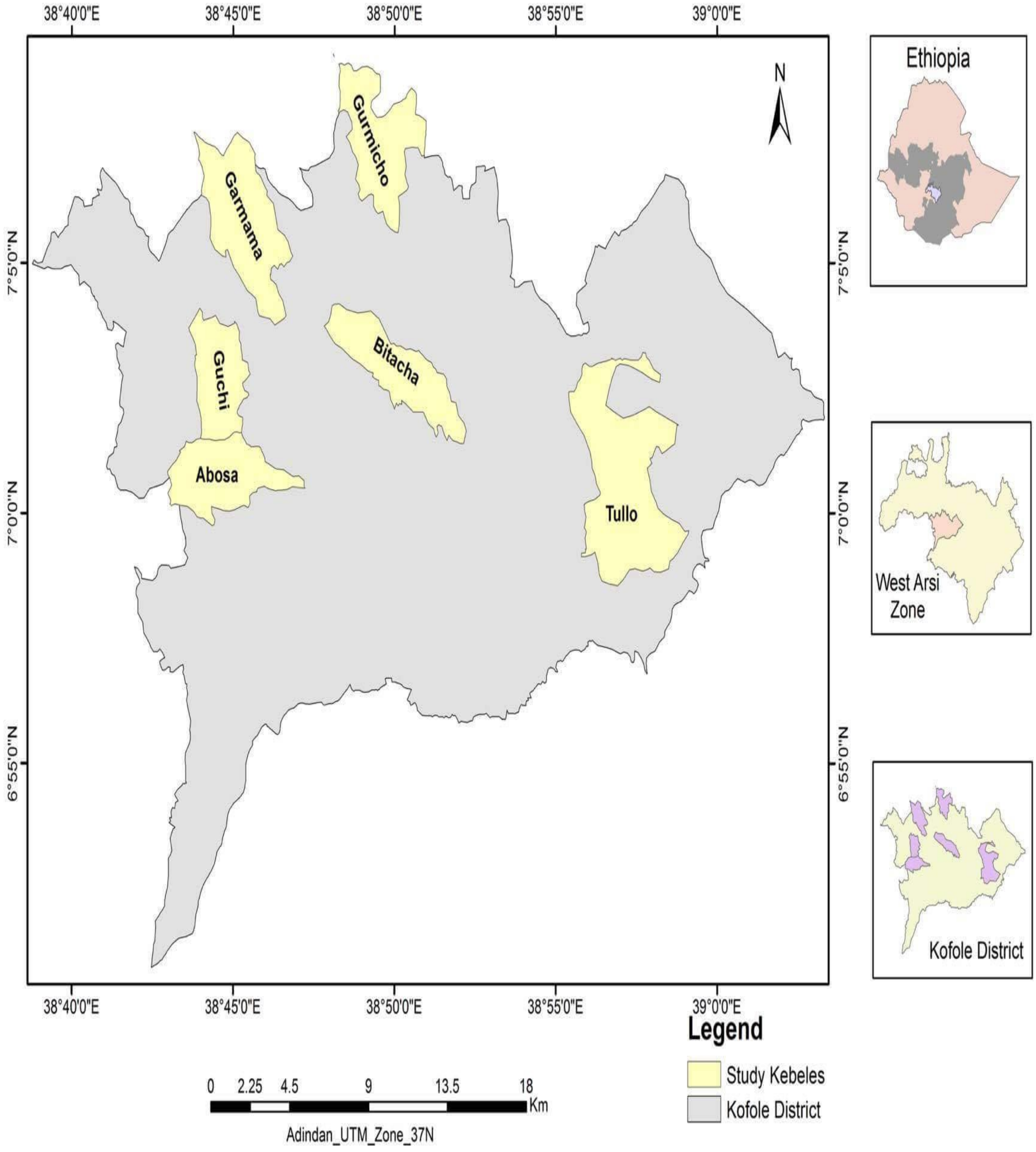

Figure 1: Study area map

3.2. Methodology

Before the start of actual survey, a preliminary survey was conducted by the researcher in order to get overall characteristics of the Kofele district in which 8 key informants from farmers, development agents and district level officials were interviewed based on questionnaire developed. The data obtained by preliminary survey was not used for actual study report rather used to redesign questionnaire and sampling technique.

Accordingly, Kofale district was selected purposively. The district has a total of 38 rural *kebeles*, of which the proportion for highland was 73.7% and mid-highland 26.3%. Out of this, six rural *Kebeles* were sampled. The total *kebeles* of district was stratified in to two agro-ecological zones and the rational logic beyond this stratification is that there was assumption as farming system varies between different agro ecological zones due to variation in climatic conditions. Hence, there was interest to characterize the farming system, land allocation for different land use in agro ecology (its significance) and to identify traditional grassland management practices in the two agro-ecologies. And then, four *kebeles* from twenty eight of highland and two from ten of mid-highland agro-ecological zones were sampled proportionally through systematic sampling method and based on its geographical location in its agro-ecological zone i.e. sampled *kebeles* were systematically allowed to uniformly distributed over the agro-ecological zones in order to maintain representativeness. Data were generated using questionnaires, focus group discussions, key informant interviews and secondary data source.

Data collection were mainly focused on land use and land allocation trend, income source, agronomic practices, feed resource, traditional grassland management practices, feeding calendar, herd characteristics, livestock species composition and husbandry practices.

3.2.1. Sample size determination

The sample size of the study was determined using the following formula, which was adopted from Yamane (1967).

$$n = \frac{N}{1 + N(e)^2}$$

Where n= is the sample size

N= total population size (HH)

e= marginal error.

This formula was used since the population under study was homogenous in character so the marginal error (e) of this study was 8%, which is equal to 0.08 with 95% CI.

Therefore, the sample size of this study was determined as;

$$n = \frac{4317}{1+4317(0.08)^2} \qquad n = 150 \text{ households}$$

3.2.2. Sampling technique

In this study, probability sampling was used (Kumar, 2005) to select individual respondents. Initially, rural *kebeles* were stratified in to two (high altitude and medium altitude). Secondly, from high altitude Gurmicho, Guchi, Germama and Bitacha and Tullo and Abbosa from medium altitude agro-ecological zones were selected. The selection was made by the help of key informant and supported by study area map that was found in the agricultural and natural resource management office. Thirdly, from selected *kebeles* respondent households were selected by using systematic random sampling techniques. Hence, 150 households were allocated from each *kebele* based on population proportion and individual household selection carried out randomly at each *kebele* where female headed households were allowed to be sampled mixing with male headed and hence, 31.3% female headed household were sampled randomly which was not proportional; because there was no intension to see gender variation in the objective of study.

Table 2: Distribution of sampled respondents

Name of sampled *Kebeles*	**Number of household of sampled *kebeles****					**Sampled households****		
	Agro ecology	**Male Headed**	**Female headed**	**Total**	**%**	**Male headed**	**Female Headed**	**Total**
Tullo	Medium altitude	715	370	1085	25	27	10	37
Germama	High altitude	656	151	807	19	19	9	28
Guchi	High altitude	519	118	637	15	15	8	23
Gurmicho	High altitude	482	143	625	14	15	7	22
Bitacha	High altitude	422	165	587	14	14	6	20
Abbosa	Medium altitude	381	195	578	13	13	7	20
Total		**3175**	**1142**	**4317**	**100**	**103**	**47**	**150**

Source: Own survey (2017)

Note: *Obtained from basic data source of the district agricultural and natural resource management office, **Obtained based on household of sampled *kebeles* proportionally.

3.3. Data Sources

To generate relevant information, data was gathered from various sources to achieve the objective of the study. In this study both primary and secondary data sources were used.

3.3.1. Primary data source

Primary data sources used were questionnaire, key informant interviews and focus group discussions.

3.3.1.1. Questionnaire

To gather primary data from respondent's semi-structured questioner was developed. The questioner was formulated in both open and close ended forms and interviewed through face to face contact with respondent households. The survey tool was then pretested, and after incorporating feedback, the actual survey was conducted on the selected 150 households. In order to avoid redundancy of respondent household's selection and to make the research valid, sampled households were selected randomly from *kebele* administration registration book.

3.3.1.2. Key informant interview

Key informants interviews were carried out with four individual at district level governmental offices, two from agriculture and natural resource management office and two from livestock and fishery resource office. To get information on land use system of the area, from land use administration office one expert was used; one development agent from each *kebele* who graduated in animal science and *kebeles* administrators were used to select individual respondents and elders for group discussion.

3.3.1.3. Focus group discussions

To clarify issues not well addressed though the survey tool and to validate some information collected by individual interviews, focus group discussions were conducted. Participatory tools were employed in the process of data collection to facilitate the communication between participants (Chambers, 1994). The discussion was focused on crop cultivation, traditional grassland management practices, factors that were associated with grassland shortage and livestock production constraints. Out of six rural *kebeles* selected for survey three *kebeles* were purposively selected two from highland and one from mid-highland. Respondent selection was based on land holding size per household (larger, medium and small), willingness and experience on agricultural practices. Based on the above criteria three focus group discussions were formed. Nine from each *kebele*, a total of 27 respondents were selected; male (88.9%) and female (11.1%) participated on group discussion.

3.3.2. Secondary data

Secondary data were collected from written materials on farming system and grassland management practices. Previous studies, journals and governmental reports were used.

