ASSSESSMENT OF AVIALABLE FEED RESOURECES, FEED MANAGMENT AND UTILIZATION PRACTICE IN DAWURO ZONE, LOMA DISTRCT, SOUTHERN ETHIOPIA

M.Sc. THESIS

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HAWASSA UNVERSITY

COLLEGE OF AGRICULTUR

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ASSSESSMENT OF AVIALABLE FEED RESOURECES, FEED MANAGMENT AND UTILIZATION PRACTICE IN DAWURO ZONE LOMA DISTRCT SOUTHERN ETHIOPIA

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A THESIS SUBMITTED TO THE SCHOOL OF ANIMAL AND RANGE SCIENCES, GRADUATE STUDIES, HAWSSA UNVESITY

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ADVISORS' APPROVAL SHEET

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This is to certify that the thesis entitled "Assessment of available feed resources, feed management and utilization practice in Dawuro zone Loma distract Southern Ethiopia "submitted in partial fulfillment of the requirements for the degree of Master's with specialization in Animal Production, The Graduate Program of the School of Animal and Range Science, and has be carried out by Mathewos Mengesh Folla, under my supervision. There fore, I recommend that the student has fulfilled the requirements and hence here by can submit the thesis to the school.

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DEDICATION

This thesis dedicated to my beloved wife Bereket Abera, my much-loved mother Zewuditu Godana and my sweet sister Meselech Mengesha who for giving their affection, love and encouragement.

STATEMENT OF AUTHOR

By my signature below, I declare that this thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and completion of this thesis. Any scholar matter that is included in the thesis has been given recognition through citation. This thesis is submitted in partial fulfillment of the requirement for Master Science degree at Hawassa University. The thesis is deposited in the Hawassa University Library and is made available to borrowers under the rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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ABEREVEATION

BoFED	Bureau of Finance and Economy Development
CSA	Central Statistical Authority
DA	Development Agents
EARO	Ethiopia agricultural Research Organization
LAR	Loma Administrative Annual report
SNNPRS	South Nation Nationality people regional state
SPSS	Statistical Package for Social Sciences
TLU	Total Livestock Unit

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ASSSESSMENT OF AVIALABLE FEED RESOURECES, FEED MANAGMENT AND UTILIZATION PRACTICE IN DAWURO ZONE LOMA DISTRCT SOUTHERN ETHIOPIA

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ABSTRACT

A study was conducted in Loma district in Dawuro Zone of South Nation Nationality People Region to assess the avialable feed resources, feed management and utilization practice. Primary and Secondary data sources and field observations, structured questionnaire and group discussions were employed to generate data. The study district was stratified into highland, midland and lowland agro ecology. Purposive sampling was used to select the respondents. Atotal of 385 respondents (highland=110, midland=110 and lowland=165) were purposely selected based on those having minimum 3 livestock species and interviewed individually. The results indicated that both crop and livestock farming were the main farming activity in the study area. Shortage of feed and disease were the major livestock production constraints in all agro ecology of the area. The major feed resources available in dry season were crop residues , natural pasture , and crop after math, hay and fodder tree in the study area. During the wet season, majority of the respondents feed their animal natural pasture, fodder tree and crop residue crop after math and hay. Fodder tree was the dominanted feed next to natural pasture in both lowland and mid land agro ecology. Continuous grazing system was practiced highly in low land where as zero grazing (cut and carry) system were practice highland agro ecology. Indoor feeding was highly practiced in highland respondents compared with midland and lowland. Majority of respondents in lowland agro ecology had Common grazing land compared with other agro-ecology respondents.Crop residues and purchased concentrate feeds were used to alleviate feed shortage in all agro ecology of the study area. Majority of respondents could not produce, improved forage for their animals due to land shortage,shortage of rain fall and shortage of land were the main reason that affects production of improved forage in lowland and other agro ecology respectivily.The major crop residue used for livestock feeding in both midland and lowland were teff, maize and sorghum and also wheat and barley straw was the dominant crop residue in high land agro ecology. Most of the crop residue was stocking under the shed in the study area. Most highland and midland respondents stock crop residues in open air and stocked under the shed was used by lowland agro ecology respondents. Majority (69.6%) of respondents were utilizing crop residue for livestock feeding in the three agro ecologys. Only 19.2% of respondents were providing chopped crop residue for their animals. With lack of molasses all of the respondents were not treat crop residue in the study area. 26% of respondents in the study area were practice hay production. Spring water was the major sources of water in the highland and midland agro ecology whereas rivers are mainly used by the households of lowland agro ecology. Most of respondents were providing of water for the animal twice in a day with group and individually in the study area. Development and demonstration of improved forages that can be integrated with the dominant farming system, efficient conservation and utilization of crop residue via different treatment options and maximizing the productivity of available individual and communal grazing pasture land using proven improved technologies needs attention.

Ker word: *Assessment, feed resources, feed management, utilization practices, Loma,*

1. INTRODUCTION

1.1 Background and Justification

Livestock production is an important part of the farming systems in Ethiopia and plays a vital role in the livelihood of the majority of the people (Yeshitila *et al.,* 2008). In Ethiopia, livestock generates more than 85% of the farm cash income. In terms of contribution to the national economy, livestock contribute about 13–16% of total Growth Domestic Product (GDP) and the share to total exports is about 16% (Yayneshet, 2010). In spite of this, the productivity of livestock is low mainly due to poor genetic makeup of local animals, poor nutrition and poor veterinary care among which poor nutrition is the major limiting factor (Yeshitila *et al.,* 2008). Livestock production is mainly constrained by inadequate supply and poor quality of available feed resources in Ethiopia (EIAR, 2017). This could be further emphasized by the fact that feed accounts for 60-70% of the costs associated with livestock production.

Natural pasture and crop residues which are the major livestock feed resources and provide the bulk of livestock feed in Ethiopia and also they are seasonally produced during particular periods of the year (October-January) following the main rainy season, and their extended use and quality will depend on proper harvesting, collection, storage, feeding and other management practices.

The availability of feed resources and the nutritional quality of the available feeds are the most important factors that determine the productivity of livestock. The role of natural pasture grazing as a major livestock feed resource is diminishing from time to time due to shrinking grazing land size (Yayneshet, 2010). The use of native hay is limited in coverage and it is better in terms of its feeding value than crop residues if timely cut, proper handling and storage measures are applied. Even during years of good rainy season, forage is not sufficient to feed livestock in the highlands

for reasons associated with restricted grazing land and poor management (Melese *et al.,* 2014). A basic shortcoming of the natural grasslands as a source of feed for ruminant livestock is their low production of dry matter due to a combination of the negative effects of inadequate rainfall and soil nutrients. The seasonality of plant growth, which is a reflection of the annual rainfall distribution pattern, further restricts the availability of herbage for the grazing animal to four or five months of the wet season over most of the natural grasslands and the low quality of the herbage is another shortcoming of natural grassland (Ulfina *et al.,* 2013). As a result of increasing crop production, currently crop residues represent the largest amount of livestock feed and it provide 10 to 15% of the national intake of feed by livestock and in some areas the estimate is up to 50% (Alemayehu, 2003). In selected wheat based crop- livestock production systems of the Ethiopian highlands, the contribution of crop residues and aftermath grazing account for 70% of the total feed supply, while native pasture accounts for only 30% of the total feed supply. According to Zewdie (2010), assessment of the quantity and quality of available feed resources in relation to livestock requirement has not been yet well addressed in most livestock production areas of the country. There is also little study done in study area in assessment of available feed resources, feed management and utilizations. Similarly the management and utilization methods of available feed resources of the area are not yet well described for the livestock rearing households of the study area.

Feed resource assessment is important to diagnose the problems and suggest intervention measures to be taken by farmers and policy makers. In this context, the primary focus needs to identify the existing feed resources, utilization practices during wet and dry season improving the existing management system and to alleviate the feed shortage without livestock production disturbance especially during dry season. Therefore, assessment of available feed resources, feed management

and utilization practice of feed in the Dawuro zone Loma district was done by the following objectives.

1.2 Objectives of the study

- To assess the availability of feed resources in the Loma district.
- To identify the existing feed management, utilization and feeding system in the Loma district.

2. LITERATURE REVIEW

2.1 Feed availability and sources in Ethiopia

2.1.1 Natural pasture

The expansion of croplands into the grasslands and the resultant decline in the size of grazing areas, native pastures remain the major contributors of livestock feed in the densely populated highlands of Ethiopia (Lemma *et al.,* 2002). Natural pastures mostly suffer from seasonally spells of dry periods during which they drop in quality, which is characterized by high fiber content, low digestibility, and low in nitrogen, very low protein and energy content (Assefu, 2012). The yield as well as quality of pasture is very low due to poor management and over stocking (Ashagre, 2008). In general, grazing land productivity is declining at a higher rate because of temperature stress and scarcity of rainfall, which is favored by deforestation that denies humid environment to the area. In addition to this, the transfers of grazing lands to cultivation for cropping and poor grazing land management are some of the reasons for dry matter reductions from grazing lands (Yeshitila *et al.,* 2008). Among grass species commonly growing belongs to the genera *Andropogon, Digitaria, Panicum, Pennisetum* and *Trifolium*(Yihalem *et al.*, 2006).

2.1.2 Grass hay

Hay is forage harvested during the growing period and preserved by drying. Hay in central highland of Ethiopia is usually harvested after the crude protein (CP) of the pasture passed peak production and the protein content of hay on DM basis was usually less than 5%, which is below the level of maintenance requirement for ruminants (Solomon *et al.*, 2008). The quality of hay prepared varies with grass legume proportion, leaf to stem ratio and physiological development of the forage up on harvest (Assefu, 2012).

2.1.3 Crop residues

Cereal crop, pulse crop, oil plants, roots and tubers are the major crop residues which are fibrous by products of different plant crops. They are cereals crop residues (teff, barely, wheat, maize, sorghum and millet); pulse crop residues (faba beans, chicken peas, haricot beans, field peas and lentils), oil crop residues and rejected vegetables are providing a considerable quantity of dry season feed supply in many farming systems of the country. The crop residues are important in fulfilling feed gaps during periods of acute shortage of other feed resources. A report by (Tolera *et al.,* 2012) indicated that crop residues contribute to about 50% of the total feed supplied in Ethiopia. Stems and leaves were the most preferable parts of crop residue and they were obtained after harvesting of grains. In order to know the net quantities of crop residues, the collection, transport, storage and processing, seasonal availability the most important factor affecting available for livestock feeding. Straws from teff, barley and wheat form the largest component of livestock diet in the medium and highland areas, while maize, sorghum and millet stover's constitute larger proportion of livestock feed in lower to medium altitudes (Alemayehu, 1985). Much has been said about the importance of crop residues as livestock feed by many authors. However, adequate information on the availability of crop residues in relation to their potential for feeding livestock in Ethiopia are limited (Alemu *et al.,* 1991).

