SCHOOL OF GRADUATE STUDIES

AVAILABILITY OF LIVESTOCK FEED RESOURCES, FEEDING PRACTICES AND COPING STRATEGIES WITH DRY SEASON IN MAREKO SPECIAL WOREDA DISTRICT OF, CENTRAL ETHIOPIA

M.Sc. THESIS

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Availability of Livestock Feed Resources, Feeding Practices and Coping Strategies with Dry Season in Mareko Special Woreda District of, Central Ethiopia

A Thesis Submitted to School of Graduates, in Partial Fulfillment of the Requirements for the Degree of Master in Animal Production.

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DEDICATION

This thesis work is dedicated to my beloved mother W/ro Kadije Enisebo Tede who passed away without seeing my success before my graduation with MSc degree. Her love, proper guidance and supports in my childhood contributed a lot in my career and day to day life.

BIOGRAPHICAL SKETCH

The Author, Weya Wamisho, was born on 8th of August 1975 E.C in Mareko district of Central Ethiopia. He attended his junior and elementary school at Hudase Junior from 1994 to 2001 E.C and his secondary school at Koshe comprehensive secondary school from 2002 to 2005 E.C After successful completion of secondary school, he joined Dilla University in 2006 E.C and studied Animal Science and awarded B.Scdegree. In Animal Production in 2008E.C.After graduation, he was employed in Bureau of Agriculture and served in administrative positions in Mareko District of Central Ethiopia. The author worked there until he joined the School of Graduate Studies at Wolkite University, College of Agriculture and Natural Resource Science in September 2014 E.C to pursue his M.Sc. degree in Animal Production.

STATEMENT OF THE AUTHOR

I declare that this thesis is my authentic work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for M.Sc degree at Wolkite University and deposited at the University/College library to be made available to borrowers under rules of the Library. I intensely 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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LIST OF ABBREVIATIONS AND ACRNOYMS

ADF	Acid Detergent Fiber
BW	Body Weight
CP	Crude Protein
CSA	Central Statistical Agency
DA	Development Agents
DM	Dry Matter
FGDs	Focus group discussions
GDP	Gross Domestic Product
ME	Metabolize Energy
NDF	Neutral Detergent Fiber
SE	Standard Errors
SPSS	Statistical Package for Social Science
TLU	Tropical Livestock Unit

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ABSTRACT

The study was aimed with to study assess the availability of Livestock Feed Resources, Feeding Practices, Coping Strategies with Dry Season and estimate the DM yield of available feed resources. Household survey was involved by interviewing a total of 138 respondents which comprises three Keble's from midland and two kebeles from the lowland agro-ecologies. The collected data from, quantitative data were analyzed by using SPSS, version 22. The results revealed that the dominant feed resource in the area were crop residues (94.2. %), natural pastures(2.89%) , fodder trees (1.44%) and improved forage 1.45% The feed utilization practices in the area were free grazing(52.17%),Tethering (41.3%) and Stall feeding (6.53%).. The study results showed that a total of 561.533 tones of dry matter are produced for total TLU values of 673.92 but in actuality1536.5376 tones of dry matter is required for the surveyed existing stocks regardless of the nutritional content of the dry matter. Quantification estimate clearly showed that the time of abundant feeds availability in the study kebeles were only 4.38 months. The findings of this study have shown that almost all the respondents experienced acute scarcity of feed supply during the dry season and use crop residues (68.84%), purchase forage (rent grazing land) 5.79%, reduction of stock 7.24%, fodder trees 13.04% and purchase concentrates 5.07%. Livestock feed production and utilization practices were mainly crop-residues-pasture-based, improvement in feeds and feeding systems is needed through introducing improved forage species, improving the quality of crop-residues, over-sowning pasture land with suitable legume forages specie and conserving feeds when abundant in supply.

***Key Words**: Coping strategies, feed scarcity, feeding practices, feed resources, Mareko special woreda.*

1. INTRODUCTION

Majority of the world people are living in developing countries and depend directly or directly on livestock for their livelihoods (World Bank, 2008; FAO, 2009). Globally, livestock contributes about 40% to the agricultural gross domestic product (GDP) and about 30% of the agricultural GDP in the developing countries (World Bank, 2009). Ethiopia is largely an agrarian country with over 90% of its population in rural area are depend on agriculture accounting for half of gross domestic product (GDP), 83.9% of the exports and 80% of total employment (Matous *et al*., 2013). The livestock subsector contributes directly to livelihoods worldwide, providing not only food, but also non-food products, draught power and financial security (Ruane and Sonnino, 2011). Ethiopia is a home for many livestock species which is suitable for livestock production and has the largest livestock population in Africa (CSA, 2014). The livestock feeding system of the country is unsuccessful and mainly based on overgrazed natural pasture, crop aftermath and poor quality crop residues. The use of improved forages and agro-industrial by products is minimal in rural areas (Mengistu, 2005; Zereu and Lijalem, 2016). The livestock nutrition problem is further complicated with the issue of land holding. According to Altaye *et al*. (2014) and (CSA, 2014/15) the fast growing human population created high demand for cropping land aimed at increasing the production of human food of plant origin. There has been significant reduction in the available natural grazing and forage production area. At present, inadequate animal nutrition is a common problem all over Ethiopia. Mengistu (1998) and Kechero *et al*. (2013) reported that natural pastures are highly overgrazed resulting in the elimination of nutritious plants, increase in unpalatable plant species and sever land degradations.

Feeding systems/practices in the country include communal or private natural grazing and browsing, cut and carry feeding, hay and crop residues. The country's stocks are feeding almost entirely on natural pasture and crop residues. Practice of grazing is mostly on the permanent grazing areas, fallow-lands and cropland after harvest (Tesfaye, 2008). 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 comes from permanent pastures and transient pastures between cropping cycles, crop residues and crop aftermath grazing. Herding depends on size of land per household and season. Tethering is also the common way of managing animals in highland of mixed farming areas. Tethering or herding depends on size of herd and land per household and season.

During the wet season, livestock are entirely herded by children and women by roadsides or on available grazing land or tethered around homestead. In this season, most of farmers herding their stocks on natural pasture around homesteads and the other practicing are also stall-feeding (generally using locally produced feedstuffs). During the dry season, on the other hand, most of them allow their animals to graze on crop stubbles and natural pastures, but, few of them use stall-feeding. Based on the economic importance of the class of cattle, concentrate supplementation varied among classes of cattle kept. Farmers offered concentrate supplements mainly to milking cows, without considering milk yield, physiological status and body condition of the cows. Sintayehu et al. (2008) reported that 58 % of the farmers provided supplementary feeds mainly to lactating cows.

Livestock feed resources are classified as natural pasture, crop residue, improved pasture and forage, agro industrial by products, other by-products like food and vegetable refusal, of which the first two contribute the largest feed type (Alemayehu, 2003).