3.4. Data Analysis

3.4.1. Descriptive analysis

Descriptive statistics were used to characterize the farming system and to describe traditional grassland management practices. Descriptive statistics such as mean, percentages, standard error, frequency distributions and crosstabs were used by using

Statistical Package for Social Science software (SPSS ver. 20), feed availability was analyzed by FEAST spreadsheet program (Duncan *et al*., 2012).

3.4.2. Inferential analysis

Multiple linear regression model (MLRM) was used to identify the factors that affect the grazing land size in the study area. Regression coefficient indicates the relationship between the variables; as for the direction of the relationship, the positive regression coefficient value indicates that when one variable increase another also increases, while the negative value show inverse relationship (Pallant, 2007). To explain the degree of variation due to selected variables coefficient of variation was estimated by adjusted R square value.

1. **Variables Selection and Model Hypothesis**

Variables for MLRM were identified based on land allocation association it has with grazing land per HH and the relationship they have with grazing land either positively or negatively. Hence, one dependent variable and seven explanatory variables were identified. Grazing land size (ha) per HH was selected as dependent variable, while crop land size (ha) per HH, livestock holding (TLU) per HH, total land holding size (ha) per HH, household family members in number, forest land size (ha) per HH, proximity to urban center (km) and degraded land (ha) were considered as independent variables.

Grazing Land Size (Y): is dependent variable in which the model was constructed for. Data for this variable were collected as land size in hectare that utilized for livestock grazing by each farmer. The objective here was to analyze the interaction of farming systems in the area mainly between livestock production and crop farming based on farmers land allocation. The existence of grazing land as the size of land allocated for livestock grazing by individual farmer was determined by how much they interested in and prioritized between different land uses. The higher they are interested potentially or economically in one farming system, the more the land size they allocated for it and vice versa.

Livestock Holding Size (X_1): is the total livestock holding (TLU) that was owned by each sampled HH. According to the findings of Bezabih *et al.* (2015), at national level in Ethiopia cattle population increased per households. In similar way, we expect that a farmer that had large cattle population allocate more land for livestock grazing; so that grazing land size and increment in livestock population size owned per HH have a positive relationship.

Crop Land Size (X_2): was the second explanatory variable expressed by a size of a land in hectare used for crop cultivation by each sampled HH in the area. We hypothesized negative relationship between grazing land size and crop land size for this model, which implies that as farmers increase the size of the land they utilized for crop cultivation, the crop land size becoming dominant among the other land uses owned by individual farmers. It also mean that the expansion of crop land was towards other land uses as those land size which is utilized for grazing and other land uses before becomes important for crop cultivation and hence decline in size for all other land uses. This logic was in line with the study by Lemlem *et al*. (2017) who carried out a study in northern highland of Ethiopia which revealed with the generalization that the crop land expansion seriously affected grazing land size negatively.

Total Land Holding Size (X_3): was the third explanatory variable expressed by an overall land holding size in hectare by each sampled HH. According to Menberu (2014) in the highlands of Ethiopia household land per capita is decreasing over time and it affected grazing land size. Similarly it is hypothesized that the total land holding size per household and grazing land size are positively correlated.

Family Size (X_4): are the family members of brothers/sisters found at age range of 15-64 in number of the HH head, socially and economically interdependent and who supported under the HH head. For inherited land, the more brothers/sisters he had the less chance of getting large land size. Hereby, IBC (2012) reported as increase in family size has resulted in land size decline. As a result, the landholding size per household decline significantly. Hence, in this study, family size was hypothesized as significant with grazing land size means that increasing size in number of family members has the likelihood of decreasing in size of grazing land per HH.

Forest Land Size (X_5): was the other explanatory variable expressed by a size of a land in hectare utilized for private forest plantation for commercial purposes by each sampled households in the area. By considering current demand increment associated with urbanization, we also hypothesized negative relationship between grazing land size for this model. It implies that as a farmers increase the size of the land utilized for forest plantation, the forest land becoming dominant among the other land uses from the total land size owned by individual farmers. It also mean that the expansion of forest land was towards other land uses as those lands which utilized for grazing decline in size.

Proximity to Urban Center (km) (X_6): is the distance in kilometer by which each sampled households are settled from urban center. We hypothesized negative relationship between grazing land size and proximity to urban center for this model, which implies that as farmers settle far from urban center they allocate more land size for grazing.

Degraded Land Size (ha) (X_7): is a land size in hectare that is not suitable for agricultural activities in each sampled HH in the area. According to the finding of FDRE (2014), land degradation causes land fragmentation in the highlands of Ethiopia. Similarly we hypothesized negative relationship between grazing land size and degraded land size for this model, which implies that as more land size is degraded, the farmer use fertile land for other land uses like crop cultivation than grazing.

2. Model specification

According to David (2005) regression model used when the study involves more than two variables, a dependent and independent relationship variables to provide meaningful and accurate conclusions of the phenomenon under study.

Hence, the following MLRM equation was used

($Yi = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \beta6X6 + \beta7X7 + \varepsilon i$).

Where Yi = Grazing land size as a dependent variable

$\beta0$ = constant

livestock holding (X1), crop land size (X2), land holding size (X3), family size (X4), forest land size (X5), proximity to urban center (X6) and degraded land (X7) as independent variables.

$\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, $\beta 5$ $\beta 6$ and $\beta 7$ = coefficients of each respective independent variables.

ε_i = the residual variance in Y after taking into consideration the effects of the Xi variables included in the model.

Model result was interpreted that, the existence of grazing land as the land size allocated for livestock grazing by individual farmers. Mathematically, Y and X have linear association in which any change in each of Xi resulted in a change of Y and vice versa.

3. Test for multicollinearity

According to Gujarati (2003) multicollinearity refers to a situation where it becomes difficult to identify the separate effect of independent variables on the dependent variable because of existing strong relationship among them. The measures that were suggested to test the existence of multicollinearity were Variance Inflation Factor (VIF).

As a rule of thumb, if the VIF is greater than 10, the variable is said to be highly collinear. The larger the value of multiple regression coefficients between variables, the higher the VIF, causing higher collinearity in the variable. Before fitting variables into the regression models for analysis, multicollinearity problem among variables was tested.

Table 3: Variables summary

Symbol	Variable Name	Variables Description	Hypothesized Effect
Y	Grazing land size	Area of a land in hectare utilized for livestock grazing by each HH	
X1	Livestock holding	Number of livestock population (TLU) owned by each HH used for varies activities.	Positive
X2	Crop land size	Area of land in hectare utilized for crop cultivation by each HH.	Negative
X3	Total land holding size	Total land size in hectare that belongs to each HH under the legal or customary recognition.	Positive
X4	Family size	Household members of male and female that are found in age range 15-64 under each HH head.	Negative
X5	Forest land size	Area of land in hectare utilized for forest production by each HH for commercial purpose.	Negative
X6	Proximity to urban center	The distance (km) between each sampled HH from urban center.	Negative
X7	Degraded land size	Area of land in hectare that is not suitable for agricultural activities in each sampled HH.	Negative

4. RESULTS AND DISCUSSION

4.1. Household Demographic Characteristics

Table 4 shows the summary of demographic character of the respondents. The study result revealed that, 69% were male headed households and the remaining were female headed households. More than 50% of the respondents were not able to read and write, on average 53.65% had no formal education with only 19.6% of respondents' educated junior secondary school and above. The finding was consistent with ERSS (2013) survey report with a value of 54.5% illiterate farm household heads; at national level. Regarding to marital status, 92.87% of the respondents were married and majority (89.70%) of the respondent's occupation was mixed crop-livestock farming. About 98.92% of the respondents were Muslims.

4.2. Age, Household Family Size and Dependency Ratio

Table 5 shows average household family size and dependency ratio. The survey result shows that, the mean age of respondents was 44.89 with the age range of 20-65 years. The majority (83.3%) of the sampled households was found in the age group of 25-59 years, while 1.33% lies in the age group of 15-24 years and in the age group of 56 years and above was 16.7%. The average household family size was, 9.24. The result was consistent with the finding of Yassin *et al.* (2016) who reported 8; in the same district. Sampled households had a family size of 4-8 (42.6%) members, followed by 10-20 (28%). Furthermore, based on age category under <15 years was at average 4.37; while family size that was found at range 15-64 years was 4.32. This implies that about 50% of the population in the study area was dependent on the labour force and other means of living. Based on Ethiopian age group classification, 15-64 age groups are considered as working labor force (ERSS, 2013). The respondent's population dependency[5] ratio was 1.14%. The result of this study shows a difference with the finding of Abdi (2016) in Kofele district which showed the dependency ratio of 1.67%.

Table 4: Demographic character of the respondents in the study area (N=150)

Socio-economic information	**Parameters**	**Agro-ecology (%)**		**Average (%)**
		High altitude	**Mid-altitude**	
Gender	Male headed	67.74	70.18	68.96
	Female headed	32.26	29.82	31.04
Marital status	Married	89.25	96.49	92.87
	Single	2.15	0.00	1.08
	Divorced	1.08	0.00	0.54
	Widowed	7.53	3.51	5.52
Educational level	Illiterate	63.44	43.86	53.65
	Read and write only	13.98	12.28	13.13
	Primary school	9.68	17.54	13.61
	Junior secondary school	9.68	19.30	14.49
	High school	2.15	5.26	3.71
	Higher education	1.08	1.75	1.41
Religion	Muslim	97.85	100.00	98.92
	Orthodox	1.08	0.00	0.54
	Protestant	1.08	0.00	0.54

Source: Own survey result (2017).