2.1.4 Agro-industry by-product

The major agro-industrial by products commonly used are obtained from flour milling industries (wheat bran, wheat short, wheat middling and rice bran), edible oil extracting plants (noug cake, cottonseed cake, peanut cake, linseed cake, sesame cake, sunflower cake etc), breweries and sugar factories (Molasses). The current trends of increasing urban population has a significant effect on the establishment of agro-industries due to the corresponding increasing demand for the edible

main products (Yayneshet, 2010). Agro-industrial by-products have special value in feeding livestock mainly in urban and peri- urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply (Firew and Getnet, 2010). They are in general rich in energy or protein or both and have low fiber content and high digestibility compared with the other classes of feeds (Seyoum and Zinash, 1989). Agro industrial by products are mostly used for supplementation of ruminants kept on low quality feeding to assist them perform well due to its high nutrient density to correct nutrient deficiencies set by the basal diet. Agro-industrial by-products have side effects through the production of toxins, if kept under unsuitable storing condition. Alfa toxin in groundnut meal and gossypol in cotton seed meal are among the major toxic components (Alemu *et al*., 1991).

2.1.5 Cultivated Pasture and Forage

Improved forages are play a great role in full filling feed gaps of livestock feeding during the time of inadequate crop residue and natural pasture supply. In most situations, natural forages do not meet the nutrient requirements of livestock for most of the year even during the wet growing season due to nutrient deficiencies, low digestibility, and limited intake (Mekonnen and Ali, 2013). Production of cultivated forage and pastures depends on availability of species that are adapted to the climatic, edaphic and biotic factors prevailing in the environment in which they are to be utilized. Cultivated forage and pasture crops are mainly important as cut-and-carry sources of feed and as a supplement to crop residues and natural pastures.

Forage crops are commonly grown for feeding cattle oats and vetch mixtures, fodder beet, elephant grass mixed with siratro and desmodium species, Rhodes/ lucerne mixture, Guatemala, hedgerows of Sesbania, leucaena and tree-lucerne being common ones (Alemayehu, 2006). Improved forage crops especially legumes are needed to improve the nutritional values of crop residues. Improved

forages also provide benefits such as soil fertility through their nitrogen fixing ability and reducing soil erosion (Yeshitila, 2008). Due to its positive biological impact on degraded lands the government of Ethiopia has given due attention in stock exclusion and watershed areas. However, not much progress achieved until recently (CSA, 2012). Due to unprecedented population increase, land scarcity and crop dominated farming, there has been limited introduction of improved pasture and forages to smallholder farming communities and the adoption of this technology by smallholder mixed farmers has been generally slow (Abebe *et al*., 2008). However, for the majority of small scale farmers who have small land holdings or communal lands, particularly as positive results may not be achieved in the short term (Mekonnen and Ali, 2013; Mergia *et al*., 2014). One option, which had some measure of success at the smallholder level, is the cultivation of improved fodder plants. The contribution of cultivated forages and pasture crops to the diet of farm animals in Ethiopia is relatively very small in terms of energy value. This was due to the low adoption of improved forages, low level of awareness, lack of adequate extension service, lack of suitable forage seeds and planting materials by smallholder (Mekonnen and Ali, 2013) and due to land scarcity and a crop-dominated farming system to introduce improved cultivated species into traditional grazing areas (Zewdie, 2010).

2.1.6 Fodder Trees

One of important animal feeds in Ethiopia in different climate zone like arid, semi-arid, and mountain zones were fodder tree and shrubs. During dry season when the grass dry up and deteriorate in quality and quantity, most browse species have benefit of maintaining their greenness and nutritive value from those fodder trees. Tree fodders are generally rich in protein, vitamins and mineral elements and can used as dry season feed sources and supplements to poor quality grasses and crop residues. However, their utilization is reducing by the presence of tannins

and other phenolic, Compounds in their leaves. Compared to grasses, fodder trees and shrubs have relatively high concentrations of crude protein and minerals. These nutrients are subject to less variation than in grasses and this particularly enhances their value as dry season feeds for livestock. However, nutritive value of fodder trees decreases with aging, since they become woody as they mature. Nevertheless, such situation can easily overcome by regular lopping of the plants (Alemayehu, 2004).

2.1.7 Non-conventional feed resources

Livestock feed resources are classified as conventional and non-conventional (Alemayehu, 2003), where the non-conventional ones vary according to the feeding habit of the community and others, e.g. vegetable refusals, sugar cane leaves, Enset leaves, fish offal and etc are non- conventional feed types. Yeshitila (2008) also identified non-conventional feeds and it includes like residues of local drinks coffee, areke, tela, chat left over called geraba, fruits and vegetables rejects.

2.2 Livestock Feed Management

2.2.1 Hay Making

The most commonly used ways of feed preservation techniques in Ethiopia is hay making. The principle of hay making is to reduce water content of harvested plant material to retard enzyme activity. Once dried the farmers' transport the hay and put it in stack for future use or they may readily feed to their livestock. For the dry season usage, farmers store hay under-shed to protect it from elements of weather and from the animals themselves. However; as both grasses and legume decline in quality as the dry season progresses ways of preserving nutritive quality through hay making during the rainy season may be worth while (Yeshitila, 2008).

2.2.2 Silage Making

Silage-making is a fermentation process aimed at preserving forage in its wet state away from air and also is a management tool that allows producers to match feed resources (forages, crop residues, agro-industrial by-products, etc.) with feed demand for a dairy herd. The basic function of silage-making is to store and preserve feed for later use with minimal loss of nutritional qualities. Silage making, for farmers, is aimed at producing good quality, high energy and protein-rich conserved feed (Jatkauskas and Vrotniankiene, 2009).

Ensiling of both legume and grass forages is one of the major means of preserving forages for livestock consumption (Halling and Scholefield, 2001). It is a simple technique of conserving forages by compression, followed by airtight sealing (Danner *et al.,* 2003). Ensiling conserves forage biomass and its by products, together with their nutrients, by using either chemical or biological additives which rapidly reduce the forages pH to a low final pH (Dinić *et al*., 2010b).

2.2.3 Urea Treatment of Crop Residues

Urea treatment is important for improving nutritive value of cereal straws and stovers. It has been used in tropical and in developing countries. Straw treatment with urea has advanced from providing for maintenance to ward improvement of production. It is the ammoniating effect that improves nutrient content and intake of straw (Willie, 2001). Beyond improving the nutrient content, urea - molasses treatment with stands previous loss of crop residue and consequently save the bulk which leads to improved utilization of feed proper to the feeding calendar (Rehrahie and Ledin, 2001). The practice of straw treatment in Ethiopia was mainly concentrated on research stations level with little or no on-farm application. There is a need to demonstrate the technology under farmers' management with intention of developing a system which is both practical and easy for farmers adopt. (Rehrahie and Ledin, 2001)

2.3 Animal feeding practices in Ethiopia

Feeding of livestock in different places differs depending on forage availability, climatic variability of a given location or region to mitigate feed shortage problems during worse conditions, season of the year and type of animal the owner prioritize to feed (Beyene *et al*., 2011). The feeding systems in the country include communal or private natural grazing and browsing, cut and carry feeding, hay and crop residues. At present, in the country stock are fed almost entirely on natural pasture and crop residues. Grazing is on permanent grazing areas, fallow land and cropland after harvest (Tesfaye, 2008). Adane and Berhan, (2005) reported that the herbage yield and nutritional quality of natural pasture is generally low. In certain areas where improved forage crops have been introduced, farmers failed to utilize them at its optimum developmental stages, which would ensure an appropriate balance between quality and quantity to satisfy livestock requirements and support reasonable animal production (Taye, 2004). In the mixed crop-livestock systems of the Ethiopian highlands, the total feed resources available for livestock production come from permanent pastures and transient pastures between cropping cycles, crop residues and crop aftermath grazing. Forage obtained from crop thinning and defoliation from annual crops and perennial crops is important for livestock feeding (Tsige, 2000). However, these feed resources are high in fiber, with low to moderate digestibility and low levels of nitrogen (Tsige, 2000). Such low quality feeds are associated with a low voluntary intake, thus resulting in insufficient nutrient supply, low productivity and even weight loss (Hindrichsen *et al*., 2004).

2.4 Watering sources and frequency

Temporary surface water, ponds, rivers, streams traditional well hand dug wells like hand and bore holes are the main source of water for cattle in Ethiopia. In highland areas water sources of cattle is rivers, streams and temporary surface water both in dry and wet seasons. In all pastoral areas, temporary surface water and ponds are used in the wet seasons. Livestock watering frequency varies from season to season, species to species and accessibility of water sources. During the wet seasons most of the livestock are watered every 1-2 days. Belay *et al.* (2012) reported that in Ginchi area there are three water sources and these include rivers,streams and springs and majority of the households (98%) water their animals at river. On thesame report, during the dry season, when animals are herded, watering takes place almost all at rivers and streams and 80.3% of the respondents water their animals once in a day where as 19.7% twice a day.

3. MATERIALS AND METHODS

3.1 Description of study area

3.1.1 Location

The study was conducted in Loma district, located at 6°55′N and 7°01′30″N latitude, and 37°15′ E and 37°19′E longitude with at altitudinal range between 501 to 3300 masl. Loma is one of the administrative districts under Dawuro Zone of Southern Nations, Nationalities and Peoples Region Gessa is the district town and is found 457 km from Addis Ababa and 285 km from the regional capital city of Hawassa. The district is divided into 25 rural kebeles and 3 municipalities, totally 28 kebeles. The total land area is 56,340 ha, out of which 21,424.5 ha is crop land, 16,529.5 ha are covered with perennial crops, 1,797.125 ha are grazing land, 4,809 ha are forest land, 10,881 ha covered with bushes and undulation land and 898.875 ha are for urban construction purpose. The Agro – Ecology of the district comprise of 45.6% lowland (less than 1500 masl), 41.4% midland (between 1500 to 2300 masl) and 13% highland (greater than 2300 masl) out of the total land size of the district. The annual mean temperature ranges between 15.1 and 29.5°C and the annual mean rainfall ranges 900 to 1800 mm (LAR, 2013). Belg and Meher are the two cropping seasons, with the short and long rainy periods, respectively. Major crops grown are enset, wheat, pea, bean, teff, maize, sorghum, barley, potato, haricot bean, sweet potato and vegetables such as cabbage (LAR, 2013).