1.1. Statement of the Problem

Livestock nutrition is one of the major strategic area that aimed activation of food insecurity and poverty of the local community through improving impacts of nutrition on livestock production. According to the information obtained from Guraghe Zone Agricultural office in 2014 E.C, the livestock population of Mareko district was reported to be in the top ten lists among other woreda as of the zone. . However, there is no documents indication the livestock available feed resources, feeding practices, coping strategies during scarce and estimation of DM yield of

available feed resources in this district Therefore, the current study was conducted with following general and specific

1.2. Objectives

1.2.1. General objective

The main objective this study was to assess the available livestock feed resources, feeding practices, coping strategies and estimation of DM yield of available feed resources in Mareko special Woreda district of Central Ethiopia.

1.2.1. Specific objectives

The specific objectives of this study were:

- To identify the available livestock feed resources and feeding practices in different agro-ecologies in the study area.
- To identify the coping strategies and estimate the DM yield of available feed resources in the study area.

1.2. Significance of the Study

The study was provided information about livestock feed resources, feeding practices, coping strategies and DM yield of available feed resources in the study area which can be used as an input or base line for planning development for any concerned bodies. It also helps policy makers to draw sound decisions in order to improve livestock feed resources under Ethiopian condition.

2. LITERATURE REVIEW

2.1. Livestock Feed Resources in Ethiopia

Major feed resources in Ethiopia include natural pasture, crop residues, collected fodders, agro industrial byproducts, multipurpose trees and shrubs, stubble grazing, cultivated forage and conserved forages (Berhanu *et al.*, 2009; Adugna *et al.*., 2012; Dawit *et al.*, 2013; Geleti *et al.*, 2014). However, concentrate feeds, crop residues (teff straw, wheat straw and barley straw) and conserved forage (hay), are used both in wet and dry seasons. Accordingly, the contribution of major feed resources is indicated as grazing (56.23%), crop residue (30.6%), hay (7.44%), agro-industrial by products (1.21%), concentrate/other feeds (4.76%), and improved fodder/pasture (0.3%) (CSA, 2015).

2.1.1. Natural pasture

Natural pasture is the major livestock feed resource (Solomon et al., 2008; CSA, 2015) which currently is being declining in coverage due to conversion of pasture lands in to crop lands (Amare *et al.*, 2005; Mekasha *et al.*, 2014). The grazing capacity of natural pasture depends on the amount of herbage biomes produced in a specific season. During dry season, the grazing capacity of a give pasture land is low but high during rainy season. Due to the deterioration of natural pastures that caused lower carrying capacity, animals are forced to forage on farm lands with minimum litter cover resulting in over degradation of land, damage of physical and biological soil and water conservation structures. This situation in turn has resulted in reduction on yield of food crop and incurring additional cost for construction and maintenance of natural resource conservation structures every year.

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). Hay making is commonly used means of feed preservation technique in Ethiopia, which is expected to mitigate problems of livestock feeding during the dry period and therefore such experience is a good indicator that there are certain practices of efficient feed utilization (Alemayehu, 2003).

2.1.2. Crop residues

Crop residues are the fibrous by-products which result from the cultivation of cereals, pulses, oil plants, roots and tubers and represent an important feed resource (Yayneshet, 2010). They are important in fulfilling feed gaps during periods of acute shortage of other feed resources. The amount of crop residue produced is closely related to grain production, farming system, the type of crops produced and intensity of cultivation. Crop residues contribute up to 30-80% of the total feed DM available in the highlands of Ethiopia (African Rising, 2014). In the highlands and mid-altitude, various food crop residues: cereals (teff, barley, wheat, maize, sorghum and millet) pulse crop residues (faba bean, chickpea, haricot bean, field pea, lentil), oil crop residues and reject vegetables are providing a considerable quantity of dry season feed in most farming areas of the country. Currently, with the rapid increase of human population and expansion of arable land and with the steady decrease in grazing land, the use of crop residues is increasing (Alemayehu *et al.*, 2017).

Crop-residues and stubble grazing are the major sources of feed starting from harvesting of food crops to the wet periods during the time at which feed from grazing areas is inadequate or almost unavailable. In most intensively cultivated areas, crop residues and aftermath grazing accounts for about 60 to 70% of the basal diet, particularly, wheat straw is the dominant feed in wheat-based farming system (Alemayehu *et al.*, 2017). Moreover, most of the crop residues used as livestock feed fluctuate in seasonal supply and used without any treatment and/or strategic supplementation (Solomon, 2004). The plant species, agronomic practice used, soil, temperature and the stage of growth influence the chemical composition and the palatability of straws.

Residues from leguminous crops have better quality than the residues from cereals. Legume straws contain less fiber, high digestible protein than cereal straws (Solomon, 2004). 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 toward improvement of production. It is the ammoniating effect that improves nutrient content and intake of straw (Alemayehu *et al*., 2017).

2.1.3. Agro-industrial by-Products

The major feed resources in the country are crop residues and natural pasture, with agro industrial by-products and manufactured feed contributing much less (Berhanu *et al.*, 2009).

Agro-industrial byproducts have special value in feeding livestock mainly in urban and per urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply (Belay and Geert, 2016). The major agro-industrial by products commonly used are obtained from flour milling industries (wheat bran, wheat short, wheat middlings 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 have a significant effect on the establishment of agro-industries due to the corresponding increasing demand for the edible main products (Yayneshet, 2010). Currently, oil seed cake and grain processing byproducts are the major agro industrial byproducts (Firew and Getnet, 2010). Most oil extraction is done almost entirely by mechanical processing method (CSA, 2015). Wheat bran is by product of wheat flour milling plant and the cheapest and mostly available energy concentrate feed with CP content ranging from 80-140 g/kg DM (McDonald *et al.*, 2010). Whereas, Noug seed cake is very good protein concentrate with 30.8% CP, 32.4%NDF and 29.7% ADF on DM basis (Abebe, 2008).

2.1.4. Improved forages

Improved forages play important role in livestock production systems. Improved forage yield is higher than that of natural pasture and have higher nutritional value and longer productive season.

Improved forages could be used to fill the feed gaps during periods of inadequate crop residues and natural pasture supply. Crop residues (straw and Stover) and native pasture hay are deficient in critical nutrients and low in digestibility and feed intake. Improved forages can improve the productivity of natural pastures by improving the fertility status of the soil. They can also improve the feed value of natural pastures when grown in mixed stand (Admassu *et al.*, 2008). However, not much development has been accomplished in Ethiopia, in the area of increasing the use of improved forage (CSA, 2012/13). Mekoya et al. (2008) stated that unsatisfactory and limited success rates of improved forage development in Ethiopia because of shortage of land in the mixed crop-livestock production system. Technical problems such as methods of planting and management and low interest of farmers in improved forages were also reported to be

reasons for the poor rate of adoption of improved forage production in different parts of the country. The low adoption rate of forage technologies has traditionally been linked to limited knowledge of farmers, lack of competent and sustainable technical support and the low priority attached to promotion of forage technologies and shortage of planting materials is the reasons for poor contribution of improved forage as livestock feed (Ergano et al., 2010).The contribution of improved forage as livestock feed is at its infant stage and reported to be about 0.22% of total feed supply indicating there is call for further effort of the national extension and research activities of the country (CSA, 2012/13).Improved forages have been grown and used in government ranches, state farms, farmers demonstration plots, dairy and fattening areas. Forage crops are commonly grown for feeding dairy cattle with oats and vetch mixture, fodder beet, elephant grass and desimodium species, Rhodes/Lucerne mixture, tree Lucerne, Palmaris or tri folium mixture and sesbania being common ones (Mangistu, 2006). Due to population increase, land scarcity and crop-dominated farming there has been limited introduction of improved forages to smallholder farming communities and the adoption of this technology by smallholder farmers have been generally slow (Mekoya et al., 2008).