[5] *Dependency ratio is defined as population that is not of working age (<15 &>64) divided by total number of working age (15-64). The value is then multiplied by 100 to express in percentage.*

Table 5: Average household family size and dependency ratio

Parameter	Household size by age category	Aver. Household size	Dependency ratio (%)
Household family size	<15	4.37	1.14
	15-64	4.32	
	> 65	0.55	

Source: Own survey result (2017).

4.3. Family Income Source in the Study Area

Table 6 shows summarized source of income for the farming family. The survey result shows that, mixed crop-livestock farming contribution was higher, majority (74.00%) of the respondents earned income for their livelihood from this farming system. The finding agrees with Bezabih *et al*. (2015), who reported that the livelihood of the farmer in highland highly depends on crop and livestock production which provides a major source of livelihood. Income generated from other source of activities includes, trade (12%) and remittance (3.5%). However, the contribution of off-farm activities for livelihood was limited as compared to agricultural activities.

Table 6: Contribution of livelihood activities to household income (%) (N=150)

Parameters	N (%)	Rank
Mixed crop-livestock farming	74.00	1
Trade	12.00	2
Labor	8.67	3
Remittance	3.33	4
*Other	2.00	5

N= number of respondent, *other includes employment in government and private institutions/company.

4.4. Farming System of the Study Area

From key informant interviews, it was revealed that the district entirely introduced crop agriculture in recent years; crop agricultural practices were introduced around 1960s, before that they were pastoralist (DANRMO, 2017). In past livestock production system was the principal mode of farming system. The grazing system was free grazing and grazing land was communal. Farmer's practices during that period traditional method of grassland management such as seasonal migration, depending on rainfall availability and they had the rule and regulation for sustainable use.

4.4.1. Land holding size per household

Table 7 shows summary of land holding size per household and land allocation. The survey result revealed that, nearly 90% of respondents had land for cultivation and the average land holding size per household in the study area was 2.24 hectare. According to ESSR (2013) reported that, at national level the average land holding at household level was 1.7 hectare. It indicates that the farmer in the study area endowed with relatively larger land holding per household.

From the total land holding size per household, crop land accounts for 56.78% while 40.96% was grazing land. Private forest land proportion was lower 1.8% of the total land. The result of this study is in agreement with other findings such as Nina *et al*. (2012), who reported a higher tendency of converting a grazing land into cropland in the highlands of Ethiopia. Total land holding size per household varies with agro ecology; it was lower in high altitude than medium altitude agro ecological zone. General Linear Model (GLM) analysis result shows that, land holding size per household by agro ecology was statistically insignificant at 5% (P>0.05).

Table 7: Mean ± SD land holding and land allocation of the respondents (N=150)

Variables	**Agro-ecology**		
	High altitude	**Mid-altitude**	**Average**
Grazing land	0.81±0.66	1.03 ±0.89	0.92±0.78
Crop land	1.18±0.73	1.35±0.86	1.27±0.80
Forest land	0.05±0.11	0.03±0.06	0.04±0.08
Total Land Holding	2.04±1.28	2.43±1.53	2.24±1.41

Source: Primary data (2017), there is not significant difference between both altitudes.

Table 8 shows summarized land holding size per household by category in the study area. Respondents land holding size per household in percentage shows that, 1.08% own 0.00-0.25 hectare; while 61.83% own 1-2.5 hectare of land. However, none of the respondent households were owned more than 6.75 hectare.

Table 8: Land holding size per household in the study area (N=150)

	Agro-ecology (%)		
Land size (ha)	**High altitude**	**Mid-altitude**	**Average (%)**
0.00-0.25	2.15	0.00	1.08
0.26-0.99	16.13	7.02	11.57
1-2.5	56.99	66.67	61.83
2.6-6	24.73	26.32	25.52

Source: Primary data (2017), N= number of respondent

Table 9 shows the summarized source of land and farmer's opinion on land holding size per household trend. The result shows that, land holding size per household was declining (93.3%) and remains constant (6.7%). Main source of land was inherited from their parents (61.09%) and through land distribution (33.25%).

Table 9: Land source for both crop and grazing land in the study area (N=150)

Variables	Parameters	Agro-ecology (%)		Average (%)
		High altitude	Mid-altitude	
Source of land	Land distribution	41.94	24.56	33.25
	Inherited from parent	53.76	68.42	61.09
	Shared from relatives	4.30	7.02	5.66
Land holding trend	Decreasing	93.55	92.98	93.27
	No change	6.45	7.02	6.73

Source: Primary data (2017), N= number of respondent

4.4.2. Agronomic practices and rainfall distribution in study area

Figure 2 shows the rainfall distribution in months in the study area. FEAST method was used to determine rainfall distribution, rated by a scale (0-5); highest value indicates highest rainfall distribution. Furthermore, bi-modal pattern of rainfall in the study area gave a wide opportunity for the farmer to cultivate crops more than twice per a year.

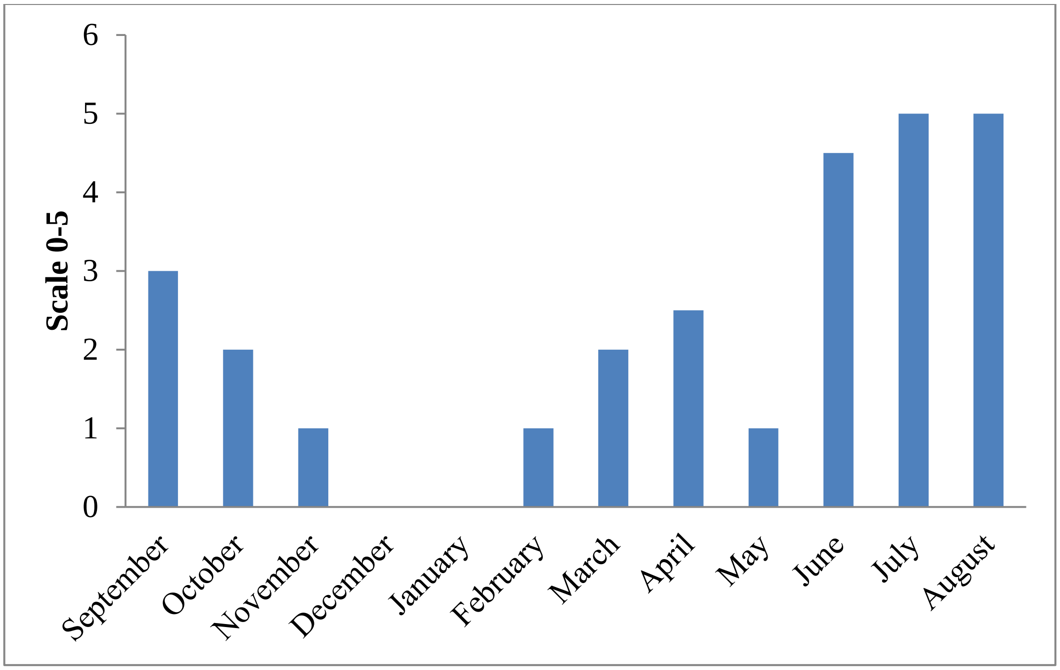

Figure 2: Rainfall distribution in months in the study area.

Figure 3 shows agronomic practices of the study area. Mixed crop-livestock farming was practiced, in which both livestock and crop production was practiced simultaneously as a means of the farmers' livelihoods. According to key informants, loss of soil fertility was the main factor for reduced agricultural productivity, which is mainly resulted from land degradation. The survey result shows that, soil fertility decline was the causes for land fragmentation (29.37%). The result agree with the report of FDRE (2014), which stated that, in the highlands of Ethiopia cereal crops were cultivated which provide little ground cover during the most erosive rain fall.

Cropping pattern has directly related with the agro-ecological condition of the area and dietary habits. Frequency of cultivation depends on crop type (annual or perennial) and agricultural productivity. During group discussion elders explained that, when crop cultivate twice/three times per a year the productivity varies. Due to that respondents prefer to cultivate crop twice per year (98%). The two distinct rainy seasons favorable for crop production were locally named as *Ganna*[6] (main rain season) and *Arfassa* [7] (short rain season).

Short rainy season *(Arfassa)* extends from March to May; at this season mainly cash crops like potato, kale and head cabbage was cultivated. Long rainy season *(Ganna)* was the main rain season favorable for crop cultivation, most of the land is covered with crops during this season and extends from June to August; at this season cereal crops were cultivated. Planting and harvesting activities usually last for one to two months depending on the type of crops.

1. Rain-fed Agricultural Practices

Agricultural practice in the study area was mainly depending on rainfall. The farmer in the study area cultivates crops such as barely, wheat, maize and *enset* as food crops. Potato kale, head cabbage, beet root and carrot were common cash crops widely cultivated in the study area and they were cultivated more than twice per a year.

potato (Solanum tuberosum L.) is a root crop that was widely practiced in the study area as cash crop (62.7%), cultivated twice per year on average land size of 0.4 hectare; mainly cultivated for both home consumption and market (70.29%).

The result was consistence with other study finding such as Mamo (2014), who reported that, the farmer at the same district cultivate potato in 0.49 hectare. The other common cash crop type cultivated in the area for market were, head cabbage (83.33%), beet root (92.3%) and carrot (100%).