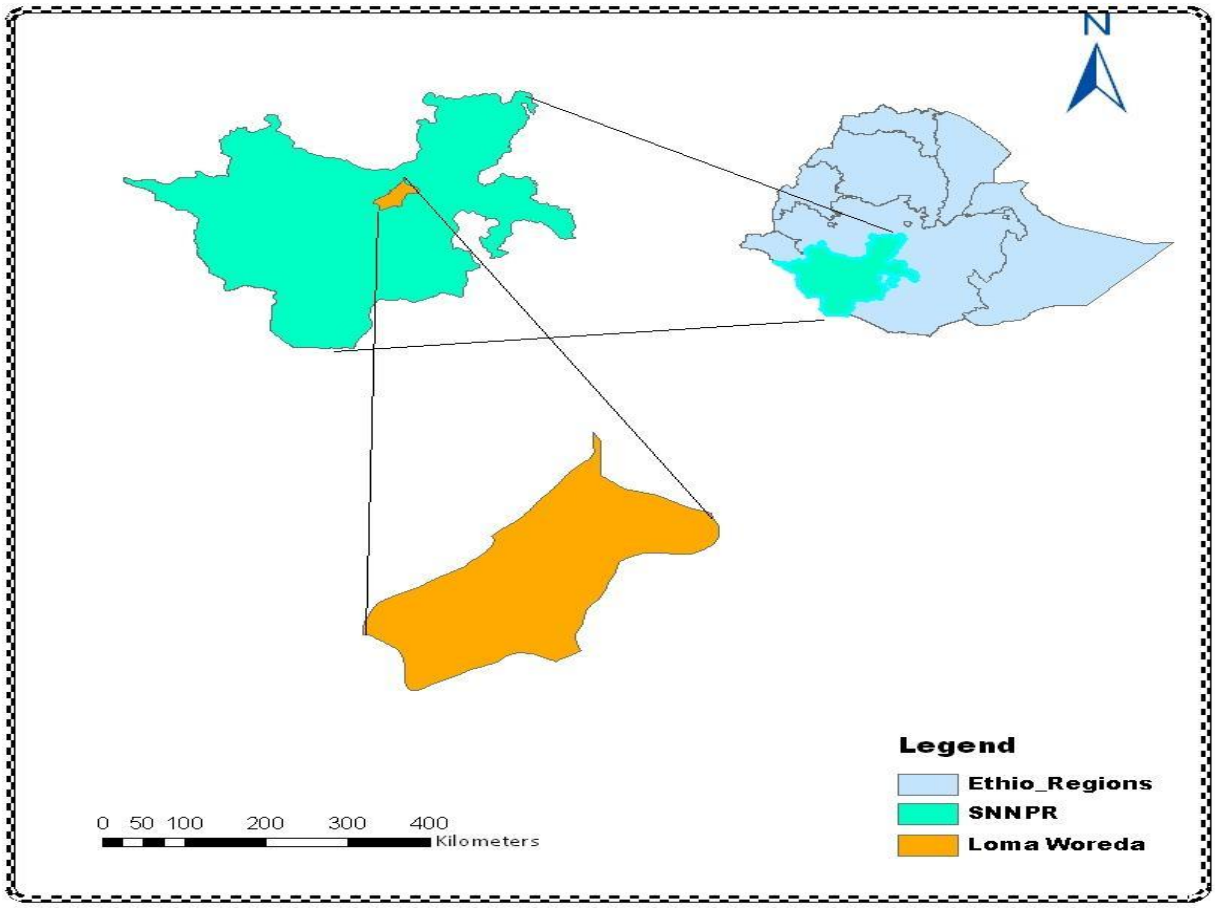

Figure 1: The study area map

3.2 Sampling and design

A single and multiple visits formal survey method was used to collect information on primary and secondary data. The Loma district was selected purposively because of large numbers livestock population, feed resource available and infrastructure. The district was stratified in to three agro-ecologies namely highland, midland and lowland agro-ecologic kebeles. For the study 7 kebeles were selected randomly based on secondary data provided like list of kebele (2 kebeles from highland, 2 kebeles from midland and 3 kebeles from low land) out of 28 total kebeles. Totally 385 farmers, 55 farmers from each kebeles was be purposely selected based on those having at least three livestock species. Both primary and secondary data were collected during the survey work, which was held from January 2021 to October 2021. Primary data were collected from sampled

households using structured questionnaires while secondary data were obtained from concerned governmental organization. The questionnaires were administered through house to house visit and directly interviewing farm families. The designs were involve cross-sectional study by applying formal survey, field observation, focus group discussion and key informants interview.

The sample size was determined using the formula recommended by Yamane (1967) for survey studies:

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

Where: N=total population of Loma district who rear livestock

n= sample size, and e= standard error of the proportion (5%) and the confidence interval of 95%.

3. 3 Data Collection procedure

Data collected during the survey include household characteristics, current production and utilization pattern of animal feeds at household levels, livestock characteristics, feed conservation methods, the potential of feed availability in the area, the trends of feed production in the area, and constraints related with animal feed. The questionnaire was translated in to local language, pre–tested and re-formed in such a way that interviewing households would respond without difficulty and biasness and then administered on study households' selected from farmers. Data were collected by the researcher, experts from district, and the development agents (DA) of kebeles after training.

3.4 Data Analysis

The data were managed and organized with Microsoft-Excel spread sheet (2007) and analyzed using Statistical Package for Social Sciences (SPSS) (version 21). Descriptive statistics (frequencies, chi-squires, percentage and means) were employed to present the data obtained from the household survey.

4. RESULTS

4.1 Household characteristics

Table 1 shows household characteristics of the respondents in the study area. The proportions of male headed households 57.3 % in highland 70.9% in midland and 52.1% in lowland with the overall male headed households being 59.0%. While 42.7%, 29.1 and 47.9% were female headed in high land, midland and in lowland agro ecology, respectively, with the overall female headed households being 41.0%. The mean age of the respondents was 54.9 for highland, 53.9 midland and 52.6 years for lowland agro ecology households. The overall mean age of respondents in the study area was 53.6 years. Out of the households included in the current study, Literacy status were about 20.0% 38.2% and 50.9% were illiterate in highland, midland and lowland agro ecology, respectively. About 32.7%, 30.9 and 23.0% of the households in highland, midland and in lowland attended read and write respectively. 22.7%, 18.2% and 18.2% of household in highland, midland and lowland agro ecology respondents were attended elementary school. Secondary school attended respondents were 16.4%, 9.1% and 5.5% in highland, midland and lowland respectively. The rest accounted for about 8.2%, 3.6 and 3.0% above secondary school highland, midland and lowland agro ecology respectively. The overall average family size in the study area was 6.17 persons per household. 5.65 for highland households, 6.03 and 6.61 midland and lowland person per household respectively.

Table 1: Household characteristics of the respondents'%

Variables	Agro ecology			Over all	X^2
	High land N=(110)	Midland N=(110)	Lowland= (165)	N=(385)	
Sex of respondents %					
Male	57.3	70.9	52.1	59.0	0.000***
Female	42.7	29.1	47.9	41.0	
Literacy status %					
Illiterate	20.0	38.2	50.9	38.4	
Read and write	32.7	30.9	23.0	28.1	
Elementary	22.7	18.2	17.6	19.2	0.000***
Secondary	16.4	9.1	5.5	9.6	
Above secondary	8.2	3.6	3.0	4.7	
Age of the household head(Mean ±SE)	54.9±0.73	53.9±0.76	52.6±0.67	53.6±0.40	
Family size per household (Mean ±SE)	5.65±0.12	6.03±0.13	6.61±0.01	6.17±0.72	

*The chi-square (x^2) value denoted significance difference between agro ecology *** (P<0.001), N=Number of respondents and SE=Standard error*

4.2 Farming system characteristics

4.2.1 Land holding and using pattern per household

Table 2 indicates average land holding per household and the use pattern in the study area. The overall mean of land using pattern in the study area were 3.45 hectare per household. The overall mean of crop land and grazing land per household of the study areas were 2.53 ha and 0.83 ha respectively. Land holding patterns of household in highland, midland and lowland agro ecology were 2.00 ha, 2.48 ha and 5.08 ha respectively. The average crop land holding per household was

1.40 ha, 2.27 ha and 3.46 ha per household in highland, midland and lowland agro ecology respectively. The average grazing land in highland, midland and lowland agro ecology was 0.46 ha, 0.64 ha and 1.20 ha respectively.

Table 2: Land holding (ha) and use pattern of the sampled households in study area

Variables	Agro ecology			
	High land N=(110) Mean ±SE	Midland N=(110) Mean ±SE	Lowland N=(165) Mean ±SE	Over all N=(385) Mean ±SE
Land holding pattern	2.00±0.35	2.48±0.40	5.08±0.41	3.45±0.76
Crop land	1.40±0.14	2.27±0.06	3.46±0.05	2.53±0.06
Grazing land	0.46±0.01	0.64±0.01	1.20±0.01	0.83±0.1

N=Number of respondents, SE=Standard error and ha =hectare

4.2.2 Livestock holding and composition

Livestock herd size and composition per household (TLU) are presented in Table 3. The average livestock holding per household in highland, midland and lowland was 5.31, 6.69 and 7.90 TLU respectively. The overall livestock herd size per household in the study area was 6.73. Cattle were the most important species in all agro ecology which can be seen from total cattle holding per household. Higher number of cattle and goat were kept in lowland agro ecology compared with the highland and midland ones. Whereas Highland agro ecology higher number crosses cattle, sheep and horse were kept than by than other agro ecology.