2.1.5. Fodder trees /shrubs

Shrubs and fodder trees play a significant role in livestock production in all agro-ecological zones of tropical Africa. The importance, however, increases in areas that are arid. Fodder tree foliages commonly browsed directly from trees, or after lopping by livestock herders. The role of fodder trees in ruminant nutrition has not been truly defined and is likely to be different depending on whether they are used as strategic supplement or total feed source (Sisay, 2006). Tree legumes are extremely important elements in improved forage production programs because of their productivity and multi-purpose uses. Being perennial trees or shrubs, they have a three- dimensional root system and crown, which greatly increases the productivity of systems where land area is limited. Apart from large quantities of quality forage, browse legumes have deep rooting systems to increase their productivity during the dry season, and they produce other products such as fuel wood, construction timber, seeds, and bee products. In addition, browse species provide shelter and privacy, which is valued by many farmers (Alemayehu, 2002).

2.1.6. Nutrient Balance in Terms of Dry Matter

Major feed resources used for the estimation of DM supply side were natural pasture, crop residues and stubble grazing (Bedasa, 2012).The difference between dry matter available and required was measured by balancing the amount of feed required by the total livestock population and the amount of feed supplied. During the calculation, metabolize able energy and digestible protein requirements were taken as the major limiting constitutes for animal maintenance and production (Mergia et al., 2014)

2.1.7. Other feed resources

Livestock feed resources are classified as conventional and non-conventional (Alemayehu, 2003), where the non-conventional ones vary according to feed habit of the community and others, e.g. vegetable refusals are non-conventional. In most dairy cattle production systems in the country, both conventional and non-conventional feed resources are used. Yeshitila (2008) also identified non-conventional feeds and it includes like residues of local drinks: coffee, areke, tella, chat left over called geraba, and vegetables reject.

2.1.8. Seasonal Availability of Feed Resources in Ethiopia

The performance of any livestock depends on feed availability, nutrient content, feed intake, digestibility and metabolism of the feed digested (Onyeonagu, 2013). 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 (Endale, 2015). Feed resource availability is influenced by seasonal fluctuation of rainfall. In some areas feed is available relatively in higher quantity and better quality during the rainy season and early dry season compared to the long dry season (Kassahun, 2016).

According to Dereje et al. (2014), feed shortage is commonly experienced among most farmers particularly from every December onwards. High temperature in drier seasons leads to feed shortage as grasses dry out and the residues are consumed by termites. Fodder conservation for the dry season is not a common practice. Thus, the excess forage available during the rainy season is often wasted by being trampled upon by animals and burning during the dry season. Thus, feed shortage is a problem in the months between December to February, but not as such important from October to November in most highland areas of Ethiopia as indicated in Table 1.

The duration extending from planting of Major Belg and Meher crops until their harvest makes major challenge to the availability of livestock feeds. Belay et al. (2012) confirmed that feed shortage also occurs in a very wet seasons due to water logging of the grazing pasture lands and intensive cropping. Natural pasture supports animal productivity in the rainy season, while in the dry season these pastures can hardly maintain the animals as most of the feed resources are less available and of poor nutritional quality. This could be due to the poor practices of feed conservation and flash burning of the feed resources during the dry season. In the wet season natural pasture is the sole sources of livestock feed, while in the dry season, natural pasture, crop residues, stubble grazing and grass hay are the major feed resources. Next to natural pastures, crop residues are other main resources of livestock feed during the dry season (Tesfaye *et al*., 2010). According to Dereje et al. (2014), there is plenty of natural pasture during the wet season, while farmers do not have a tradition of conserving and keeping the excess forage for the dry season, when there is a relative shortage of feed.

Table 1.Feed calendar in the central Ethiopian Highland

Months	**Feed Shortage**	**Crop Aftermath**	**Free Grazing**	**Straw Cereals**	**Straw Legumes**	**Cut And Carry**	**Demand for improved Forage**	**Straw Cereals**	**Straw Legumes**
Dec–Feb	XXX	XXX	X	X	-	-	XX	X	-
March –June	XX	-	XX	XX	XX	XX	XXX	XX	XX
July–Sept	XX	X	XXX	XX	XX	XX	X	XX	XX
Oct–Nov	X	X	X	X	-	X	X	X	-

Key *XXX=very important, XX=important, X=less important (Source: Amede et al. 2018)*

2.2. Livestock Feeding Practices

Free grazing is a predominant feeding practice in pastoral and agro-pastoral production system Ethiopia. The practice of feeding animals on whatever feed resource that is locally available rather than relying solely on any particular feed resource/ingredient was found to be a very important strategy for coping with feed scarcity among farmers in urban and per urban areas (Constantine *et al.*, 2012). In the urban and per urban areas of Ethiopia, livestock grazing on seasonal fallow land and permanent pasturelands during cropping season and on croplands after harvest is common. Production problem common to most Ethiopian livestock feeding systems are seasonality in animal feed supplies and of poor quality when fed alone it is often unable to provide even for the maintenance needs of livestock (Alemayehu, 2006). Conserved hay is the main source of nutrients for cattle in non- grazing season, or all the time if they don't have access to browse.

In lowland, indigenous management grassland land practices are not widely used due to increase in population pressure and livestock density. Some of the practices like grazing land fire application were practiced to control pest and to facilitate vegetation growth (Angassa and Oba, 2008). The role of indigenous knowledge on grassland management is invisible compared with crop and forest land management (Angassa *et al.*, 2012). The grasslands are used for livestock grazing for millennia. In the highlands plant growth is slow due to low temperature. Stocking density and intensity of cultivation determine the carrying capacity of land. In the lowlands, the short growing season suits only fast maturing plants; limited rainfall and recurrent drought, shrub invasion and overgrazing are major features of lowland grasslands (Angassa and Oba, 2008). Overgrazing and seasonal feed shortage are evident in the country. In highlands of Ethiopia the grazing lands (except protected areas) are in poor to very poor condition and deteriorate further unless there is immediate action (Alemayehu, 2006; Hussen, 2017).

Tethering is also the common way of managing animals in highland of mixed farming areas. Tolera (1990) earlier reported that there is increasing practice of cut-and-carrsystem (feeding of grasses and weed from crop field and roadsides) in southern Ethiopia. Tethering or herding depends on size of herd and land per household and season. Those with small herd size tether their animals in front of their houses. Stall-feeding is practical during the rainy season in the

watershed when enset leaf attains its maximum rate of growth and also to protect the crop land from damage due to livestock (Funte *et al.*, 2010). Contrary to this finding, Brandt et al. (1997) reported that stall-feeding is practiced during the dry season in most enset growing areas of Ethiopia.