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[6] *Ganna refers to the season from June to August.*

[7] *Arfassa refers to the season from December to February*

Barley (Hordeum vulgare L.) is a cereal crop widely cultivated in the study area next to potato as food crop (58%), cultivated on average land size of 0.53 hectare once per year (during *ganna* season). Purpose of cultivation shows that, for home consumption (12%) and market (30.42%). *Enset*, also known as "false banana", was the third widely cultivated perennial crop in the area (53.3%), cultivated on average land size of 0.19 hectare. Reason for cultivation shows that, for human consumption (84.29%) and livestock feeding (7.44%).

2. Irrigation Practices

Table 10 shows irrigation practices of the study area. Farmers used small streams; pond and shallow well to cultivate during short and long dry season especially horticultural crops. Survey result shows that, traditional and small-scale (cultivated on average land size of 0.06-0.25 hectare) irrigation was practiced. Elders who participated in focus group discussion stated that, irrigation practices become well practiced for cash crops and such cultivation trend started lately and farmer's participation was minimal (25.70%).

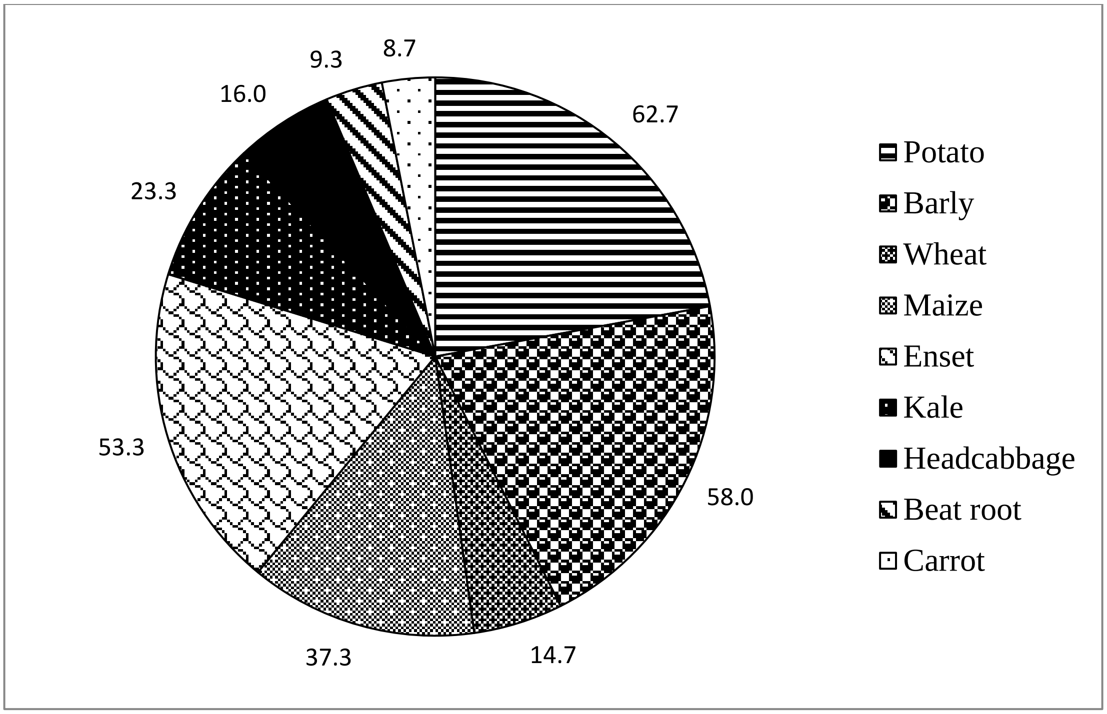

Figure 3: Type of crops produced in the study area

Table 10: Irrigation practices in study area (N=150)

Variables	**Category**	**Agro-ecology (%)** High altitude	**Agro-ecology (%)** Mid-altitude	**Average (%)**
Respondent participation	Yes	32.30	19.30	25.70
	No	67.70	80.70	74.30
Irrigated land size (ha)	0.06-0.25	86.70	54.50	70.60
	0.26-0.5	6.70	36.40	21.55
	0.6-2	6.60	9.10	7.85

Source: Primary data (2017), N= number of respondent.

3. Labor Demand and Availability

Table 11 shows labor demand and availability in the study area. Labour was an important resource that determines the production and productivity of agricultural practices in study area. Family labor and draught animal power was used for crop cultivation. Study result agrees with Bezabih *et al*. (2015) findings, which stated that family labour, hired labour and social organizations are the major source of labour for smallholder farmers.

Labor demand and availability vary with season and agro ecology. Labor shortage was critical during seeding (38.40%) and crop harvest (25.75%) in the study area. The reasons was, seeding takes place within short time, not more than ten days and all farmers became busy at that time, the next labour shortage reported as starting from November (crop harvesting) at that season there is high wind and solar radiation which affect the crop yield. Overlapping of the harvesting and planting activities of the two seasons in the months of July and August was the other reason for labor shortage. The finding agree with the ERSS (2013) report, which indicated that in the highlands more time is required during seeding and harvesting. Farmers in the study area during pick season external labor was used. Social organization like *Debo*[8] and *Honfala*[9] and hired labor was the labor source in study area.

Debo is a labor organizations practiced by the farmer especially for its economic importance. It is a labor sharing mechanism in which household mobilize large number of individuals from the community to work on his/her farm land without remuneration. It is

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[8] *Debo refers to social organization practiced by the farmer during peak labor shortage.*
[9] *Honfala refers to social organization practiced, which exchange of labor among households.*

formed from 10 to 20 parties who are willing to help each other on work like, plaughing, weeding and harvesting of crops. During focused group discussion elders argued that the importance of *Debo* was reduced due to shortage of farm land as the works were covered by the household members.

Honfala is the other method of labor sharing mechanism of which exchange of labour among households, especially at peak plaughing, weeding and harvest season. The labour was used in rotation and the working groups vary from two to ten men.

Hired labor; the availability of hired labor depends on the seasons, during peak seasons even hired labor availability was lower. Hired labor payment per day for all cropping season varies; depend on work load and time of work per day. Hired labor cost Ethiopian Birr was 50 for seeding, 60 for harvesting, 70 for weeding and 65 for plaughing.

Table 11: Labor demand and availability in the study area (N=150)

Variables	**Parameters**	**Agro-ecology (%)**		**Average (%)**
		High altitude	**Mid-altitude**	
Labor availability throughout the year	Yes	47.30	42.10	44.70
	No	52.70	57.90	55.30
Critical labor shortage season	Seeding	31.20	45.60	38.40
	Harvesting	26.90	24.60	25.75
	Plaughing	20.40	12.30	16.35
	Weeding	17.20	15.80	16.50
	Threshing	4.30	1.70	3.00

4.4.3. Livestock production system in study area

Farmers keep livestock for various economic and social reasons in the study area. Draught power, milk, source of income and transportation were the main reason of livestock keeping. Livestock holding per household determine agricultural productivity. Moreover, households who had large number of livestock maintain better social credibility and status. In the study area traditional livestock production practice was dominant and cattle, sheep, equine were the main livestock species. The proportion of livestock species composition shows that, cattle is the first (61.3%), sheep (27.7%) second and equine (11%) third. Majority (78%) of cattle breeds in study area were local breed. The finding of this study result shows breed improvement practice was better when compared with other findings; ERSS (2013) reported that, at regional level (91.4%) and national level (91.0%) cattle breed is local.

Livestock husbandry practices of the respondent was poor, proper housing management were not well practiced. Housing for large animals was not known in the study area rather fencing was used to keep the animal overnight. Calves and sheep were kept in small barn attached to the living house to protect from wild animals and heavy rain. The result agreed with the finding of Sintayehu *et al*. (2008), who reported that in the mixed crop-livestock system husbandry practices was poor most households (70%) kept their cattle within their own residence compound.

1. Livestock Holding Per Household in Study Area

Table 12 shows summarized livestock holding per household in the study area. The average livestock holding per household in the study area was 6.15 Tropical Livestock

Unit one TLU= 250 kg live body mass; ILCA, 1990, of which 4.41 TLUs were cattle and 0.45 was sheep. Cattle were the main species type used for draught power and milk. Number of livestock per HH and species composition varies with agro ecologies mainly based on land size and feed availability. GLM Analysis shows that, in the study area the livestock population size variation by agro ecology was not statistically significant at $p>0.05$.

From total cattle population milking cow account for 45% and oxen for 13.2%. This result is higher than other findings CSA (2015), who reported that in mixed crop-livestock farming out of the total cattle holding, cows and oxen represented 42%.

Table 12: Livestock holding per household in the study area (Mean ± SD)

Livestock class	Herd size (TLU[10])	Mean ± SD
Cattle	4.41	5.88 ± 4
Sheep	0.45	4.5 ± 4.3
Equine	1.27	1.82 ± 1.7

Source: Primary data (2017)

4.4.4. Purpose of livestock keeping

Oxen were the most preferred animal since they are used for plaughing, transportation of different items and threshing crops. Survey result indicates that oxen were kept for draught power and cows for milk. The role of oxen under traditional agricultural practice is very high and determines the overall agricultural production and productivity. Farmers that lack oxen typically face problems in agricultural practice, due to that the farmer borrows, hire or share oxen from other households. The result indicates that livestock production and

[10] Tropical Livestock Unit (TLU)

crop cultivation was interdependent. The study finding agree with the finding of Abdi *et al.* (2013), who noted that in mixed crop-livestock farming milk and drought power is the major purpose of keeping cow and oxen.