Table 3: Composition of livestock specious per household TLU

Livestock	Agro ecology			
	High land N =(110) Mean ±SE	Midland N=(110) Mean ±SE	Low land N =(165) Mean ±SE	Over all N=(385) mean ±SE
Cattle	2.12±0.09	2.80±0.12	3.50±0.12	2.91±0.08
Local cattle	1.75±0.01	2.42±0.12	3.40±0.12	2.64±0.08
Cross cattle	0.38±0.009	0.29±0.007	0.01±0.004	0.23±0.004
Sheep	0.04±0.002	0.36±0.012	0.11±0.006	0.27±0.009
Goat	0.008±0.001	0.27±0.009	0.41±0.008	0.27±0.008
Poultry	0.028±0.001	0.036±0.014	0.04±0.001	0.03±0.008
Donkey	0.27±0.006	0.06±0.003	0.43±0.004	0.02±0.003
Horse	0.60±0.006	0.29±0.004	0.04±0.001	0.28±0.002
Mule	0.12±0.003	0.20±0.004	0.00±0.00	0.08±0.001
Total livestock(TLU)	5.31±0.12	6.69±0.07	7.90±0.06	6.73±0.05

N=Number of respondents, SE=Standard error and TLU=Total livestock unit

4.2.3 Main farming activity, reason of keeping livestock and major source of income

Table 4 shows Main farming activity in the study areas. All respondents in the study area were responded that both crop and livestock farming are the main farming activity in all agro ecology. Cattle were kept for draught power 18.2%, 20.0% and 15.2% in highland, midland and lowland agro ecologies, respectively. Livestock kept for income were 37.7%, 34.5% and 36.4in highland midland and lowland agro ecology respectively. Respondents are responded about using livestock

for home consumption was 27.3%, 27.5% and 21.2% in highland, midland and lowland agro ecology respectively. Less number of households uses livestock for transportation purpose in highland 4.5%, in midland 3.6% and in lowland 3.0% some proportions of respondents were kept livestock as asset in highland, midland and lowland agro ecology 12.7%, 16.4% and 24.2% respectively. The overall mean of reason of keeping livestock in the study area were 17.4% for Crop cultivation like plouing and threshing, 36.1% for income generating, 24.2% for home consumption, 3.6% for transportation and 18.7% for asset. Both crop farming and livestock production was sourcesof income in the study area.

Table 4. Main farming activities, reason of keeping livestock and major source of income of the respondent's %

Variables	Agro ecology			Over all N=(385)	X^2
	High land N=(110)	Mid landN=(110)	Low land N=(165)		
Main farming activity					
Both crop and livestock farming	100	100	100	100	ns
Reasons of keeping livestock					
Crop cultivation (ploughing and threshing)	18.2	20.0	15.2	17.4	
Income generating (selling livestock and livestock products)	37.3	34.5	36.4	36.1	ns
Home consumption (Milk, milk by products, meat and egg)	27.3	25.5	21.2	24.2	
Transportation	4.5	3.6	3.0	3.6	
Asset	12.7	16.4	24.2	18.7	
Sources of income					
Both crop and livestock farming	100	100	100	100	ns

The chi-square (x^2) value denoted significance difference between agro ecology ^{ns} (P>0.05) and N=Number of respondents

4.2.4 Role of livestock

Table 5 shows that role of livestock in the study area. Cattle were used for crop cultivation purpose in all agro ecology. Incomes generated from cattle were 19.1%, 29.1%, and 24.2% in highland, midland and lowland agro ecology respondents as responded. The proportions of Small ruminants were used for income generating, 49.1% in highland, 51.8% in midland and 54.5% in lowland agro ecology of as reflected by the respondents. Chickens were playing a great role in generating income for respondents of highland 31.8%, midland and 19.1% and lowland agro ecology 21.2%. In highland, midland and lowlands of agro ecology cattle are uses for home consumption like producing (Milk, milk by products and meat) were 32.7%, 24.5% and 27.3% respectively. Role of small ruminant for home consumption (milk and meat) in the highland were 18.2%, in midland 20.0% and in lowland agro ecology 30.3% percent Equines were play great role for transportation in highland 56.4%, midland 48.2% and lowland 35.2%.

Table 5: Role of livestock in the study area%

Role of livestock	Agro ecology			Overall N=(385)	X^2
	High land N= (110)	Mid land N= (110)	Low land N= (165)		
Traction power(plough)					
Cattles	100	100	100	100	ns
Income generation					
Cattle	19.1	29.1	24.2	24.2	ns
Small ruminant	49.1	51.8	54.5	52.2	
Chicken	31.8	19.1	21.2	23.6	
Home consumption					
Cattle	32.7	24.5	27.3	28.1	
Small ruminants	18.2	20.0	30.3	23.9	ns
Chicken	49.1	55.5	42.4	48.1	
Transportation					
Equine	56.4	48.2	35.2	44.9	0.000^{***}

*The chi-square (x^2) value denoted significance difference between agro ecology ^{ns} (P>0.05) and *** (P<0.001), N=Number of respondents*

4.2.5 Livestock production constraints

Table 6. Show the livestock production constraints in the study area. The overall livestock production constraints in the study area were shortage of feed 54.0%, disease 17.1%, poor genetic potential 11.2%, marketing problem 9.6% and shortage of veterinary services. Respondents were responded that in all agro ecology, feed shortage followed by disease occurrences and poor genetic potential are the main livestock production constraints.

Table: 6 Livestock production constraints in the study area %

Livestock production constraints	Agro ecology			Over all	X^2
	High land N=(110)	Mid land N=(110)	Low land N=(165)	N=(385)	
Shortage of feed	50.9	52.7	57.0	54.0	
Disease	15.2	19.1	18.2	17.1	0.81^{ns}
Market problem	11.8	9.1	8.5	9.6	
Poor genetic potential	13.6	10.9	9.7	11.2	
Shortage of veterinary services	5.5	8.2	9.7	8.1	

The chi-square (x^2) value denoted significance difference between agro ecology ^{ns} (P>0.05)
N=Number of respondents

4.3 Feed resources and feeding system

4.3.1 Available feed resources in dry season

Table 7: The major feed resources available in dry season of the study areas is presented in Table 7. The major feed resources available in dry season were crop residues (50.0%), Natural pasture (18.8%), and crop after math (16.4%), hay (9.8%) and fodder tree (6.0%) in the study area.

Table 7: Feed resources availability in dry season in the study area

Feed resources availability in dry season	Agro ecology			Overall N=(385)	X^2
	Highland N=(110)	Midland N=(110)	Lowland N=(165)		
Natural Pasture	23.6	18.2	15.9	18.8	
Crop residue	54.5	55.5	43.3	50.0	0.03***
Hay	7.3	9.1	11.9	9.8	
Fodder tree	5.5	5.5	6.7	6.0	
Crop after math	9.1	11.8	24.4	16.4	

*The chi-square (x^2) value denoted significance difference between agro ecology and *** (P<0.05), N=Number of respondents*

4.3.2 Available feed resources in wet season

Table: 8 indicate major feed resources available in wet season of the study areas. The feed resources available in wet season were natural resources (44.9%), fodder tree (18.2%), and crop residue (16.6%), crop after math (11.2%) and hay (9.1%) used in the study area. Natural pasture was the major feed resources in all agro ecology of study area and also fodder tree was the second widely used in midland and lowland agro ecology whereas crop residue was in highland agro ecology.

Table 8: Feed resources availability in wet season in the study area%

Feed resources availability in wet season	Agro ecology			Overall N=(385)	X^2
	High land N=(110)	Mid land N=(110)	Low land N=(165)		
Natural pasture	45.5	50.0	41.2	44.9	
Crop residue	18.2	14.5	17.0	16.6	
Hay	15.5	7.3	6.1	9.1	
Fodder tree	11.8	17.3	23.0	18.2	0.08^{ns}
Crop after math	9.1	10.9	12.7	11.2	

The chi-square (x^2) value denoted significance difference between agro ecology ^{ns} (P>0.05) and N=Number of respondents

4.3.3 Seasonal variability of feed resources and feed calendar

Feeding calendars for different feed resources are indicated in Table 9. Natural pasture,improved forage and fodder trees were available from Junuary to December. A limited amount of natural pasture was available in the months of January, February and March. Crop residues were available from November to March in the study area. Enset leaves and stem was available from December to march months.

Table 9: Feed resources availability across the different months of the year in study area

Feed resources	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Natural pasture	✓	✓	✓	✓	*	*	-	-	*	✓	✓	✓
Teff straw	*	*	✓	✓	✓	✓	✓	*	*	*	*	*
Wheat straw	*	*	*	✓	✓	✓	✓	*	*	*	*	*
Barley straw	*	*	✓	✓	✓	✓	✓	*	*	*	*	*
Improved forage	✓	✓	✓	✓	*	-	-	-	*	✓	✓	✓
Crop after math	*	✓	✓	✓	*	*	*	-	-	-	-	-
Enset leaves and stem	-	-	-	-	✓	✓	✓	✓	-	-	-	-
Fodder tree	✓	✓	✓	✓	*	*	*	*	*	✓	✓	✓

- ✓ =the feed resource mentioned is available in the specified month/months ‑ = Unavailable, *= limited availability;

4.3.4 Grazing system

Table 10 show types of grazing system and feeding system in the study area. Continuous grazing system was practice widly in lowland than others agro-ecology, whereas zero grazing (cut and carry) system were lower in both midland and lowland compared with highland agro ecology. Higher numbers of respondents were adopted free grazing system in lowland agro ecology than others. Indoor feeding was widly practiced in highland than midland and lowland.

Table 10: Grazing system practices and feeding system in the study area %

Variables	Agro ecology			Overall	X^2
	High land N= (110)	Mid land N= (110)	Low land N= (165)	N= (385)	
grazing system practices					
Continuous grazing	4.5	10.1	55.8	28.8	
Rotational grazing	22.7	27.3	31.5	27.8	
Zero grazing(cut and carry)system	50.0	40.9	3.0	27.3	0.00***
Rotational and zero grazing	22.7	21.7	9.7	17.1	
Feeding system					
Indoor feeding	25.5	18.5	6.7	17.1%	
Group feeding	28.2	32.1	35.8	34.5	0.00***
Free grazing	46.4	49.4	57.6	48.3	

*The chi-square (x^2) value denoted significance difference between agro ecology *** (P<0.001) and N=Number of respondents*

4.3.5 Availability, adequacy and status of communal grazing land

Table 11 shows availability, adequacy and status of common grazing land in the study area. Common grazing land is more available in lowland than in mid and highland agro-ecology of the study area. In current study area have common grazing land but in terms of adequace, the grazing land is not adequate to animals. Similarly the grazing land status was currently decreasing. Almost

all farmers have a common grazing land in lowland area where as in the rest of agro ecology, have very small amount of common grazing land. These grazing lands were not adequate to their animals and the statuses of common grazing land were decreasing in all agro ecology. According to group discussion respondents told that reduction of communal grazing lands was caused by using the grazing lands for crop production; enclosures of vast areas as a result of severe overgrazing, land degradation, deforestation and higher number of livestock population compared with grazing land.