During the wet season, livestock are entirely herded by children and women by roadsides or on available grazing land or tethered around homestead. In this season, most of farmers herd their stock on natural pasture around homesteads and the other practicing stall-feeding (generally using locally produced feedstuffs). During the dry season, on the other hand, most of them allow their animals to graze on crop stubbles and natural pasture; but, few of them use stall-feeding. Feeding livestock with maize Stover and haricot bean straw in the morning and evening, providing chopped leaf and pseudo-stem of enset around homestead in the evenings of the dry period are also common practices in highland of mixed farming area (Funte *et al.*, 2010).

2.3. Coping Strategy during Feed Scarcity

The most commonly used ways of feed preservation techniques in Ethiopia is hay making which is expected to mitigate problems of livestock feeding during the dry period and therefore their experience is a good indicator that feeds are being efficiently utilized. However; as both grasses and legume decline in quality as the dry season progresses (Adjjumo and Ademousun, 1985), ways of preserving nutritive quality through hay making during the rainy season may be worthwhile (Duru and Columbani, 1992). Herd mobility was one of the coping mechanisms to manage and utilize range resources and escape from seasonal flood and drought prone areas (Belay *et al.*, 2005; Ketema, 2015). Burning of range vegetation has been widely practiced in the agro pastoral community as a means of the traditional range management strategy

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Mareko special Woreda. The woreda is found between the longitudes of 38000'26'' and 38000'33'' E and latitudes of 7000'5'' and 80 00'04''N (Senehizebbuklet, 2007). The Woreda is located in central Ethiopia around the town of Butajira, and which is located to the distance of 158 km, 138km and 120 km from Addis Ababa, Hawassa town and Welkite town, respectively. Mareko special Woreda is bordered by Silte zone in the South, Meskan in the East, Oromia region in the West, Sodo woreda in the North (Mareko Woreda administration, 2015).

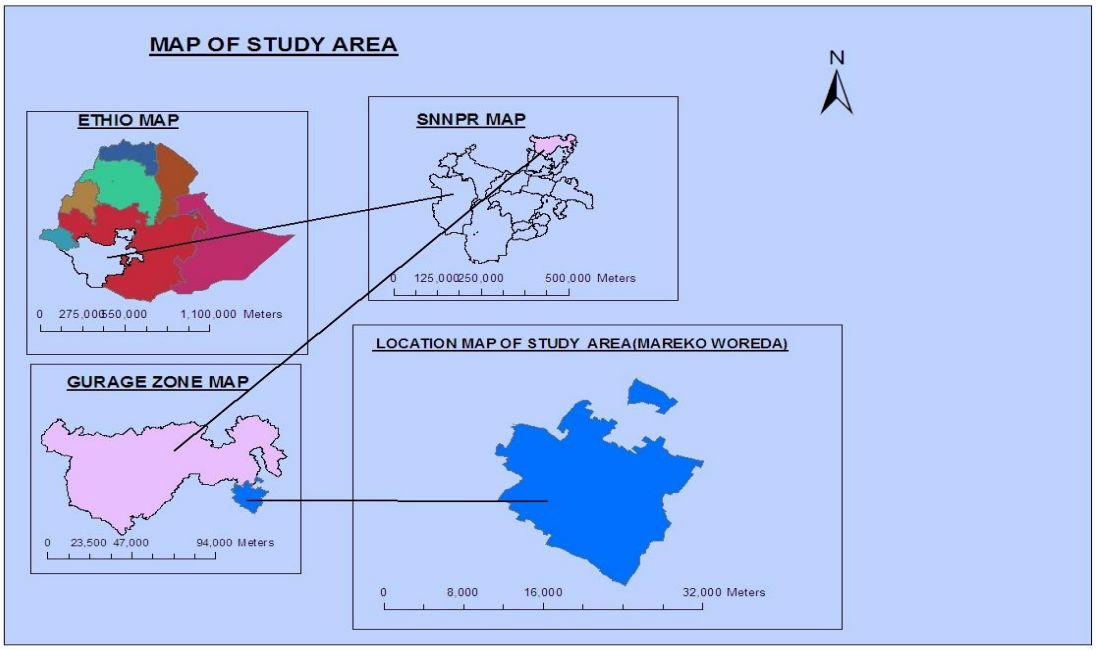

Figure 1.Geographical location of the study area

3.1.1. Climate

The woreda climatic zone is characterized by dry and tropical rainy /dry woinadega/ it constituting about 100%. Its elevation is situated between 1800 and 2000 masl. As per information obtained from Woreda agriculture and rural development office, the annual average

rainfall is 600 mm-750mm. The annual average temperature ranges from 250C to 28 0C, and of the total area of the land is estimated to be 473.76 sq. km (WOA, 2017).

3.1.2. Farming system and population

The population settlement pattern in the rural areas of the Woreda is observed as dispersed as influenced by topography, agro-climate and water sources.. Agricultural practice of the woreda is mixed farming system (specialized Mareko Fana variety and diversified crops and livestock) production is the major engagement of the people. Major types of growing crops are maize, wheat, barley, sorghum, bean, pea, and red pepper (Mareko Fana variety). Based on the 2007 census conducted by the CSA, the Woreda has 76,371 head of cattle, 23,260 head of sheep, 25,199 head of goats, 2,520 head of horses, 2,520 head of donkeys, 116 head of mule and 77,536 poultry head of population.

3.2. Sample Size and Sampling Techniques

Mareko special woreda was purposively selected based on livestock population and livestock feed resources and accessibility for study. Currently, Marko Woreda is divided into 25 rural kebeles and 3 kebeles urban administration. Stratified sampling technique was used to classify the woreda in to medium and low land agro-ecologies. Three kebeles from midland and two kebeles from lowland agro-ecologies were selected purposively based on their farming system; having livestock of any breed and size, feed resources and feeding practices. A total of 138 (92 from mid land and 46 from low land) households were selected by using systematic random sampling method. The total sample size for household interview were carried out using probability proportional to sample size- household interview were carried out using probability proportional to sample size-sampling technique (Cochran 1977)

$$n_o = \frac{Z^2 * (p)(q)}{d^2} \rightarrow n_1 = \frac{n_o}{(1 + \frac{n_o}{N})}$$

Where;

no = desired sample size Cochrans (1977) when population (HH) greater than 10,000, n1 = finite population correction factors (Cochrans formula, 1977) less than 10,000, Z= standard normal deviation (1.96 for 95% confidence level), p = 0.1 (proportion of population to be included in

sample i.e. (10%), q = 1-P i.e. (0.9) N = is total number of population, d = degree of accuracy desired (0.05). The comparable sample size among the kebeles was determined in proportion to their household size using a principle of a simple proportion formula.