4.4.5. Productivity of dairy animals

Table 13 shows summary of maximum and minimum milk yield per day obtained from local and cross breed cows. In study result shows that, majority (74.4%) of respondent own on average 1-2 local breed of cows per household. Dairy production was well practiced (80.7%) and mainly used for home consumption (88.7%). The result of this study was higher than the finding of Sintayehu *et al.* (2008), who reported that in the mixed crop-livestock farming, majority (61.7%) of the producers produce milk for home consumption. Milk yield from local breed at household level shows that, at average 1.78 liters of milk (morning and evening milking) was obtained. The result of this study differ from other studies (CSA, 2016), who reported that, at national level 1.37 liter of milk is obtained per day from local breed of cows.

Table 13: Milk yield of local and cross breed cows (Mean and SD, N=150)

Breed	**Milk yield (lit/cow/day)**	**Mean**	**Std. Deviation**
Local breed	Min.	1.07	0.44
	Max.	2.49	0.85
Cross breed (HF)	Min.	2.34	0.74
	Max.	5.44	1.58

Source: Primary data (2017). HF= Holstein Friesian

4.4.6. Livestock feed sources and feeding practice in the study area

1. Livestock feed sources

Figure 4 shows the feed type used at different months in the study area and figure 5 shows its contribution in percentage. To design livestock feeding practice and to estimate its contribution proportion FEAST method was used. Accordinly, natural pasture was the major feed resources and covers 56.5% of feed intake. It agree with other study findings, Tolera *et al*. (2012), who reported that natural pasture is the dominant feed resources in highlands of Ethiopia.

The availability of crop residues was closely related to the farming system, the types of crops produced and intensity of cultivation. Farmland byproduct was used as an animal feed source, the dominant farmland byproduct (crop residues) used as feed for livestock was wheat and barley straws and *Enset* byproducts. Crop residues/straw provides (29%) of total feed intake and it was used mainly during dry season.

2. Feeding practices

Table 14 shows major feeding strategy in the study area. Feed availability and feeding practice vary with season; feed availability mainly depends on the size of land property, which determines livestock holding. Key informants explained that feed shortage occurs in the month of December-February (long dry season) and June-August (long rainy season). During this period, feed is scarce, land is covered by crops and crop residues limited. However, the degree of the problem varies with agro ecology; being feed more serious in highland agro ecological zone. In the study area, communal land is converted to private land expect land found in schools and religious institutions. Survey result shows that, private grazing land was used (97.3%), which means that it is the land size that owned by individual farmer and managed by each household. The farmers give priority to livestock for grazing (75.30%); especially for calves, farm oxen and dairy cows.

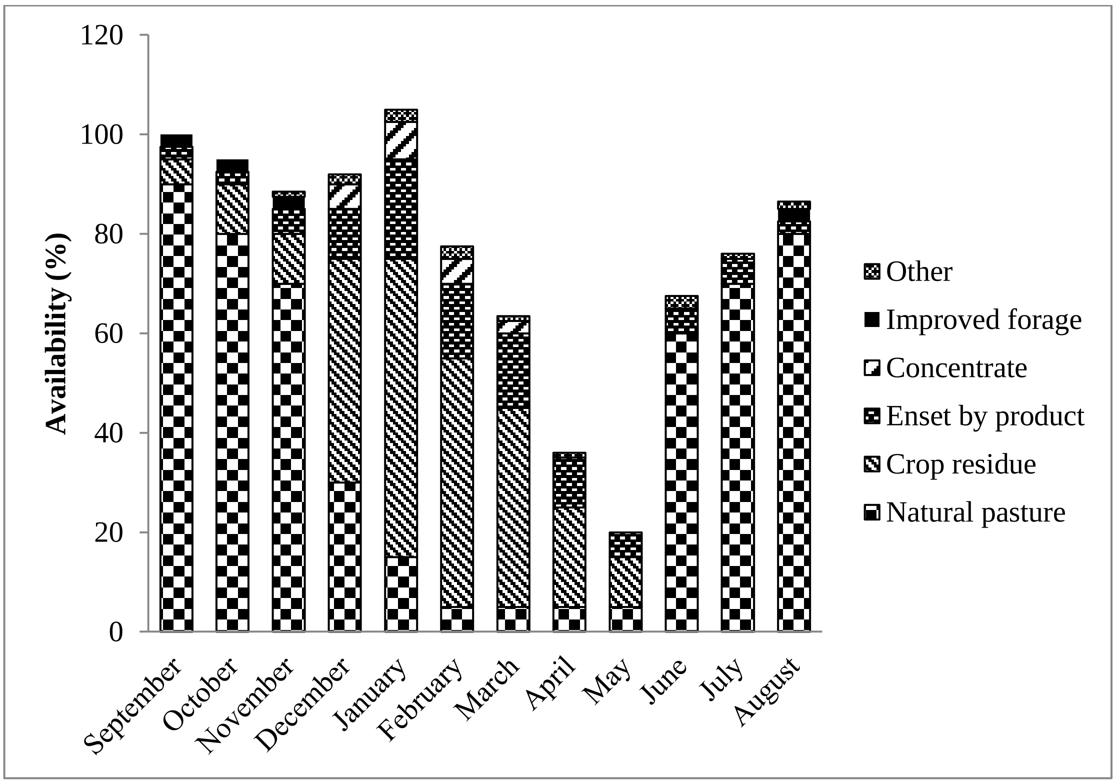
Feeding strategy practiced in study area includes, free grazing, tethered, controlled grazing, indoor feeding (zero grazing), cut and carry and herded grazing. The feeding method used varies with season i.e. free grazing was the main feeding strategy (60.65%), commonly practiced during dry season. Tethered was mainly practiced during heavy rain season (27.30%), due to cattle destruction of cultivated land. Free grazing may affect grazing land productivity and other researcher argues on it. According to Alemayehu (2002) and Gebremedhin *et al*. (2004), free grazing leads to the depletion of feed resources through overgrazing, contributes to the low productivity of livestock in the country.

Table 14: Feeding practice of the farmer in study area (N=150)

		Agro-ecology (%)		
Variables	**Parameters**	**High altitude**	**Mid-altitude**	**Average (%)**
Method of animal feeding	Free grazing	63.40	57.90	60.65
	Tethered	24.80	29.80	27.30
	Herded grazing	7.50	8.80	8.15
	Stall fed	4.30	3.50	3.90
Feed shortage season	Long dry season	44.00	52.60	48.30
	Long rainy season	33.30	26.30	29.80
	Short dry season	16.20	17.50	16.85
	Short rainy season	6.50	3.60	5.05

Controlled/rotational grazing was the other feeding practiced (8%), in which the farmer classify land into different blocks, and it was used in different seasons rotationally mostly takes 1-2 month, the logic behind is that, during this period primarily grazed land get time for rehabilitation.

Cut and carry feeding was practiced (21.30%), mainly during rainy season, major land is cultivated by crop. Due to that the farmer practice feeding livestock from different sources such as conserved feed and improved forages cultivated around homestead and mainly used to feed lactating dairy cows, calves, sick animals and draught oxen.



Source; Primary data (2017), *other includes household and horticultural wastes

Figure 4: Feed availability in the study area

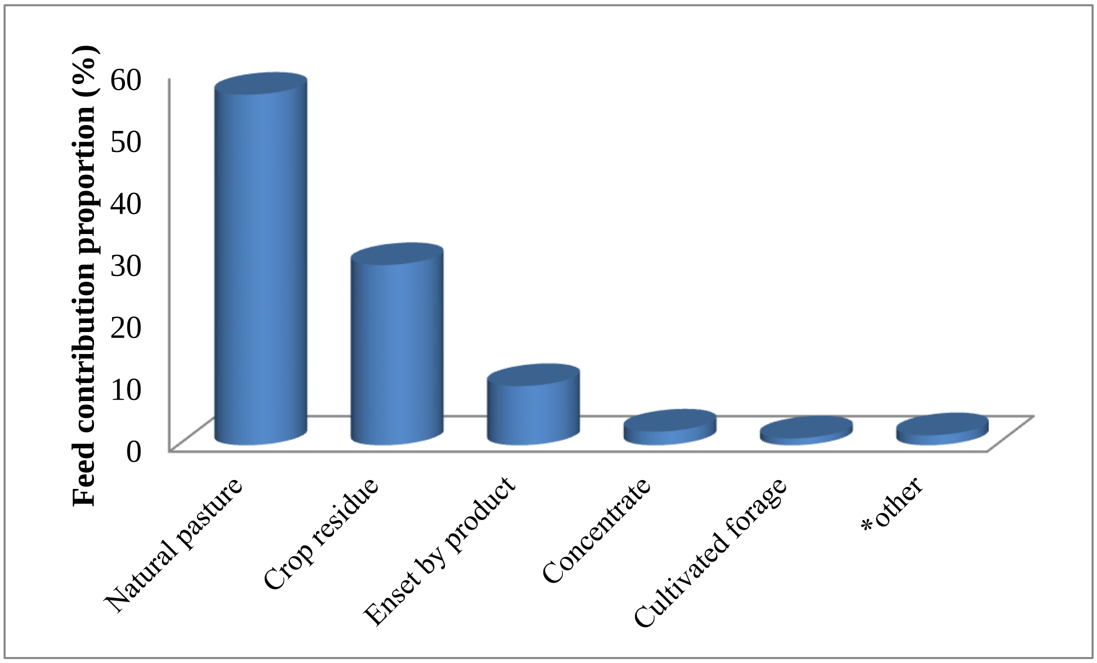


Figure 5: Livestock feed types and their contribution (%)

Note: *other includes household and horticultural wastes

3. Feed conservation practices in the study area

Table 15 shows summarized feed conservation practices in the study area. Conservation of crop residues was the main strategy used to alleviate feed shortage in the study area. Study result shows that, crop residue was conserved outside (81.0%) and the source was from own farmland (94.6%) and from market (5.4%).