Table 11: Availability, Adequacy and status of common grazing land in the area

Variables	Agro ecology			Over all N=(385)	X^2
	High land N= (110)	Mid land N= (110)	Low land N= (165)		
Is their common grazing land in the area					
Yes	10.0	24.5	98	44.1	0.00***
No	90.0	75.5	2	55.9	
Is there grazing land adequate to your animal					0.00***
Yes	0.0	0.0	29.1	12.5	
No	100	100	70.9	87.5	
Status of common grazing land %					
Decrease	100	100	100	100	ns

*The chi-square (x^2) value denoted significance difference between agro ecology *** (P<0.001) and N=Number of respondents*

4.3.6 Coping strategies against feed shortage

Table12 show measure that was taken to alleviate feed shortage in the study area. The higher numbers of respondents used crop residue to alleviate feed shortage in the study area. Whereas very fewer households purchased concentrate feed to alleviate feed shortage in the study area. All of the respondents in lowland agro ecology used crop residues for their animals in order to

alleviate feed shortage whereas in high land and midland agro ecology 81.8% and 84.5% household were use crop residue to alleviate feed shortagere, spectively.

Table 12:Copping strategy to feed shortage in the study area %.

Measure you taken	Agro ecology			Over all N=(385)	X^2
	High land N= (110)	Mid land N= (110)	Low land N= (165)		
Purchase concentrate	18.2	15.5	0.0	9.6	0.00***
Uses crop residue	81.8	84.5	100.0	90.4	

*The chi-square (x^2) value denoted significance difference between agro ecology) *** (P<0.001), N=Number of respondents*

4.3.7 Improved forage production

Table 13 shows improved forage production in the study area. Majority (80.8%) respondents were can not produce improved forage for their animals whereas (19.2 %) were produce improved forage for animals in the study area. In highland, midland and lowland agro ecology (77.4%), (76.4%) and (86.7%) respondants coud not produce improved forage respectively. In highland, midland and lowland agro ecology 22.6 %, 23.6 % and 13.3 % respondents produce improved forage in the study area respectively. The majority of respondents (32.8%) had shortage of land to produce improved forage, followed by seed shortage (28.9%) and rain fall shortage (19.1%) in the study area. The reason for not plant improved forage in high land, midland were shortage of land (50.5%) and (42.5%) whereas in lowland agro ecology were shortage of rainfall (47.7%). Seed shortage was the second largest reason for not to plant improved forage in all agro ecology respondents of the study area.

Table 13: Improved forage production in the study area %

Variable	Agro ecology			Overall N= (385)	X^2
	High land N= (110)	Mid land N= (110)	Low land N= (110)		
Do you plant improved forage to your animals %					0.04**
Yes	22.6	23.6	13.3	19.2	
No	77.4	76.4	86.7	80.8	
Reason of not plant improved forage					
Land shortage	50.5	42.5	4.3	32.8	0.000***
Seed shortage	23.3	26.7	34.7	28.9	
Rainfall shortage	3.6	7.2	47.7	19.1	

*The chi-square (x^2) value denoted significance difference between agro ecology) *** (P<0.001), ** (P<0.05) and N=Number of respondents*

4.3.8 Animals feed conservation methods

Table 14 shows that animals feed conservation and conservation methods in the study area. Higher numbers of respondents were conserving feeds to their animals at period bulk feed production season in the study area. Crop residues were the dominant feed that conserved in all agro ecology.

Table 14: Animals feed conservation methods %

Variables	Agro ecology			Over all N=(385)	X^2
	High land N= (110)	Mid land N= (110)	Low land N= (165)		
Do you conserve feed for animals					ns
Yes	51	57	63	57	
No	49	43	37	43	
Methods of feed conservation					
Hay making	22	21.8	24.4	22.7	ns
In Crop residue form	29	35.2	38.6	34.3	

The chi-square (x^2) value denoted significance difference between agro ecology) ^{ns} (P>0.05) and N=Number of respondents

4.4 Crop residue

4.4.1 Major crop residue

Table 15: shows the major crop residue in the study area. The major crop residues in the study area were teff, maize and sorghum (57.9%), wheat and barley accounts (30.9%) and Very fewer respondents were plus crop residue (11.2%) in the study area. In lowland (87.3%) and midland agro ecology (52.7%) teff, maize and sorghum and wheat and barley straw (69.1%) used as major crop residue whereas wheat and barley straw the major crop residue in highland agro ecology.

Table 15: major crop residue in the study area

	Agro ecology			Over all	X^2
Major crop residue in the area	Highland N=(110)	Mid land N=(110)	Low land N=(165)	N=(385)	
Teff, maize and sorghum	19.1	52.7	87.3	57.9	
wheat and barley straw	69.1	29.1	6.7	30.9	0.000***
Pluse crop straw	11.8	18.2	6.1	11.2	

*The chi-square (x^2) value denoted significance difference between agro ecology) *** (P<0.001), N=Number of respondents*

4.4.2 Storege system of crop residue and utilization

Table 16 shows storege system of crop residue and utilization in the study area. Stacks under the shed were the most used storage system of crop residue in the study area and (42.9 %) of respondents were stack the crop residue outside the shed in current study area. Majority of respondents in highland (60.0%) and midland (68. 2%) agro ecology were stacks the crop residue outside the shed but in lowland agro ecology (85.5%) respondents were stock crop residue under the shed. Most of respondents, utilize the crop residue for feeding of the livestock and for house construction in the study area. Less number of respondents utiliz crop residues for fuel. Majority (65.5%), (65.5%) and (75.2 %) respondents use crop residue for feeding purpose in highland,

midland and lowland agro ecology, respectively. Higher number of households were utilize crop residue for house construction in highland and lowland when compeer to mid land.

Table 16: Storing system of crop residue and utilization in the study are %

Variables	Agro ecology			Over all	X^2
	High land N=(110)	Mid land N=(110)	Low land N=(165)	N=(385)	
Storeg system of crop residue					0.000***
Stacked open air	60.0	68.2	14.5	42.9	
Stacked under shed	40.0	31.8	85.5	57.1	
Crop residue utilization					
For feeding	65.5	65.5	75.2	69.6	
for fuel	18.2	8.2	3.0	8.8	0.000***
For construction	12.7	9.1	12.1	11.4	
For sale	3.6	17.3	9.7	10.1	

*The chi-square (x^2) value denoted significance difference between agro ecology) *** (P<0.001), N=Number of respondents*

4.4.3 Utilization of crop residue

Table 17 show utilization of crop residue and reason of not treating crop residue in the study area. The majority of respondents (80.8%) in the study area were not practicing chopping of crop residue while (19.2%) of respondents provide crop residue after chopping. Similarly most of respondents in highland; midland and lowland agro ecology have no trainis of chopping crop residue (74.5%), (83.6%) and (83.0) respectively. All of the respondent in the study area were not treating crop residue with urea molasses. Reasons of not treating crop residue in the study area were lack of molasses (45%),

Table 17: Crop residue chopping, treatment and reasons of not treating crop residue in the study area %

Variables	Agro ecology			Over all	X^2
	High land N=(110)	Mid land N=(110)	Low land N=(165)	N=(385)	
Do you chop crop residue					
Yes	25.5	16.4	17.0	19.2	0.14^{ns}
No	74.5	83.6	83.0	80.8	
Do you treat crop residue with urea molasses					
No	100	100	100	100	
Reason of not treating crop residue					
Lack of urea and molasses	8.80	13.7	11.5	11.3	0.85^{ns}
Lack of molasses	35.9	38.0	35.7	36.5	
Lack of awareness	12.2	15.2	18.1	34.8	
Lack of interest	17.3	16.7	17.6	17.4	

The chi-square (x^2) value denoted significance difference between agro ecology) ns (P>0.05) and N=Number of respondents

4.5 Hay production and its sources

Table18 shows hay production and sources in the study area. Majority of respondents 74% were not practices hay production where as 26% were practice hay production the study area. 10%, 21% and 47% of respondents were produce hay in highland, midland and lowland agro ecology study area respectively. 12.5%, 10.5% and 3.0 % of respondents were produce hay from communal grazing land, private grazing land and cultivated land boundaries in the study area. Majority of respondents in lowland agro ecology used communal grazing land whereas private grazing was highly used in highland and mid land agro ecology.

Table 18: Hay production and it sources in the study area

Variables	Agro ecology			Over all	X^2
	High land N=(110)	Mid land N=(110)	Low land N=(165)	N=(385)	
Are you produce hay					
Yes	10	21	47	26	ns
No	90	79	53	74	
From where do you produce hay					
Private grazing land	5.2	12.2	14.0	10.5	0.000***
Communal grazing land	2.1	4.5	30.9	12.5	
Cultivated land boundaries	2.7	4.3	2.1	3.0	

*The chi-square (x^2) value denoted significance difference between agro ecology) ns (P<0.05), *** (P<0.001) and N=Number of respondents*

4.6. Water sources and watering frequency in the study area

Table 19 indicates water sources, types of water and watering frequency for livestock in the study areas. Spring water was the major sources of water in the highland and midland agro ecology where as rivers are mainly used by the households of lowland agro ecology. Individual watering system was used mainly in highland and midland respondents, group watering system were mostly used in lowland agro ecology households. Households who live in highland agro ecology were providing water mainly once a day whereas the majority of the households in the midland provide twice a day. Lowland respondents provide water for their livestock free choice.