W= [A/B] x No,

Where, W= the required sample size from each Kebeles

A= Total number of households in each Kebeles

B= Total number of households in all selected sample Kebeles and No=Total sample size selected from all sample Kebeles

Table 2.Distribution of sampled respondents, with the probability and proportional to size by Kebele

Agro-ecologies	**Name of Sampled Kebeles**	**Total number of households in the sampled *kebeles***	**Number of Sampled households**	**Remark**
Mid altitude	Dide Halibo	525	23	(525/3,152) x138=23
	Makakelgne Garedbaq	890	39	(890/3,152) x138=39
	Goto Gotibale	685	30	(685/3,152) x138=30
Low altitude	Bedara feqa	571	25	(571/3,152)x138= 25
	Elale Gebeba	480	21	(480/3,152) x138=21
Total		**3,152**	**138**	**138**

3.2.1. Data Sources

Data Sources for this study was obtained from the primary and secondary source. Primary data was collected by the formal survey through interviewing the selected farmers and Local language

was used to collect the data. Focus group discussion and field observation also used to collect data for this study. In addition, published and unpublished documents/literatures, CSA reports, and different organizations including government institutions such as woreda agricultural offices were reviewed to know the existing gaps in livestock feed resources, feeding practices and coping strategies in different agro-ecologies of the study area.

3.2.2. Focus group discussion

A total of five Focus group discussions (FGDs) 5 farmers group discussions were conducted, one in each kebeles with Knowledgeable farmers with the aid of kebeles development agents (DA) by considering both female and males of different age categories (younger and elder).

3.2.3. Household survey

Before conducting the formal survey, the semi- structured questionnaires was pre-tested and translated to Maerkgna. A total of five enumerators, one from each kebeles, are trained for one day. Then household survey was carried out using local language (Maerkgna). The questioners were used to collected data on aspects like household characteristics (age, sex, marital status, household size, and educational background), land holding sizes, available livestock feed resource, and feeding system/feeding practice and coping strategies.

3.2.4. Field observation

Field visits were taken place in some households to observe the livestock feed resources, feeding practices and coping strategies.

3.3. Data Collection Procedures

Data collection process was involved a number of participatory steps and questionnaire survey method. Prior to questionnaire, focus group discussions was done once in each kebeles of the study sites with elders, key informants and development agents in order to crosscheck data. The

discussion were used to investigate and understand the general description of farming system, range of farm sizes, farm labor availability, livestock feed resources and feeding practices, annual rainfall pattern, water availability, general description of livestock production, types of animals raised and herd sizes, the purpose of rising animals e.g. for milk, draught, income, fattening, calf and manure production, the general animal husbandry practices including; management, veterinary services and reproduction, ease of access to credit and how available are necessary input problem identification and potential solutions, opportunity for livestock production in relation to availability of feed resources and feeding system. In order to characterize and prioritize livestock production, feed resources and feeding systems in the study district, farmers were interviewed using a structured questionnaire. Quantitative questionnaire was focus on livestock inventory, crops-yields and areas to derive crop residue availability, grazing resources; cultivated forages-yields and areas, and collected fodder: Proportion of diet, purchased feed; contributors to household income, milk production, sale of livestock, and sale of crop production. Seasonality of feed supply: overall seasonal availability of feed in different months and so forth. The questionnaires were close and open-ended questions. The pre-testing of questionnaire is employed with selected 25farmers, farmers, 10 farmers from low altitude and 15 farmers from mid altitude region. The pre-testing of questionnaire was used for restructuring the questionnaire according to livestock production and feeding systems. Field observations were done to gather additional information concerning to of availability livestock feed resource and feeding practices in the district.

3.4. Estimation of Dry Matter Yield of Available Feed resources

3.4.1. Dry matter yield of different land uses

The total quantity of dry matter (DM) available in natural grazing was determined by multiplying the average value of grazing land holding by a factor of 2t DM/ha/year (FAO, 1987). The quantities of available DM in fallow land and aftermath grazing were determined by multiplying the available land by the conversion factors of 1.8 for fallow land and 0.5 for aftermath grazing (FAO, 2018).

3.4.2. Dry matter yield of crop residue

The quantity of available crop residues (DM basis) was estimated from the total crop yields of the households, which were obtained from questionnaire, according to conversion factors. The conversion factors are 1.5 for barley, wheat, teff, 2 for maize, 1.2 for pulse and oil crop straws and 2.5 for sorghum (FAO, 1987).

3.4.3. Estimation of annual requirements of feed for livestock

Data of livestock population in the sampled households was obtained from the interview of household heads during the survey. The number of livestock population was converted in to TLU using the conversion factors of cattle (0.7), sheep (0.1), goat (0.1), mules (0.7), horses (0.8), and donkeys (0.5) (Varvikko *et al.* 1993).The DM requirements of the livestock population was calculated according to the daily DM requirements for maintenance of 1 TLU (250 kg) livestock consumes 2.5% of its BW (6.25 kg DM/d) or 2.28 tones/year/TLU (Kearl, 1982).

3.5. Determination of Chemical Composition

Representative samples feeds were collected from lowland and midland agro-ecologies with the aid of enumerators who have been hired and received training for feed samples gathering The samples were collected then dried in the shade before being subsample and transported to the animal nutrition lab at Hawassa University.

The samples were dried in an oven at 65°C for 72 hours, and feed samples were ground in a Wiley mill to a particle size of 1 mm. Feed samples were analyzed for DM, nitrogen (N), and ash levels (AOAC, 2005). Micro-Kjeldahl was used to measure nitrogen (AOAC, 2005). The nitrogen content was multiplied by a factor of 6.25 to determine the CP content (N x 6.25). Vansoest and Robertson (1985) was used to determine the neutral detergent fiber (NDF) and acid detergent fiber (ADF), respectively. Ankom Daisy II incubator was used to measure acid detergent lignin (ADL) according to AOAC, (1990).

3.6. Method of Data Analysis

The collected data from, field observation and from individual farmers were stored in Microsoft excel spread sheet. Descriptive statistics such as means, standard error of mean and percentages

were used to describe variables observed among households. Data collected at household level related to livestock feed resources, feeding practices and coping strategies were analyzed and summarize by using the Statistical Package for the Social Sciences (SPSS, 2022) version 20. The data obtained from the estimation of DM yield and chemical composition & DM of livestock feed resources were subjected to analysis of variance using SPSS,.

4. RESULTS AND DISCUSSION

4.1. Demographic Characteristics of Respondents

The households' characteristics are presented in Table 3. About 74.63% and 25.36% of the farmers were male and female-headed HHs, respectively. The result from the present study on the sex of HHs was lower than reported value (91.3%) by Yeshitila(2008) from Alaba district of Southern Ethiopia and (95.6%) Teshager *et al (*2013) from Ilu Aba Bora Zone, Ethiopia.

The overall mean family size was 3.80±0.99 person/household and there was no significant difference among the agro ecologies. This result is lower than the findings of Belay (2021) from around the Gilgel Gibe catchment, South west Ethiopia (8.94±0.17). From the sampled households in the study area, about 41.30%,49.27%,2.89%and 1.44%were illiterate, read and write only, secondary and college, respectively This result is similar to the findings of Ambaetal (2022) from Derashe special district.