The farmer traditionally judges the roughage quality by color (30.75%) and type of roughage (31.0%). Due to its relatively better palatability, farmers usually prefer barley straw to feed their animals. Animals fed barely straw show good performance and stay moist for a long period of time. Properly managed straw color is shiny, while brown color indicates poor quality, straw harvested during rainy season, is yellow and develop mold immediately.

Table 15: Respondents straw conservation practice in the study area (N=150)

Variables	Parameters	Agro-ecology (%) High altitude	Agro-ecology (%) Mid-altitude	Average (%)
Farmers' engagement in feed conservation	Yes	77.40	82.50	79.95
	No	22.60	17.50	20.05
Method of feed conservation	Stacked out side	83.30	78.70	81.00
	Stacked under shade	13.90	6.40	10.15
	Bailed out side	2.80	4.30	3.55
	Baled under shade	0.00	10.60	5.30
Indicators used by farmers to evaluate feed quality	Roughage type	46.20	15.80	31.00
	Color	24.70	36.80	30.75
	Smell	10.80	33.30	22.05
	Appearance	15.10	10.50	12.80
	Maturity	3.20	3.60	3.40

Source: Primary data (2017), N= number of respondent

4. Livestock water source and watering frequency

Table 16 shows summary of water sources and watering frequency in the study area. According to the survey result, rivers, protected and unprotected spring, piped water and hand-dug wells were the sources of water for livestock and for agricultural uses in the study area were. In the study area livestock water was easily accessible, 27.40% of the respondent animal was watered at home and travel on average <1 km distance to reach water point during dry season (55.30%). Farmers participated on focus group discussion pointed out that, Wabe, Ashoka and Totolmo were large perennial rivers used for both agriculture and livestock.

Table 16: Source of water for livestock and watering frequency (N=150)

		Agro-ecology (%)		
Variables	**Parameters**	**High altitude**	**Mid-altitude**	**Average (%)**
Water source during dry season	Hand dug-well	47.30	36.80	42.05
	Motorized pump	39.80	36.80	38.30
	Spring	10.80	12.40	11.60
	River	2.10	14.00	8.05
Distance travel during dry season	Watered at home	35.50	19.30	27.40
	<1 km.	52.70	57.90	55.30
	1-5 km.	11.80	22.80	17.30
Watering frequency during dry season	Twice in a day	19.40	54.40	36.90
	Once in a days	72.00	36.80	54.40
	Ad-lib	8.60	5.30	6.95
	Once in two days	0.00	3.50	1.75

Source: Primary data (2017)

4.4.7. Livestock health and breeding practice

Table 17 shows livestock vaccination and breeding practices in the study area. Livestock health influences the agricultural productivity. Disease type that affects livestock was mainly dependent on agro ecology. Animal disease type is closely linked to the kind of environment in which the herd is kept and the management used (Desta *et al*., 2000).

Farmers who participated in group discussion reported that, lumpy skin disease locally called *Finno gaala*; Black-quarter (*Abba gorba*) and Anthrax (*Abba senga*) are the main diseases that affect livestock during *Birra*[11] and *Bonna*[12] season. Farmers vaccinate their animal during outbreak and on routine bases. Local bull was used for mating and AI or bull with exotic blood was used (13.95%).

Table 17: Livestock vaccination and breeding practice (N=150)

		By agro-ecology (%)		
Variables	**Parameters**	**High altitude**	**Mid-altitude**	**Average (%)**
Vaccination practice	Yes	70.90	71.90	71.40
	No	29.10	28.10	28.60
Season of vaccination	During out break	90.90	87.80	89.35
	On a routine base	9.10	12.20	10.65
Breeding system	Natural	86.10	86.00	86.05
	Modern (AI)	13.90	14.00	13.95

Source: Primary data (2017)

4.4.8. Livestock production constraints

Table 18 shows summary of livestock production constraints ranked based on their importance in the study area. The survey result shows that, feed shortage was the primary challenge of livestock production in the study area (68%) followed by low productivity (57.3%), health problem (56%) and scarcity of water (52%). Key informants explained that

[11] *Locally the farmer name the season from September-November as Birra*

[12] *Bonna refers to the season from December-February*

feed shortage was the main challenge and the problem was escalating from time to time. The study results agree with other findings, who reported that feed shortage, poor health and low productivity were the main livestock production constraints in Ethiopia (Desta *et al*., 2000).

Table 18: Livestock production constraints in study area (N=150)

Constraints	**Constraints level (%)**					**Rank**
	1	**2**	**3**	**4**	**5**	
Feed shortage	68.0	21.3	4.7	4.0	2.0	1
Low productivity	31.3	57.3	6.7	4.7	0.0	2
Disease and parasite	0.0	18.0	56.0	20.7	5.3	3
Water scarcity	2.0	3.3	16.0	52.0	26.7	4
Market	0.0	0.0	12.0	16.7	71.3	5

Source: Primary data (2017)

4.5. Traditional Grassland Management Practices

Table 19 shows traditional grassland management practices in the study area. To maximize grassland productivity the farmer traditionally uses different management strategies. The study result shows that, grassland was managed traditionally (84.15%), among this private enclosure (*kalloo)*[13], fencing and draining of marshy area was the main s traditional strategy used to manage grassland.

[13] *Farmer locally name the enclosed/reserved grazing land as Kalloo*

Enclosure (*kalloo*) was the main grassland management strategy used (76.20%), refers to conserved grassland area that is owned and managed by each household, used to feed during feed shortage (60.61%). Additionally the farmer practices this strategy for feeding lactating cows, oxen, calves and weak animals during long rainy season.

Digging the ditches, was done in the area to improve feed availability (19.65%), the farmer traditionally dig the ditches to drain marshy areas. Excess accumulation of water on natural pasture land was one challenge for livestock owners in highland agro ecological zone. Consequently, it affects forage availability and vegetation growth rate.

Table 19: Traditional management practices in the study area (N=150)

		By agro-ecology (%)		
Variables	**Parameters**	**High altitude**	**Mid-altitude**	**Average (%)**
Do you manage the grassland	Yes	80.6	87.7	84.15
	No	19.4	12.3	15.85
Management strategy	Fencing	64.7	74	69.35
	Draining of swampy land	23.3	16	19.65
	Fire application	9.3	10	9.65
	Bush clearing	2.7	0	1.35
Do you use enclosure	Yes	69.9	82.5	76.20
	No	30.1	17.5	23.80
Farmer opinion on purpose of enclosure	Overcome feed shortage	58.06	63.16	60.61
	Rehabilitation	41.94	36.84	39.39

Source: Primary data (2017), N= number of respondent

Table 20 shows summary of farmer perception on grazing land condition of the study area. The current condition of grazing land of the study area was found under poor condition (89%); evaluation was based on grassland productivity and species composition (Palatability). Although the current traditional grazing land management trend was weak (90.60%), evaluated based on previous management practices.

Table 20: Farmers perceptions on grassland condition in Kofele district (N=150)

Parameters	**Criteria**	**By agro-ecology (%)**		
		High altitude	**Mid-altitude**	**Average (%)**
Condition of grassland	Poor	90.30	87.70	89.00
	Fair	7.50	7.00	7.25
	Good	2.20	5.30	3.75
Traditional management trend	Weak	93.50	87.70	90.60
	Strong	5.40	7.10	6.25
	The same	1.10	5.20	3.15

Source: Primary data (2017)

Table 21 shows extension services given on grassland management in the study area. Extension approaches in the study area shows that, governmental and Non-Governmental Organization (NGOs) participated on grassland improvement. The survey result shows that, the majority (85.0%) has an access to extension services and contacted with extension agents once per month (74.6%). The source of information about improved forage was from development agent (56.85%) and neighboring farmers (22%).

Table 21: Extension services on improved forage development (N=150)

Variables	Parameters	By agro-ecology (%)		Average (%)
		High altitude	Mid-altitude	
Discuss about grassland management	Yes	75.30	94.70	85.00
	No	24.70	5.30	15.00
Frequency of contact	Daily	1.40	9.30	5.35
	Monthly	71.40	77.80	74.60
	Yearly	27.20	12.90	20.05
Source of information about improved forage	From neighbors	19.40	24.60	22.00
	Extension agent	50.50	63.20	56.85
	Social media	19.40	8.70	14.05
	*Other	10.70	3.50	7.10

Source: Primary data (2017), N= number of respondent, *other includes from cooperative members

Table 22 shows improved forage development practices in the study area. The study result shows that, improved forage seed sources were from governmental organization (68.18%) and NGOs (31.82%). Farmers who participated in group discussion pointed out that; improved forage seed availability and low awareness were the main reason for low productivity of natural pasture.

Table 22: Improved forage development practice (N=150)

Variables	Parameters	By agro ecology (%)		Average (%)
		High altitude	Mid-altitude	
Do you cultivate improved forage	Yes	35.50	7.10	21.30
	No	64.50	92.90	78.70
Source of seed	Government	36.36	100.00	68.18
	NGOs	63.64	0.00	31.82

Source: Primary data (2017), N= number of respondent.