Table 19 sources of water, types and frequency of watering of respondents' %

Variables	Agro ecology			Over all N=(385)	X^2
	High land N=(110)	Mid land N=(110)	Low land N=(165)		
Sources of water					
River	19.1	11.8	60.6	34.8	0.00***
Spring	54.5	68.2	15.8	41.8	
Pond	26.4	20.0	23.6	23.4	
Types of watering system					
Group watering	32.7	26.4	77.6	50.1	0.000***
Individual watering	58.2	50.9	9.1	35.1	
Group and Individual watering	9.1	22.7	13.3	14.8	
Frequency of watering					
Once a day	62.7	19.1	9.1	27.3	0.000***
Twice a day	30.9	71.8	18.8	37.4	
Free choice	6.4	9.1	72.1	35.3	

*The chi-square (x^2) value denoted significance difference between agro ecology) *** (P<0.001) and N=Number of respondents*

5. DISCUSSION

5.1 Household Characteristics

The higher male respondents compared with female, the proportion of female headed household in the present study was lower than the 47.7% for Hawassa town (Haile *et al*., 2012) and it was higher than the finding of Assefa *et al*., (2013) and Azage (2004) who reported that, the majority (85% and 67%) of the respondents were male household heads in Adami Tullu Jiddo Kombolicha District and in Addis Ababa, respectively. Education plays great role in transferring technology and in initiating farmers' willingness to adopt different technologies. The high percentage of illiterate compared to the other categories can hinder in the adoption of agricultural technologies in the study area. Similar finding was reported by Yisehak *et al*., (2013), in three districts of Jimma zone Southwest Ethiopia. In midland and lowland agro ecology farmers are forced to stop education at elementary school mostly because of distance from school and other socioeconomic factors like wealth difference of the farmer. Highland agro ecology respondents were better educated than midland and lowland agro ecology respondents. The average age of the sampled households in this study was 53.6 years. This result is higher than the report of Solomon (2004) (42.18 years). Age of the respondents in highland agro ecology was higher than lowland and midland agro ecology respondents. In the lowland and midland agro ecology, the average family size was relatively higher than highland agro ecology and this might be due to difference in farming systems and family planning program among farmers. The overall average family size in the current study area was 6.17. It is very close the report of Terefe (2007) (6.68 persons). The average family size of the respondents in current study is higher than national average family size of rural areas (4.9) per household (CSA, 2011) and lower than Solomon (2004) (8.73 persons per household) for the Bale highlands.

5.2 Farming characteristics

5.2.1 Land holding and use pattern of household

The overall mean of land using pattern in the study area were 3.45 hectare per household. In current study finding farmers who lives in the lowland agro ecology had more landholding per household than those farmers living in the highland and midland agro ecology. The land allocation differences in this agro ecology might be due to differences in the size of the land and farming system. The land holding in the current study was in line with the report of (Yadessa *et al.*, (2016). This figure is higher than the figure reported by IPMS (2007) in Burie District and Asrat *et al*. (2013) in Boditti area. The amount of crop land and grazing land in current study was 2.53 ha and 0.83 ha per household respectivly. This finding was higher than finding of Bedasa (2012) reported that the amount of land size allocated for crop production was 1.7 ha and grazing land was 0.4 ha in Jeldu district west shewa zone. Lowland agro ecology respondents had highest land size, than midland and highland agro ecology respondents. Similarly the size of crop land and grazing land in the lowland agro ecology were highest than both midland and highland agro ecology. This is might be due to higher number population found in highland and midland agro ecology.

5.2.2 Livestock holding

The overall livestock herd size per household in the study area was 6.73 TLU per household. Current study finding were higher than finding of Asrat *et al*. (2013) for cattle in Delbo (3.9) and lower than finding of Gashaw (1992) (10.6 TLU) for the Selale area, Solomon (2004) (10.09 TLU) for the Bale highlands. This higher value may be due to higher pasture landholding in the study area. The number of the different livestock species owned per household was comparatively highest at lowland agro ecology than midland and highland agro ecology in current study area. The

livestock size variation per households in different agro ecology areas might be due to the difference in household land holding, variation in human population density and existence of grazing land. The livestock species raised in the study areas include cattle, goat, sheep, chicken, donkey, horse and mule. Cattle followed by horse, sheep, goat and chicken are the dominant species raised by majority of the surveyed households in the study area. Households found in lowland agro ecology had highest in (TLU) of cattle, goat, poultry and donkey. Whereas the average crosses cattle breed and horse holding number in the highland agro ecology which is reared was higher than that in the other agro ecology. which may be attributed to the easy access opportunity for the necessary input such as veterinary and aritificial insemination services and better access to market available in the highland areas. Similarly mule and sheep were higher in midland agro ecology than others.

5.2. 3 Main farming activity, Purpose of keeping livestock and major source of income

Both crop and livestock productions are the main farming activity and sources of income in the study area, both are complementary. Livestock provides power for land preparation and crop transportation after harvest and manure as fertilizer, while crop by-products represent an important source of animal feed. The current finding is in agreement with Teshager Ayalew (2013), who reported that HHs incomes were obtained from both crop and livestock in Ilu Aba Bora zone of Southwest Ethiopia and Yisehak *et al.* (2013) in Jimma zone of Southwest Ethiopia. In current study all respondents in highland, midland and lowland agro ecology practice crop and livestock production as main farming activity. Livestock generate income for the farmers directly by selling the animal or through the production of milk and milk products and hides and skins. Majority of respondents in lowland agro ecology were keeping livestock as asset next to income generation.

5.2.4 Role of livestock

Livestock are used as sources of draught power, milk, meat and manure, which are analogous to the assessment results of Alemayehu *et al.,(*2000). Small ruminants were the most important livestock species generating income for respondents in the study area. This finding is in agreement with the report of Dhaba *et al*. (2012) who indicated that about 53% of the respondents keep small ruminant in Ilu Abba Bora, Ethiopia for income generation. Chickens and cattle were playing a great role for home consumption and income generation in the current study area. Chickens meat, egg, cattle milk and milk by products were used for home consumption. In the current study, chickens are the source of income and used to home consumption in all agro ecology of the household. Higher numbers of midland agro ecology respondents were used chicken for home consumption compared with other agro ecology. Current finding was in line with finding of Dereje and Tesfaye (2008),who indicated that almost all the respondents in Western Harerghe kept poultry for income generation and home consumption. Equines (donkeys, horses and mules) are the most valuable pack animals for transportation of people and other goods in many parts of the study area especially where other means of transportation are not available. In current finding highland agro ecology respondents were uses equines for transportation purpose than respondents of other agro ecology.

5.2.5 Livestock production constraints

The results show that feed shortage is the major constraint identified by most of the respondents. Farmers indicated that increment in crop land at the expense of grazing land and this lead to shortage of land for forage production. which it might be shifting of grazing land into crop cultivation has lose the potential of the livestock in the area and also put immense pressure on the existing land. The observations are in agreement with that of (Dawit *et al.,(*2013);and (Teshager *et*

*al.,(*2013). Other livestock production constraints in the study area were next to feed shortage, disease occurrence, poor genetic potential, market problem and shortage of veterinary services. The most prevalent diseases reported in the area include Triopnosmiases, pasteurellosis, blackleg, mastitis, parasite and anthrax. The interaction of these constraints affects the overall livestock productivity in the area. This is in agreement with work of Zemenu *et al*., (2014) and (Solomon 2006).

5.3 Feed resources and feeding system

5.3.1 Available feed resources

During the group discussion, it was piercing out that natural pasture, crop residues, and some improved forages are major available feed resources. This finding is in agreement with the report of Zinash *et al. (*1995) and Terefe (2007) for the Ethiopian central highlands. In general natural pasture and crop residues are the major feed resources. Crop residues from cereals like maize, teff, wheat, barley and pulse crops were feed resource in the area. The importance of natural pasture and crop residue in this study is in agreement with report of Adugna *et al.* (2012), Ahmed *et al*. (2010) and Belay *et al. (*2012) who worked on natural pasture assessment in the central zones of Ethiopia, in the central highlands of Ethiopia and in Dandi district, respectively. It was generally accepted by all respondents that there is seasonal shortage of feed resources in the study areas. The crop residues, natural pasture and crop aftermath in the current study were the major feed resources for dry season, in their descending order of study area. The result in this study is agreement work of Tolera *et al.(*2012) and Seyoum *et al.*(2001) who reported that the major feed resources for cattle in the highlands of Ethiopia are crop residues and natural pasture stubble grazing. Contrary to the current study, Tesfaye (2008) reported that the major dry season feed resources for cattle in Metema district were natural pasture (55.7 %), crop residues (20.7%),

stubble (14.3 %) and hay (9.3 %) and which due to agro- ecological differences between the study areas. Crop aftermath was highly available feed resources in lowland agro ecology compared with other agro ecology in dry season. Natural pasture was the major feed resources in wet season of all agro ecology in study area. The finding was in line with Tesfaye (2008) reported that in wet seasons, all the respondents in the three agro ecology zones use natural pasture and to some extent hay and crop residues to feed their animals. In current finding fodder tree was the second widely used in midland and lowland agro ecology whereas crop residue was in highland agro ecology.

5.3.2 Grazing and feeding system

Current finding showed that majority of respondents were practicing continuous grazing system in the studded area. This finding was in line with the finding of the Getachew *et al*.(2015) who indicated that the highest (62.2%) percentage of respondents practice continuous grazing system in Meta-Robi District West Shewa Zone, Oromiya Regional State, Ethiopia. but it was lower than reported in Jeldu district 94.5, 4.4 and 1.1% of the respondents practiced let to graze, cut and carry and tethering (Bedasa, 2012). The difference were might be due to livestock owners followed different feeding systems for efficient utilization of the available feeds and the accessibility of the grazing land. Highest proportions of respondents were practicsed livestock feeding management system were let to grazing their livestock followed by group feeding and indoor feeding system in the current study area. The finding was agreement with Getachew *et al*. (2015) who reported that livestock feeding management was based predominant on let to grazing system in most part of the extensive and smallholder crop–livestock farming systems in Ethiopia. There was significance difference ($P<0.001$) in feeding system of livestock between current study area. A respondent in highland and midland agro ecology reveals indoor feed system compared with lowland agro

ecology respondents, whereas in lowland agro ecology let to graze feeding system was more practiced.

5.3.3 Availability, adequacy and status of common grazing land

Majority of the respondents in current study area have common grazing land but in terms of adequace, the grazing land is not adequate to animals. Similarly the grazing land status was currently decreasing. This is in agreement with Agajie *et al.* (2001) who reported Smallholder livestock production systems and constraints in the highlands of North and West Shewa zones and the declining communal grazing lands due to expansion of farm land as major reasons for Shortage feed and drop in livestock productivity. These grazing lands were not adequate to their animals and the statuses of common grazing land were decreasing in all agro ecology. According to group discussion respondents told that reduction of communal grazing lands was caused by using the grazing lands for crop production; enclosures of vast areas as a result of severe overgrazing, land degradation, deforestation and higher number of livestock population compared with grazing land.