Table 3.Demographic characteristics of respondents (% of respondents)

Demographic characteristics	**Variables**	**Agro-ecologies**		**Overall (%)**
		Mid altitude (%)	**Low altitude (%)**	
Sex of the household	Male	80.43	63.04	74.63%
	Female	19.06	36.95	25.36%
Age of household head	≤30	11.95	4.34	9.42%
	31-39	29.34	21.73	26.8%
	40-49	31.52	45.67	36.80%
	50-59	19.56	21.73	20.28%
	≥60	7.60	6.52	7.24%
Family	<4	42.39	30.43	38.40%
	>5	57.60	69.56	61.59%
Marital status	Married	76.08	86.4	79.71%

	Single	13.2	4	10.14%
	Widowed	4	6.52	5.07%
	Divorced	6.8	2.17	5.07%
Educational status of the household	Illiterate	35.2	53	41.30%
	Read and Write	54.06	41	49.27%
	Secondary	3.2	2	2.89%
	College and above	7	4	5.79%

4.1.2. Landholding and land use pattern of the households

Land is the most important limiting factor for livestock production in the study areas. The size of land available greatly determines the amount of production. However, as opposed to family size, the land holding per HH was decreased. The total land holding of cultivated land (food crop production) of the respondents in the mid altitude (1.44ha/HH) was no significant ($p>0.05$) different from lowland (1.75 ha/HH) (Table 4). The size of land allocated for home stead in the study kebele*s* was in the range of0.14-0.21.ha/HH. The crop land holding was ranged from 1.11 to 1.21 ha per HH which is in line with the report of Bedasa (2012) who reported the land size of 1.7 ha for crop production and 0.4ha for grazing land in Jeldu district of West Shoa zone.

The average grazing land in the study area (0.014ha) was lower 0.52 ha reported by Mekete (2018) and 0.46 ha reported by Ahmed *et al.* (2010) in the central highlands of Ethiopia.

4.1.3. Land holding and land use system

Table 4.Mean of land holdings in the study areas

Parameter	Agro-ecologies			
Land holding (ha)	Mid altitude (Mean ±SE)	Low altitude (Mean ±SE)	Over all (Mean ±SE)	p-value
Cultivated (Food crop	1.11±0.06^{ns}	1.2±0.03^{ns}	1.15±0.04	1.1

production) land				
Grazing land	0.14±0.02[a]	0.33±0.03[b]	0.23±0.05	0.01
Homestead land	0.21±0.02ns	0.14±0.02[ns]	0.12±0.02	0.16
Forest and woodland	0.06±0.06[ns]	0.07±0.01[ns]	0.06±0.03	0.46
Fallow land	0.02±0.06[a]	0.01±0.01[b]	0.01±0.03	0.00
Total land holding	1.44±0.06[a]	1.75±0.11[b]	1.6±0.28	0.00

[a–b] Mean values along the same rows with different superscripts are significantly different (P<0.05),SEM =Standard Error of Mean ,ns=non-significance

4.1.4. Livestock Population and Herd Composition

The total population of livestock in the study areas was estimated to be 682.94 TLU. As shown in Table 5, around 84% of the total TLU of the livestock population in the study areas was cattle. About55.72% of the cattle's were oxen followed by cows (28.55%), bulls (5.03%), heifers (10.41%) and calves (0.26%). Contrary to the current study, Bedasa (2012)in the Highlands of the Blue Nile Basin reported the lower values of 5.35TLU for cattle, 0.49 for sheep, 0.03 for goats, 0.22 for donkeys and 0.02 for poultry. Average number of cows, bulls, heifers and calves kept by respondents was significantly (P<0.05) higher in highland than lowland. The average number of sheep kept by the households in mid altitudes was higher (p<0.05) than the low altitude whereas the average number of goats per household in the low the altitudes was higher (p<0.05) than the mid altitudes. Horse holding was higher (p<0.05) in low than mid altitudes. There were no significance (P > 0.05) differences between the two altitudes in number of chickens, donkeys and mules per HH About 71% of the respondents indicated that the total number of livestock and herd compositions was declining from time to time. Agajie*et al.* (2001) also reported that 73% of the sampled farmers in north and west Shoa zones indicated a decline in livestock population. In the current study, the major reasons responsible for declining livestock numbers were shortage of grazing land, expansion of crop lands, animal diseases, shortage of feeds and water.

Table 5.Livestock population in the study areas

Animals Species	Agro-ecologies		Total	Conversion factor	Total TLU
	Mid altitude	Low altitude			
Cattle					**576.04**
Cow	103	132	235	0.7	164.5
Oxen	152	169	321	1	321
Heifer	81	39	120	0.5	60
Calves	23	54	77	0.02	1.54
Bulls	17	12	29	1	29
Sheep	87	25	112	0.1	11.2
Goat	163	59	222	0.1	22.2
Donkey	69	48	117	0.5	58.5
Horse	12	4	16	0.8	14.4
Mule		1	1	0.7	0.7
Poultry	232	237	469	0.01	4.69
Total					**682.94**

Table 6: Mean livestock holding size of the sampled households in the study area in TLU

Species	Mid altitude Mean ±SEM	Low altitude Mean ±SEM	Over all mean Mean ±SEM
Cows	1.20±0.06[a]	1.03±0.05[b]	1.3± 0.03

Oxen	2.12±0.14^{ns}	2.0±0.05^{ns}	2.50± 0.05
Bulls	0.50±0.11^{a}	0.34±.15^{b}	0.64± 0.08
Heifer	0.34±0.05^{a}	0.20±0.07^{b}	0.45± 0.05
Calves	0.026±0.69^{a}	0.013±0.07^{b}	1.34± 0.03
Sheep	0.53±0.05^{a}	0.10±0.06^{b}	0.43±0.05
Goat	0.36±0.04^{a}	0.45±0.13^{b}	0.14±0.02
Donkey	0.67±0.07^{ns}	0.65±0.06^{ns}	0.68±0.05
Horses	0.10±0.03^{a}	0.00±0.00^{b}	0.670±0.06
Mule	0.00±0.000^{ns}	0.00±0.000^{ns}	0.04±0.01
Poultry	0.04±0.03^{ns}	0.00±0.000^{ns}	0.02±0.01

$^{a-b}$ Mean values along the same rows with different superscripts are significantly different($P<0.05$),

4.1.5. Feed resources availability

The major feed resource available in the study areas are presented in Table 7. According to the respondents, the largest (94.2%) feed resource for livestock was from the crop residues, but small amount 2.89%is contributed from the natural-pasture. However, very few respondents were reported that fodder trees (1.44%)and improved forages (2.17%).The higher shares of crop-residues than other feed resources might be shortage of grazing-lands due to gradual turning households into crop production and the absence of alternative feed resources and hence, the increased dependence on crop-residues in the central highlands of Ethiopia (Biratu *et al.*, 2017). The study reported by Alemayehu (2009) showed that crop-residue is contributed the major feed resource gradual turning households into crop production and the absence of alternative feed resources and hence, the increased dependence on crop-residues in the central highlands of Ethiopia for high lands of Ethiopia next to communal-grazing areas which is contradicted result from the present study. But it was similar to what the (Sintayehu, 2008) report, which was demonstrated that crop-residues are major feed resources followed by natural-pasture for high lands of Ethiopia. In general, crop- residues and natural pasture are the major feed resources of the area, which agreed with the report of Seyoum *et al.,* 2000*)* who reported that the major basal

feed resources in the highlands of Ethiopia as natural pasture, crop-residues and stubble grazing.