4.6. Factors Affecting Grazing Land Size in the study Area

4.6.1. Model summary

Table 23 shows variables model summary. To explain the variation due to exploratory variables, adjusted R square value was estimated. Accordingly, the value of adjusted R^2 is 0.98. This indicates that, 98% of the variation in grazing land size in study area was due to selected exploratory variables; while other factors that were not studied in this research contributes only to 2% for grazing land size variations.

Table 23: Model summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.992[a]	0.984	0.984	0.0970

a. Predictors: Livestock holding (TLU), crop land size, land holding size, family size, forest land size, urbanization and degraded land size.

4.6.2. Regression analysis

Table 24 shows the significance test for regression among variables. To identify the factors affecting grazing land size in the study area; all variables were tested whether they are related or not, the result shows that, family size, livestock holding (TLU), urbanization and land degradation were not significantly related with grazing land size ($p>0.05$); while the relationship of land holding size, crop land and forest land with grazing land size was significant ($p<0.01$).

Table 24: Significance test for regression relationship among variables

Variables	Unstandardized Coefficients (B)	Sig.	VIF
(constant)	0.001		
Livestock holding (TLU)	0.001	0.808	2.095
Crop land	-0.963*	0.000	5.709
Land holding size	0.982*	0.000	6.256
Forest land	-0.971*	0.000	1.116
Family size	-0.001	0.818	1.053
Urbanization	-0.001	0.524	1.160
Land degradation	-0.127	0.556	1.103

* indicates regression relationship is significant at 1%

The influence of four variables namely family size, livestock holding (TLU), proximity to urban center and land degradation were not significant for grazing land size variation. Regression coefficient (B) value indicates the direction of relationship of variables. Accordingly, crop land and forest land have a negative relationship with grazing land size.

Crop land indicates that, when crop land size increases the grazing land size decreases. The rate of change is based on how much the variables are correlated; the more correlated they are the more they contribute for variation. Crop land regression coefficient value was higher, due to the dominance of current crop agricultural practice of the farmer i.e. Majority of the respondent cultivate cash crop (potato) than food crop, such trend influence the grazing land size negatively.

Total land holding per household direction of relationship with gazing land was positive. Land size per household is highly dependent on their family status i.e. household head that has larger land holding in the area, larger land size is allocated for the next generation and vice versa. Similarly, the farmers that had large land holding size allocate more land size for grazing land.

Finally, to estimate grazing land size per household in the study area, the variables which are affect grazing land were analyzed and the following predictive regression equation was established (see appendix table 1).

Grazing land size (ha) = -0.08 + (-0.97*crop land size (ha)) + (-0.96*forest land size (ha)) + (0.98*total land holding size (ha)).

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Land holding, land allocation trend, crop-livestock production practices and traditional grassland managements of Kofele district were studied. Agriculture was the main economic base of the farmers to support the livelihood of their families. Agricultural practices were characterized by traditional, small-scale, subsistence and rain-fed. The dominant crops grown in study area were potato; head cabbage and kale were common cash crops; while wheat, barley and *enset* were food crop.

Livestock and crop productions were interdependent in the study area. Traditional livestock production system was dominant and livestock was kept mainly for draught power and milk. Livestock vaccination on routinely base was not well practiced and traditional breeding system was used. Feed shortage, low productivity and disease were the main constraint of livestock production in the area. Natural pasture and crop residues were the major feed source in the area. Free grazing was a common feeding practice during dry season; while tethered and herded grazing is practiced during main rainy season.

Mixed crop-livestock farming system was a common feature of Kofele district. Enclosure, fencing and wet land drainage were the traditional grassland management strategies in the area. Crop land size, forest land size and total land holding per household influence the grazing land size significantly.

5.2. Recommendations

Based on the survey result the following issues were forwarded as recommendations that were targeted to increase livestock productivity and the following points should be imperative.

- Promote controlled grazing, rotational grazing and cut and carry feeding system.
- To address feed shortage; properly allocate land size for crop, forest and grazing.
- Capacity building on livestock production practices, especially on housing, disease prevention and breed improvement to enhance livestock productivity through the best utilization of resource.
- Encourage farmer’s indigenous knowledge on traditional grazing land management.

Further direction, to improve livelihood of the farmer and to enhance livestock productivity and to suggest appropriate intervention measures, the other parameters like nutritive value estimation and biomass yield determination of the natural pasture need further investigation.

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7. APPENDICE

Appendix table 1 MLRM analysis result output

Variables	Un standardized Coefficients		t	Sig.	VIF
	B	S.E			
(constant)	-.008	.015	-.538	.591	
Total Land Holding	.980	.013	73.697	.000	5.528
Forest Land	-.960	.023	-40.940	.000	5.473
Crop Land	-.971	.087	-11.203	.000	1.025

Appendix table 2 ANOVA summary table for total land holding size.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5.683[a]	1	5.683	2.918	.090
Intercept	705.696	1	705.696	362.355	.000
Agro ecology	5.683	1	5.683	2.918	.090
Error	288.234	148	1.948		
Total	1010.838	150			
Corrected Total	293.917	149			

Agro ecologically total land holding size per household was not significant differ ($p>0.05$)

Appendix table 3 ANOVA summary table analysis for crop land.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1.156[a]	1	1.156	1.852	.176
Intercept	225.424	1	225.424	361.014	.000
Agro ecology	1.156	1	1.156	1.852	.176
Error	92.414	148	.624		
Total	324.620	150			
Corrected Total	93.570	149			

Crop land size was not significantly differ agro ecologically ($p>0.05$)

Appendix table 4 ANOVA summary result for grazing land

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1.722[a]	1	1.722	3.019	.084
Intercept	120.191	1	120.191	210.742	.000
Agro ecology	1.722	1	1.722	3.019	.084
Error	84.408	148	.570		
Total	206.445	150			
Corrected Total	86.130	149			

Grazing land size was not significantly differ by agro ecology ($p>0.05$)

Appendix table 5 TLU conversion

*Conversion equivalents of sub-Saharan Africa livestock in to TLU (ILCA, 1990).

Species	**Conversion factor***
Cattle	0.75
Sheep and goat	0.1
Mule	0.7
Horse	0.8
Donkey	0.5
Poultry	0.01

Appendix table 6 ANOVA summary result for livestock population (TLU)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	58.988[a]	1	58.988	3.694	.057
Intercept	5600.553	1	5600.553	350.693	.000
Agro ecology	58.988	1	58.988	3.694	.057
Error	2363.554	148	15.970		
Total	8076.255	150			
Corrected Total	2422.543	149			

Appendix Figure 1 Reconnaissance field survey

Source: Photo taken during field visit (2017)

Appendix Figure 2 Grassland condition at Gurmicho *kebele*

Source: Photo taken during field survey (2017)

Appendix Figure 3 Focus group discussion

Source: Photo taken during focus group discussion (2017)

7.1. Questionnaire used to collect the data

PART I. GENERAL INFORMATION OF THE STUDY AREA

Farmer's name (code) ___________________________ *Kebele* ______________________

Enumerator's name________________________ Date of interview___________________

Agro ecology A. Highland B. Mid-highland

PART II.SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

1. Gender of respondents A/ Male B/ Female
2. Age of respondent _______________________
3. Major occupation A/ Crop production only B/ Livestock rearing only C/ Mixed crop-livestock farming D/ Other, specify_________________________.
4. Marital status A. Married B. Single C. Divorced D. Widowed
5. If your answer is "married" to question No.4 how many wives do you have? A/ One B/ Two C/ More than two
6. How many family members do you have? Children (<15years) -------- Adult (15-64 years)--------- Dependents (>65 years) Total ____________________
7. Educational status of the respondents. A. Illiterate B. Read and write only C. Primary School (1-4) D. Junior Secondary School (5-8) E. High School F. Higher education
8. Religion A. Muslim B. Orthodox Christian C. Protestant D. Wakefata E. Other, specify ____________________

PART III.FARMING SYSTEM CHARACTERIZATION

1. Do you have access of land for cultivation? A/ Yes B/ No
2. If your answer is "yes" to question No.1, where do you get? A/ Through land distribution B/ Inherited from parents C/ From A&B D/Shared from relative D/ Other, specify _________________

3. How many hectares do you allocate from your land for A/ Crop cultivation (cereal, vegetables) ___________ B/ Livestock (pasture) ____________ C/ Improved forage development_____ D/ Forest plantation ____ E/ Other ______, Total_________

4. How many cropping seasons do you have? ______.

5. Traditional naming of seasons,

"*Arfassa*" is from ______________ to ___________________month

"*Ganna*" is from __________________ to _______________ month.

"*Birra*" is from __________________ to ________________ month.

"*Bonna*" is from__________________ to ________________ month.