5.3.4 Livestock feed shortage and coping mechanisms

Farmers' adopted coping strategies with dry season feed scarcity were increasing use of crop residue. The largest proportion of crop residues was used for livestock feeding in the critical shortage of livestock feed during the dry season in current study area. The main season with livestock feed deficiency in the current study area started from the end of January to the beginning of May which is in line with reports for highland of Ethiopia (Yami *et al.,* 2015). The feed shortage problem during dry seasons in the study area is related with moisture stress that resulted in low herbage growth on existing grazing land (Ashenfi *et al.,* 2013). Crop residues which are serving as the main source of roughage during dry season (Mekasha *et al*., 2014; Salo *et al*., 2017)

are low in their nutrient content (Deribe, 2015). Jayasuriya (2002) reported that when smallholder farmers in developing countries faced with limited feed availability for feeding livestock they use what is locally available to them, at either no or low costs. None of the respondents were purchases feeds, to alleviate shortages of feed in lowland area whereas highland and mid land area very small numbers of respondents were purchases concentrate feed to tolerate feed shortage. Current study finding disagree the finding of Duguma and Janssens, (2016) Farmers' adopted coping strategies with dry season feed scarcity were increasing use of agro-industrial by- products and concentrate mix (87 %), increasing use of conserved hay (74.13 %), increasing use of non-conven- tional feeds (50 %), purchasing green feeds when avail- able (14.8 %) in Assessment of feed resources, feeding practices and coping strategies to feed scarcity by smallholder urban dairy producers in Jimma town. The difference is might be due to availability of agro industrial by products and livestock production system.

5.3.5 Improved forage production

Improved forage production is believed to overcome feed shortage but is constrained by many challenges including small land holding, lack of forage seeds, and limited knowledge on forage species and their rain fall shortage. This situation was exacerbated by absence of improved forage seed provision and transfer system in the current study area. In contrary to report for Anelemo district (Salo *et al*., 2017) and Robi district (Yadessa, 2015), in which land was primary constraint, forage seed/planting material shortage was the secondary constraint followed by land shortage and lack of awareness. In current finding about most of farmers did not grow improved forages while the rest (19.2%) cultivated few forage species such as elephant grass, desho grass, Sesbaniya, green leaf desimodum, lucenia and oat for feeding of livestock in the study area. Current study finding was higher than the finding of Ajebu *et al*. (2016) farming system and

shifting cultivation in Abobo woreda, Gambella Regional State. Higher numbers respondents were practice cultivate improved forage production in midland and highland respondents compared with lowland respondents, which could be varied due to the availability of forage seed and rain fall in highland community.

5.3.6 Animals feed conservation methods

Majority of the respondents in current study area were practices animal feed conservation for dry season. Farmers in lowland agero ecology had better traneds in feed conservation than compared with that of highland and midland farmers. Current study finding was higher than the finding of hussen *et al*. (2016) reported that 31.85% of respondents was practice feed conservation in Jimma Zone, Southwest Ethiopia. Crop residues was the dominant types of feed that was conserved by most of the household followed by natural pasture hay in current study area. This is due to the better crop production presences in the study area. There was no silage making practices in all agro ecology of current study area, which may be due to lack of awareness mainly linked with in adequate extension services.

5.4 Crop residue

According to Tsegaye *et al.* (2008), shortage of grazing lands and the absence of alternative feed resources emphasize the increased dependence on crop residues in the central highlands of Ethiopia. Crop residues which are serving as the main source of roughage during dry season (Mekasha *et al.*, 2014; Salo *et al.*, 2017) are low in their nutrient content (Deribe, 2015). Present study result indicated those teff, maize and sorghum crop residues were majorly used for fed livestock in the study area followed by wheat and barley crop residue. This result is similar with the report of Dereje and Tesfaye (2008) who described that different feed resource such as stover of maize and sorghum on field are used for cattle fattening especially during the dry season where

feed shortage is more sever. Very small numbers of respondents were providing pulse crop straw for animals in current study area. There was a significance difference between the study area ($P<0.001$) in major crop residue. Farmers lives in the two agro ecology (lowland and midland) the major sources of crop residue was teff, maize and sorghum, whereas wheat and barley straw was the most important crop residue in highland area. This finding was in line with the finding of Solomon and Alemu (2009) reported that teff, wheat and barley straws were the major crop residues available in the highlands. This is due to the most cultivated dominant crop in midland and lowland was teff, maize and sorghum and also wheat and barley was majorly select to grow in highland agro ecology. Moreover, farmers reported that crop residues are mainly fed during feed shortage.

5.4.1 Storing system of crop residue and utilization

Storage of crop residues is important to utilize the available residue efficiently during the time of feed shortage. All farmers store the crop residue and thus decreased feed shortage. In all agro ecology systems the storage practice of crop residues is under taken either stacked in the open air near the homestead or under the shade. It was found that the majority of the sampled households (57.1%) in the current study area stocked under the shed. Rest of respondents was store feed outside the shed or open air. It is agreement in the finding of Tesfaye and Chairatanayuth (2007) reported the major storing crop residues stocked under the shed in East shewa zone and disagree with the Works of Mulugeta, (2005) in Yarer area reported that about 91% of the farmers stored crop residues outdoor. Majority of respondent store a crop residue outside the shed in highland and midland whereas majority lowland respondents stocked crop residue under the shed in current study. Crop residues was used as major sources of livestock feed in the studed area. In focal group discussion the respondents were discussed about the contribution of crop residues as livestock feed

depends on proper collection, handling, processing, and storage. There was a well-established practice of crop residue conservation for livestock. However, baling crop residues was totally unknown and stacking loose straws into heaps was the sole traditionally adopted handling and storage of the crop residues to extend their use as feed. Such a practice may lead to losses in both biomass and nutritional quality during collection, transportation, storage and feeding. Baling crop residues is not only convenient and reduces cost of transportation, but also helps to reduce the space required for storage and facilitates feed budgeting as compared to the traditional handling of crop residues in loose form (Massawe and Mruttu, 2001). Farmers reported that crop residues are mainly fed during the dry season. However, small amounts of crop residues are used for house construction particularly for plastering of walls and thatching of roofs and also sold as an income source in current finding. This finding is in agreement with Yeshitila *et al.* (2008) who reported that all feed resources produced, crop residues alone accounted 68.7% of livestock feed supply.

5.4.2 Improvement of nutritive value of crop residue

Number of practices are suggested and to some extent experimented in Ethiopia to treat crop residues to improve its palatability and digestibility. Amare *et al*. (2011) and Descheemaeker *et al*. (2011) already demonstrated that crop residues management like chopping and urea treatment improves the feed quality. Smith (1993) also listed chopping, grinding, and treatment with urea as the most appropriate methods of improving the feed value of crop residues at the smallholder level. Hence, untreated crop residues may reduce the quality of available feed for livestock. Chopping of large cereals maize and sorghum was observed in small number of farmers in current study finding. In surveyed household most of farmers have no trained of chopping crop residue. In the focal group discussion time most respondents answered that the reason they not chopping crop residue were lack of interest. Because of molasses unavailability and lack of interest, all of the

respondent in the study area were not treat crop residue. This finding was agrees with Lemma *et al.* (2003).

5.5 Hay production and its sources

Hay making in farming, being prepared for more difficult times is essential. One of the things a smallholder livestock farmer can do is to prepare enough animal feed for the dry or cold season. Turn forage into hay to make sure enough high-quality feed the whole year round. The current study indicated that majority of respondents in the study area do not make hay. Higher numbers of respondents in lowland agro eology were produce hay compared with other agro ecology. This is might be due to avialality of natural pasture, crop residue and low trand on hay production in the the study area. Communal grazing land was the first sources hay production in lowland agro ecology whereas private land was the major source of hay production in midland and highland area. This is might be avaliablity of common grazing land in lowland agro ecology, it can be shows producing hay from communal grazing land.

5.6 Water sources and watering frequency in the study area

The main sources of water in the study area were spring which disagree the finding of Belay *et al.*(2012) who reported that in Ginchi area there are three water sources and these include rivers,streams and springs and majority of the households (98%) water their animals at river. This might be rivers were available in low altitudes and, in high altitude the presences of spring mostly at wet season. Most of the respondents in the study area were practiced group watering system followed by individual watering system. There is significance difference ($p<0.001$) in types of watering system in the studded area. Majority of respondents in lowland agro ecology watering the livestock in group and the rest of agro ecology respondents provide water for the livestock individually.

Watering frequency of livestock was varied from one agro-ecology to the others. In highlandlivestock has been believed to be watered every other day. However, the lowland area was relatively enriched with water source.Presences of river in the lowland area the farmers watering their livestock free choice. So most of the farmers in themidland watered their animals twice a day, only very small number of them water once in a day. Present study revealed that watering frequency wastwice in a day (37.4%), *ad libitum* (35.3%) and one in a day (27.3%). This result was lower than findings of Belay *etal.*(2012) 52.2% of the respondents were watering their animals twice a day, 38.9% once a day and 7.8% *ad libitum*.

6. CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

Natural pasture and crop residues were the most important feed resources avialabily in wet and dry seasons respecatvily. All most all farmers were dependants natural pasture and crop residues. Shortage of feed were the main constraint of livestock production due to increased human population, intensification of crop land and over grazining,farmers were uses crop residue and purchasing concentrate feed in order to allivate feed shortage problem for the livestock. Improved forage production and availability of agro industrial by products is inadequate in the study area. Shortages of land, improved seed and rain fall shortage were the challenges of improved forage production in the study area. Farmers were majorily practices continuous grazing system due to presences of natural pasture especially in lowland agro ecology. There is an availability of common grazing land in the area but it is not adequate for their animals and currently in case intensive crop production the grazing land were decreasing. Conservation of livestock feed were the most important strategy to solve feed shortage in dry season. Crop residue and hay was the most conserved feeds and they can be stored stocked under the shed in the area. Feed treatments were useful to improve palatablity of roughage feed, increase digestability and increase feed intake. With lack of feed improvement techinplogies and interest farmers were not utilize crop residue with chopping and treating. Spring water, river water and pond water were the main water sources in the tudy area.

6.2 RECOMMENDATION

- The adoption of tree legume forages as live fences, use of urea-molasses-blocks and increased conservation and proper storage of hay, and utilization of the locally available crop residues could be of importance in alleviating feed shortage.
- Training and demonstration of the feeds and feeding technologies; feed conservation strategies, crop residue management and utilization options, improved forage cultivation strategies needs a special focus.
- Awareness creation on the production and use of improved forages should be done by Development Agents in each kebeles. Government should encourage farmers in order to use different options such as utilization of non-conventional feeds, forages development program, use of irrigation, alternative means of crop residue utilization and conservation practices.

7. REFERENCE

Abebe, M., 2008. Multipurpose fodder trees in Ethiopia: Farmers' perception, constraints to adoption and effects of long term supplementation on sheep performance. PhD thesis, Wageningen University, Wageningen, the Netherlands.220p.

Adane, K. and Berhan, T., 2005. Effect of harvesting frequency and nutrient levels on natural pasture in the central high lands of Ethiopia. *Trop.Sc.* 45:77-82.