Table 7.The most dominant feed resources available in the study areas

Parameter		**Agro-ecologies**		
Feed resources (%)		**Mid altitude**	**Low altitude**	**Overall (N=138)**
Crop residues		93.34%	96.2%	94.2%
	teff straw	6.52%	21.7%3	11.59%
	barley straw	13.04%	17.39%	14.49%
	wheat straw	89%	86%	93%
	maize straw	100%	100%	100%
Natural pasture		3.1%	2.5%	2.89%
Fodder trees		1.3%	1%	1.44%
Improved forage		2.17%		1.45

4.1.6. Grazing land availability and constraints

About 31.5 and 21.73% of respondents were used communal grazing land in mid and lower altitudes, respectively (Table 8).The respondents indicated that the majority of communal grazing lands were open grass lands (21.19%), but 5.42% was tree covered grassland. Constraints related to grazing lands were weed (16.3%), over grazing (4.88%), and the occurrence of drought (23.86%), in all altitudinal zones. Similarly, shortage of land, low technical know-how on improved forage production and high cost of feeds and poor access to markets were indicated as livestock productivity problem in Diga Woreda, Ethiopia (Adugna *etal.,* 2014).

4.1.7. Causes of grazing land deterioration

Table 8.Grazing land availability and causes of feed shortage in the study

Parameter	Agro-ecologies		
	Mid Altitude	Low Altitude	Overall Mean
Communal grazing land			
Yes	31.52 %	21.73%	26.61%
No	68.48%	78.26%	73.39%
The type of communal grazing			
Open grassland	27.17%	15.21%	21.19%
Tree covered grassland	4.34%	6.5%	5.42%
Types of Constraint			
Weed	20%	10%	17.5%
Drought	30%	30%	30%
Over grazing	36.6%	40%	37.5%
Burning of grass	13.3	20%	15%

The causes of grazing land deterioration vary among the two agro ecologies. Drought problem was being the major contributing factor in the low altitude (Table 9).This was in line with the study reported by Teshager *et al*. (2013) in who reported expansion of crop land, increased human population, overgrazing and lack of knowledge on improved forage production as the major reasons of grazing land deterioration. The sizes of communal grazing lands in the study areas were decreasing from time to time and this indicates that the quantity of feed obtained from these sources was also decreasing.

Table 9.Major reasons of grazing land deterioration in the two agro ecologies (%)

Major cause of grazing land deterioration	Agro-ecologies		
	Mid altitude	Low altitude	Overall Mean

Decrease the size of land	25.3.%	15.52%	20.41%
Drought	32.3%	39.04.%	34.05%
Over stocking	24.4%	15.34%	21.73%
Weeds	12.6.%	10.9%	12.31%
Over stocking and drought	7.7%	19.6%	18.11%

4.1.8. Grazing land system

Grazing systems were practiced in all agro-ecological zones (Table 10). Cut and carry system) (71%), continuous grazing (7.97%) and rotational grazing (21%) were the major ones. In Jeldu district, about 94.5, 4.4 and 1.1% of the respondents practiced let to graze, cut and carry, and tethering, respectively (Bedasa, 2012).

Table 10.Grazing land systems in the study areas

Description	**Agro-ecologies**			
Have you adequate grazing for your livestock		**Mid Altitude(n=92)**	**Low Altitude(n=46)**	**Overall Mean(N=138)**
	Yes	4.34	6.5	5.42
	No	95.66	93.5	94.58
Ways of utilizing grazing land	Continuous grazing	4.3%	16.2%	7.97%
	Rotational grazing	23.6%	15.2%	21%
	Cut and carry system	72.1	68.6	71

4.1.9. Source of crop residue and its utilization practices

Crop residues are the primary feed resources for livestock in the study areas. About100% of the sampled households gave priority to livestock in feeding of crop residues. In the study areas, crop residues such as maize, wheat, barley and teff straws, were the major livestock's feed resources during

the dry season, which is in agreement with the report of Alemaye and Sisay (2003), who reported that crop residues are the major feed resources in most areas of Ethiopia. Availability of crop residues varied according to the type of crops grown across agro-ecologies. Both crop residues and crop aftermath are being utilized untreated by the majority of the respondents. Similarly, Mohammed *et al.* (2016) reported that stubbles of crops like maize, sorghum and *teff* were allowed to be grazed by livestock from October to December in Kersa, Omo Nada and Tir Afeta of Ji mma administration zone.

4.1.10. Problems related to crop residues utilization

According to the responses of the sampled households, the major constraints associated with crop residue utilizations were collection and transportation, storage, and feeding problems (Table 11). About 60.53% in medium and 57.17% in lowland residences responded the problems in collecting and transporting the crop residues from the farm to homes. Problems associated with storage of crop residues were mainly related with improper storage practices as a consequence many crop residues can be wasted Collection and preservation of straws when the availability was better and application of different processing and treatment methods to improve the feeding value could be an option to enhance the expected from crop residue in animal feeding (Daniel, 1988).

Table 11.Problems associated with crop residue utilization in the study areas (% of respondents)

Types of Problems	**Agro-ecologies**		
	Mid altitude	**Low altitude**	**Over Mean**
Collection and transportation	60.53%	57.17%	60.14%
Feeding	13.14%	12%	13.04%
Storage	26.34%	30.43%	26.81%

4.1.11. Stubble grazing/Crop aftermath

After harvesting the crops, livestock were allowed to graze stubbles of maize, sorghum, teff, wheat and barley between October and December. Farmers used aftermath grazing as one means to sustain their livestock before they started feeding of collected crop residues. The land owners only allowed their livestock to graze on the stubbles for first two months. Then other neighboring community could graze their livestock after two months. Stubble consists of the stumps of reaped crop such as cereals and legumes, left in the field after harvest.

Grazing of stubble was commonly practiced in small farm holders of the study areas. Along with base of crop harvest, stubble often contains valuable feed in the form of grain and weeds, which has been left out during harvesting process. Stubble grazing was advantage for the livestock as it allows them to graze selectively and probably find at least a maintenance diet from what might be a sub-maintenance feed if taken as a whole. But on-field grazing however leads to a lot of wastage through trampling. The aftermath was not accessible to other neighbor cattle owners in the community as agreed to the report of Sisay (2006) and Andualem (2015) where aftermath were accessible to livestock owned by individual farmers. In contrast, Yeshitila (2008) at Alaba Woreda reported that aftermath grazing was available after the harvest of cereal crops from late November to late March which was accessible to all the community in the study area, so that all livestock classes in the locality were able to graze without any restriction.