6. Is land used for more than one crop per year? A/ yes B/ No

7. What happened to the size of land holding over the last five years (2012-2017)?

A/ Decreasing B/ No change

8. If your response is "Decreasing" to question no.7, what were the reasons?

A) Because of large family size B) declining in the fertility

C) Both D) others, specify

9. Which farming system contributes more to your livelihood? (**Put in scale of 0-5 where 5=highly related and 0=have no contribution**)

S/No	Source of income	Scale
1	Mixed crop-livestock farming	
2	Trade	
3	Remittances	
4	Labor	
5	Other specify	

10. How does the rainfall pattern vary over a year? **(Put on a scale of 0-5, where *5* = heavy rainfall levels and 0=no rainfall at all).**

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainfall pattern (score 0-5)												

11. **Crop Cultivation Practice**

10.1 Major crops grown under rain-fed condition

Name/type of crop	Land size/Hek	Cropping Season/ month				Yield/kun.		Total
		Cultivation		Harvesting				
		Arfassa	*Ganna*	*Arfassa*	*Ganna*	*Arfassa*	*Ganna*	
Potato								
Barley								
Wheat								
Maize								
Enset								
Vegetables								
Kale								
Head cabbage								
Beet root								
Carrot								
Other specify								

12. **Purposes of crop cultivation in the study area.**

Crop types	**Main objective of cultivation**			
	Home consumption	**Market**	**Both**	**Forage**
Potato				
Barley				
Wheat				
Maize				
Enset				
Cabbage				
Kale				
Beet root				
Carrot				
Other specify				

13. Do you use irrigation for crop cultivation? A/ yes B/ No

If the answer is "yes" to question No.13 how many hectare of land is used or irrigated? ---

14. Type of crop/vegetable cultivated under irrigation

Name of crop/vegetable	**Land size(ha)**	**Cropping season/month**		**Yield/kun.**
		Cultivation	**harvesting**	

15. Do you need external labour for crop cultivation? A/ Yes B/ No

16. If the answer is "Yes" to question No.15 what type? A/ Human labour B/ Machineries

17. Is labour readily available throughout the year? A/ yes B/ No.

18. If the answer is "No" to question No.17 when it is the shortage is critical? ______

2. Livestock Production System.

1. Cattle herd structure

S/N	Species of animal	Count by breed type		
		Local	**Cross**	**Total**
1	Milking cows			
2	Dry cows			
3	Oxen			
4	Male calves			
5	Female Calves			
6	Heifers			
7	Bulls			
8.	Bullock			
	Total			

2. Sheep and goats

S/N	Animal class	Count	Total
1	**Sheep**		
1.1	Ewe (female)		
1.2	Ram (male)		
1.3	Lamb		
2.	**Goat**		
2.1	Does (female)		
2.2	Bucks (male)		
2.3	Kids		
	Total		

3. Equine

S/N	Species	Count	Total
1	Donkey		
2	Mule		
3	Horse		
	Total		

4. What type of livestock production system do they practice?

A/ Extensive/traditional B/ Semi-intensive C/ intensive system

5. The livestock production contribution for livelihood trend for the last five years (2012-2017)? A/ Increasing B/ Decreasing C/ Constant D/Unknown

6. Dairy Productivity

Category	Parameters	Milk yield per day (lit.)	Remark
Local bred	During feed shortage (Min.)		
	During Feed available (Max.)		
Cross bred	During feed shortage (Min.)		
	During Feed available (Max.)		

7. Perceived purposes of livestock keeping? **(For each rows Put in ✓ mark)**

Livestock class	Reason for livestock keeping						
	Milk	**Reproduction (breeding)**	**Meat**	**Milk and meat**	**Cash income from sale**	**Prestige**	**Transportation/draught power**
Dairy cow							
Dry cow							
Oxen							
Bulls							
Bullock							
Sheep and goat							
Equine							

PART IV: GRASS LAND MANAGEMENT PRACTICE

1. Do you have an access to grazing land for your livestock? A. Yes B. No

2. If the answer is "yes", to question No. 1 how many in hectare? ________________

3. What type of grazing land is available in your area?

A/ Open communal land B/ Communal grass reserves C/ Private land D/ Road/rivers side E/ Other specify

4. How often do you use grassland resource? A/ Mostly B/ Sometimes C/ Rarely D/ Not at all

5. Do you have an access to communal grazing land? A/ Yes B/ No

6. How many months per a year do you use a communal grazing land? ___________.

7. If you let your animals to graze, for how many time they graze per day? -----------hours

8. How do you use the grassland resource A/ Free grazing only B/ Rotational grazing only C/ A&B D/ Cut and carry system E/ Rotational grazing and Cut and carry

9. Do you prioritize your animal for grazing? A. Yes B. No

10. If the answer is "yes", to question No.9, which animal specious, age group gets priorities____

11. The grazing land availability trend in your area, A/ Increasing B/Decreasing

12. If the answer is "decreasing", what was the main reason________________________?

13. Is the grassland resource is adequate to your animal's requirement? A. Yes B. No

14. If the answer is "No", to question No.13 why? A. Grassland shortage B. Low palatability C. other specify____________________

15. At which season do you face feed shortages is critical? Why? _________________
A/ Short rainy season B/ Long rainy season C/ Short dry season D/ Long dry season

16. Do you conserve crop residue/straw? A/ Yes B/ No

17. If the answer is "yes" to question No.16 how? A. Stacked outside B. Stacked under shade C. Baled outside D. Baled under shade E. Other (specify)

18. The source of crop residue/straw is? A/ Own farmland B/ Purchased from the market

19. How do you know its quality? Can you tell us some of the quality parameters helpful to judge good quality? A. Color B. Maturity C. Species of forage type E. Smell F. Other (specify) ________

20. What measures do you take to alleviate feed shortage problems? _________________

PART V: TRADITIONAL GRASSLAND MANAGEMENT TREND

1. Do you have a traditional law to manage grassland resources? A. Yes B. No

2. If the answer is "yes" to question No. 1 who is responsible for management from community members? A/ Youth B/ Elders C/ Religious member D/ School committee

3. Do you use enclosure "*Kallo*" system? A. Yes B. No

4. If the answer is "yes" to question No. 3 what type is it? A/ Communal B/ Private C/ A&B

5. Why do you own enclosures? A/ for dry season B/ as rehabilitation strategies C/ A&B

6. Do you practice any traditional grassland management to improve grassland? A/ Yes B/ No

7. What type of management? A/ Fencing B/ dig the ditch C/ Fire application D/ Other specify_______________

8. What do you feed animals at different months/ feeding calendar? (**Put in scale of 0-10 where 10 =highly available 1=availability is less and 0= not available at all**)

Feed type	**Feeding practices by season scale (0-10).**											
	Birra			***Bonna***			***Arfassa***			***Ganna***		
	Sep	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
Natural grazing/pasture												
Crop residues/straw												
Concentrate												
Cultivated forage												
Enset byproduct												
Other(specify)												

9. What is the current condition of communal grazing land found in your area? A/Good B/ Poor C/ Unknown

10. When you compare the past and current grassland productivity currently it is,

A. More productive B. Productive C. Less productive D. Unknown

11. When you compare the past and current traditional grazing land management, it is A. Increasing/strong B. Decreasing/weak C. Unknown

12. The current condition of grassland is, A/ Good B/ Poor C/Unknown

13. The trend of grassland management is A/ Downward B/ Upward C/ The same

14. The condition of grassland cover A/ Increasing B/ Decreasing C/ The same

PART VI: LIVESTOCK FEEDING AND HUSBANDRY PRACTICES.

1. The primary method of animals feeding is, A/ Stall fed B/ Tethered C/ Open grazing D/ Herded grazing

2. Do you give supplementary feed for you animals like concentrate? A/ Yes B/ No

3. If the answer is "No", to question No.2 why? (Cost, distance, low supply………)

4. Where are the sources of water to your livestock during dry season? _______________

5. Where are the sources of water to your animals during wet season? ________________

6. Livestock distance travel up to water source (point) during dry season? A) Watered at home B) < 1km C) 1-5km D) 6-10km

7. How frequently cattle watered during dry season? A) Once in a day B) Twice in a day C) Ad-lib D) Once in two days E) Once in three days

8. What are the major disease types available in your Area?

Local name	Spp. affected	Signs and symptoms	Season of occurrence	Treatments method	
				Traditional	Modern

9. Do you experience a serious disease outbreak in your life? A. Yes B. No

10. If the answer is "yes" when and what was the disease specify____________________

11. Do you vaccinate your animal? A. Yes B. No

12. If the answer is "yes" When was the animal get vaccination?

A. On a routine basis B. During outbreak

13**.** What is the breeding system you follow? A. Traditional/natural B. Modern/AI

PART VII: MAJOR LIVESTOCK PRODUCTION CONSTRAINTS

1. Livestock production constraints in the area rank based on their importance? (Rank one for that problem that affects livestock productivity highly).

No	Constraints	Rank
1	Feed shortage	
2	Low productivity	
3	Disease and parasite	
4	Lalor shortage	
5	Market	

PART VIII: EXTENSION APPROACH

1. Proximity to urban centre (km) ____________________________

2. Have you ever discussed about grassland management & related problems with the extension agent? A. Yes B. No

3. If the answer is "yes" to question No.1 how frequently do you contact the agent for discussion A/Daily B/ Monthly C/ Yearly

4. If the answer is "no" to question No.1 what is the main reason?

   A. Have no extension agent B. Extension agent cannot easily reach them

   C. There is no need to contact the agent D. Other, specify_______________

5. Extension agent mostly gives you a technical assistance on which husbandry practice? A. Feeding and watering system B. Breed improvement method C. Housing and hygiene D. Grazing land management strategies E. all

6. From where do you get information about the importance and method of improved forage development? A. From neighbor B. Extension agents C. Radio D. Television E. Other source

7. Is there any organization before participate on grassland improvement program in your area? A. Yes B. No

8. If the answer is "yes" to question No. 7 what was name of organization and its objective? ____

9. Improved forage seed source; A/ Governmental organization B/ NGOs C/ Private