Ahmed H, Abule E, Mohammed K, Tredate AC (2010) Livestock feed resources utilization and management as influenced by altitude in central highlands of Ethiopia. Livestock Dev2 (12):125–132.

AgajieTesfaye, ChilotYirga, AlemayehuMengistu, Elias Zerfu and Aster Yohannes. 2001. Smallholder livestock production systems and constraints in the Highlands of North and West Shewa zones. In: Livestock in Food Security – Roles and Contributions. In: Proceedings of the 9th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 30-31 August 2001. ESAP, Addis Ababa, Ethiopia.

Alemayehu M (2004). Rangelands biodiversity conservation, management, inventory and Monitoring.Addis Ababa University, faculty of science, Addis Ababa, Ethiopia.103 p.

AlemayehuM(2006). Country Pasture/Forage Resource Profiles: Ethiopia. Accessed on 05/01/2009 from http:// www.fao.org/AGp/agpc/doc/counprof Ethiopia.htm.

Alemayehu, M., 2003. Country pasture/Forage resources profiles: Ethiopia. FAO web site: http://www.fao.org/ag/agp/agpc/doc/counprof/ethiopia/ ethiopia.htm.

Ashagre, A., 2008. Effect of Nitrogen Fertilizer and harvesting stage on yield and quality of natural pasture in Fogera district, North western Ethiopia. An MSc. thesis submitted to the School of Graduate studies HaramayaUniversity.94p.

Assefu, G., 2012.Comparative Feedlot Performance of WasheraAndHorro sheep fed different roughage to concentrate ratio. An MSc. thesis submitted to the school of graduate studies Haramaya University.129p.

Belay Duguma and Geert Paul Jules Janssens. (2016)Assessment of feed resources, feeding practices and coping strategies to feed scarcity by smallholder urban

dairy producers in Jimma town, Ethiopia,SpringerPlus (2016) 5:71740064-016-2417-9

Benin, S., Ehui, S. and Pender J., 2004. Policies affecting changes in ownership of livestock and use of feed resources in the highlands of northern Ethiopia. *Journal of African Economies*, 13:166-194.

Benin, S., Ehui, S. and Pender, J., 2003.Policies for livestock development in the Ethiopian highlands. Environment Development and Sustainability, 5: 491-510.

Beyene, T., Tegene, N. and Ayana, A., 2011.Effect of farming systems on livestock feed resources and feeding systems in Benishangul-Gumuzregion,western Ethiopia. *International Research Journal of Agricultural Science and Soil Science*, 1(1):020-028.

BizelewGelayenew, AjebuNurfeta, GetnetAssefa&GetahunAsebe. (2016)Assessment of Livestock Feed Resources in the Farming Systems of Mixed and Shifting Cultivation, Gambella Regional State, Southwestern EthiopiaGlobal Journal of Science Frontier Research Volume (D)XVI Issue version I,p 11-20.

CSA, (2012) Federal democratic Republic of Ethiopia. Central Statistical Agency.Statistical Abstract (CSA), Addis Ababa, Ethiopia.

CSA,(2013). Statistical Abstract.120p.

CSA (2008). Livestock and livestock characteristics, agricultural sample survey. Volume II, Statistical Bulletin.446, 188p.

Danner, H.et al.(2003) Effect of acetic acid on the aerobic stability of silages.Appl. Environ. Microbiol.69, 562 – 567

Dinić, B., Dordević, N., Andelković, B., Sokolović, D. Terzic, D. (2010b).Management of the fermentation process in ensilaged livestock feed. Biotechnologyin Animal Husbandry 26 (1-2): 105-115.

Halling M, Scholefield D (2001) Correlation between yield of forage legumes in grass mixtures and accumulation of soil mineral nitrogen in Sweden. In: Proceedings of the XIX International Grassland Congress, Brazil, 2001: 109-111

Hindrichsen, I.K., Osuji, P.O., Odenyo, A.A., Madsen, J., Hvelplund, T., 2004.Effect of supplementation of maize stover with foliage of various tropical multipurpose trees and *Lablab purpureus*on intake, rumen fermentation, digesta kinetics and microbial protein supply of sheep.*Anim. Feed Sci. and Technol*. 113: 83-96.

Jatkauskas, J. and Vrotniakiene, V. (2009).The influence of application of a biological additive on the fermentation and nutritive value of lucerne. Zemdirbyste-Agriculture 96 (4):197-208.

LAR (2013).Loma Administrative Annual report.LomaWoreda Administrative Agricultural office annual report.Gessa. Ethiopia. 24p.

Legesse, G., 2008. Productive and economic performance of small ruminants in two production systems of the highlands of Ethiopia.PhD Dissertation, University of Hohenheim, Stuttgart,Germany.

Lemma, G., 2002.Crude protein and mineral status of forages grown on PellicVertisols of Ginchi, Central Highlands of Ethiopian.PhD.Thesis.University of Sree State Bloemfontein.147p

Lemma, G., 2002.Crude protein and mineral status of forages grown on PellicVertisols of Ginchi, Central Highlands of Ethiopian.PhD.Thesis.University of Sree State Bloemfontein.147p

Mathewos A (2008). Ethnobotany of Spices, Condiments and Medicinal Plants in Loma and GenaBosaWoredas of Dawro Zone, Southern Ethiopia. A Thesis Submitted to the School of Graduate Studies in Addis Ababa University in Partial Fulfilment of the Degree of Masters in Biology (Dryland Biodiversity). 120p

MekonnenYirga and Ali Seid. 2013. Enhancing communities' adaptive capacity to climate.

Melese, G., Berhan, T. and Mengistu, U., 2014. Effect of Supplementation with Non-Conventional Feeds on Feed Intake and Body Weight Change of Washera Sheep Fed Urea Treated Finger Millet Straw. *Greener Journal of Agricultural Sciences*, 4(2): 067- 074.

Mergia A, Adugna ,T and Getnet,A. 2014. Feed resource assessment and utilization in

Baresa watershed. International Journal of Science and Research, ISSN; 2319-7064.Sciences), Vienna, October 2008.

Rehrahie M and Ledin I 2001 Effect of feeding urea treated teff and barely straw based diets to crossbred dairy cows on feed intake, milk yield, milk composition and economic benefits. Livestock Research for Rural Development, volume 16, Number 12. Retrieved on 2010 from http://www.lrrd.org/lrrd9/5/pak951.htm

Seyoum, B., Getnet, A., Abate, T. and Dereje, F., 2001. Present Status And Future Direction In Feed Resources and Nutrition Research Targeted For Wheat Based Crop-Livestock Production Systems In Ethiopia. In: Wall, P.C. (ed.). Wheat and Weeds: Food and Feed. Proceeding of two stockholder workshops. Mexico City. Mexico. pp 205-226.

Solomon, B., Solomon, M. and Alemu, Y., 2008a.Potential use of crop residue as livestock feed reduces under small holder farmers conditions in Bale high lands of Ethiopia. *Tropical and subtropical Agro ecosystems*, 8(1):107-114.

Taye, B., 2004. Effect of Days of harvesting on yield chemical composition and In vitro organic matter digestibility of Pennisetumpurpureum sole or intercropped with Desmodiumintortum or Lablab purpureus. An MSc thesis submitted to the School of Graduate Studies of Alemaya University, Alemaya,Ethiopia.

Tesfaye, D., 2008. Assessment of feed resources and rangeland Condition in metema district of north gondar zone, Ethiopia. An MSc. thesis submitted to the department of Animal sciences, school of graduate studies Haramaya University.161p.

Tolera, A, Yami, A., Alemu, D., 2012. Livestock feed resources in Ethiopia: Challenges, Opportunities and the need for transformation. Ethiopia Animal Feed Industry Association, Addis Ababa, Ethiopia.

Topps, J.H., 1995. Forage legumes as protein supplements to poor quality diets in semi-arid tropics. In: Wallace, R.J., A. Lahloukassi (eds.). Rumen Ecology Research Planning. Proceeding of a workshop held at ILRI. Addis Ababa. Ethiopia. 13-18 march 1995. Pp.183-190.

Tsige, Y., 2000. Livestock feed security and associated impacts on sustainable agricultural development. In: Proceedings of the 7th Annual Conference of

Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia, 26-27 May 1999.

Ulfina, G., Habtamu, A., Jiregna, D. and Chala, M., 2013.Utilization of brewer's waste as replacement for maize in the ration of calves. http://www.researchwebpub.org/wjar.

Willie Masimbiti 2001 Utilization of urea treated maize stover in rations for dairy cows in Zimbabwe. M.Sc. Thesis. Swedish University of Agricultural Sciences, Department of Animal Nutrition and Management.Uppsa

Yayneshet, T., 2010. Ethiopia Sanitary &Phytosanitary Standards and Livestock and Meat Marketing Program (SPS-LMM) Texas A&M University System:FeedResources Availability in Tigray Region, northern Ethiopia, for Production of Export Quality Meat and Livestock.

Yeshitila, A., Tessema, Z. and Azage, T., 2008. Availability of livestock feed resources in Alaba*Woreda*, Southern Ethiopia. In: Proceedings of the 16th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, October 8 to 10, 2008.

Yihalem, D., Berhan, T. and Solomon, M., 2006. Effect of harvesting date on composition and yield of natural pasture in north western Ethiopia: WWW3.Inter science. Wiley.Com

Zewdie W, Yoseph M (2014). Feed resources availability and livestock production in the central rift valley of Ethiopia. International Journal of Livestock Production 5:30-35.

Zewdie, W., 2010. Livestock production systems in relation with feed availability in the Highlands and Central Rift valley of Ethiopia. An M.Sc. thesis submitted to the School of Animal and Range Sciences, School of Graduate studies Haramaya University.160p.

BIOGRAPHICAL SKETCH

The author, MathewosMengesha was born in 1985 in Loma district Dawuro Zone of SNNPR. He attends his elementary school education in VillageKaeelementary school and his junior and high school education at Waka senior and higher Secondary School.

After successfully passing EGSSLE (Ethiopian General Secondary school Leaving Examination) he joined the Jimma University College of agriculture and veterinary medicine in October 2004 and graduate in July 2006 with Bsc in the field of Animal sciences. After his graduation he employed in Dawuro Zone Genabosa district and Zone garniture office from 2007 to 2018and there for he joined the schools of graduate studies of Hawassa University in September 2019 to 2022 purse his MSc. Study in specialization of Animal Production.

Figure 2: Image of observation