4.1.12. Improved forage production and forage seed availability

About 94.1% of the sampled households in the study area had no improved forages on their farm land as livestock feed source. Similar to the current findings, Belay *et al.* (2012) reported that all households (100%) interviewed in DandiWoreda, west shoa zone, did not cultivate improved forage species for their livestock feeding In the study area, the major reasons for not planting improved animal feeds were due to shortage of land(8.4%), shortage of forage seeds (3.25%) and lack of awareness (82.05%) (Table12). This showed that farmers do have an interest to grow improved forage crops but other factors were hindering its production. These findings were not supported by previous studies (Belay *et al.,* 2011; (Azage*et al.*,2013), who reported that shortage of land was reported as the most limiting factor to urban dairy production.

Figure 2.Elephent grass and Desho grass in study area

Table 12.Improved forages production and factors influencing their production and utilization in the study areas

Parameter		**Agro-ecologies**		
		Mid altitude	**Low altitude**	**Over all**
Do you have improved forages	Yes	2.17%		1.44%
	No	97.83%	100%	98.55%
Reasons for not planting improved forages				
Shortage of land		16.2%	6.%	15%
Shortage of planting material		10.3%	11.%	10.8%
Lack of awareness		73.5%	83.%	76%
Forage seed provider				
WoA		5.43%		2,7%
NGO		3.17%		1.58%
Purchase from market				
Available forage seed				
Elephanet grass		2.4%		1.2%

Desho grass	6.6%		3.3%

4.1.13. Agro – industrial by products

There is no supply of agro-industrial by-products in Mareko special Woreda. There are no any agro-industries including flour mills and oilseed mills producing by-products to be used as a supplement feed for livestock. The source of concentrate is from Addis Ababa, Bishoftu, Adama and Mojo areas. The types of concentrates available in the respondents were wheat bran and the main users of agro-industrial by-products are farmers who have dairy cows.

4.1.14. Feed management and feeding system for livestock

The feeding systems in the study areas were being dominated by free grazing (52.17%) followed by only tethering (41.3%) and stall feeding (6.5%) cut and carry system with limited movement was found in the study area. The importance of free grazing was higher in this study areas, probably due to insufficient biomass produced by the natural pasture, hence farmers opted to feed their livestock by purchasing fodder from school and church compounds and other sources in the wet season and crop residues, supplements and browse trees/shrubs during dry season. This result is in agreement with the report of Belay (2012). The study was also similar to the previous work by Mollaet al. (2014) who identified partial grazing and home feeding as the major livestock feeding practices. Homestead feeding was an interesting feature of livestock feeding which in turn has enormous advantage to promote fodder development and using cut and carry system which had importance to reduce free grazing.

Table 13.Feeding systems of available feed resource in the study areas (% of respondents)

Feeding Systems	**Agro-ecologies**		
	Mid Altitude	**Low Altitude**	**Overall**
Free grazing	53%	50.6%	52.17%

Tethering	38.7%	47%	41.3%
Stall feeding	8.3%	2.4.%	6.5%

Figure.3. Free grazing of livestock in the study area

4.1.15. Transportation, storage and utilization of feed

Feed transportation is one of the tasks in livestock production and management. Some of common means of transportation in the study areas are human power (1.44%) and donkey and horseback (96.37%) (Table 13).In the study areas, the major problems related to transporting livestock feeds were bulkiness of feed (1%), absence of transporting facilities (70.8%) and lack of road access (28.2%) (Table14).Tesfaye and Chairatanayuth(2007)also reported similar results that transportation was a problem in East Shoazone. According to the respondents' perceptions, feed storage during high production season was one of the coping mechanisms for feed shortage.

Table 14.Feed transportation mechanisms and transportation problems in the study areas (% of respondents)

Transporting Mechanism	**Agro-ecologies**		
	Mid Altitude	**Low Altitude**	**Overall**

Human power	2.17%		1.44%
Donkey and horses	96.7%	95.65%	96.37%
Car	1.08%.	4.34%	2.17%
Transporting problems			
No road access	43.6%	24.3%	37.7%
Bulkiness of feed	2.0%	1.5%	2.17%
Absence of transport Facilities	54.4%	74.2%	60.8 %

In the study areas utilization of hay and crop residue started soon after collection (53.6%) one month after collection (32%), two months after collection (13.04%) and stay conserved over two months (0.75%) Table14. Yared (2021) reported similar results that farmers in the Bassona worana woreda, north shoa zone feed their animals soon after collection (55.43%), one month after collection(31.84%),two months after collection(12.41%) and over two months(0.43%).Utilization of conserved feed soon after collection was higher in mid altitude than (57.3. %) low altitudes (46%) (Table 15).In the low altitudes, 0.86% of the respondents conserved feeds over two months after collection. This indicates that low altitudes areas get relatively abundant feed sources for livestock than the mid altitude.

Table 15.Time of feeding crop residues in the study areas (% of respondents)

Feeding crop residues time	**Agro-ecologies**		
	Mid altitude	**Low altitude**	**Overall**
Soon after collection	57.3.%	46%	53.6%
One month after	35.6%	27.14%	32%
Two months after	7.1.%	26%	13.04%
Over two months	-	0.86%	0.75%

The respondents feed crop residues to their animals in different ways in which 2.89%of the respondent practiced whole feeding, 96.37%chopped and 0.72% of the respondents treated and mix crop residues with other feeds (Table16). Contrary to the current finding, Zewdie (2010), who studied at Central Rift Valley and reported that feeding crop residues in whole (55%) and treated straw (10%). Generally, in the study areas, most of the farmers feed crop residues without treatments and this increases wastage of the feed and reduce efficient utilization of the available feeds. In the study area, 99% of the respondents store the feed outside in an open air and only 1% stored under shed. Similar results were reported by Yared **(**2021) in which the majorities (89.71%) of the respondents were stored hay under open air and 10.29% under shade.

Table 16.Ways of feeding and storage systems of crop residues in the study areas (% respondents)

Forms of feeding	**Agro-ecologies**		
	Mid altitude (%)	**Low altitude (%)**	**Total (%)**
Whole	2.76%	2%	2.89%
Chopped	95.86%	98%	96.37%
Treated	1.38%	-	0.72%
Mixed	2.76%	2%	2.89%
Feed storage system			
Stacked outside	98%	100%	99%
Stacked under shed	2%		1%

Figure 4.Teff straw and Maize-Stover stacked outside the shed in the study area

4.1.16. Feed shortage and its coping mechanisms

The findings of this study have shown that almost all the respondents experienced acute scarcity of feed supply during the dry season (Table 17).The present study was similar to the finding of Yared(2021)in the Bassona woranaworeda. Conserving crop residues and hay, purchasing roughages, reducing herd size and renting grazing land were the main coping strategies adopted by the farmers. Perceived indicators of feed scarcity on livestock performance included poor productivity, increased mortalities, slow growth rate and delayed puberty of young animals(Table17)

Table 17.Coping strategies for feed shortage and its reason in the study area (% of respondents)

Parameter		**Agro-ecologies**		
		Mid altitude (%)	**Low altitude (%)**	**Total (%)**
Is there a problem of feed shortage	Yes	90.21%	82.46**%**	87.68%

	No	9.78%	17.39	12.31%
Reason of feed shortage				
Shortage of rain or irrigable water	88.04%		67.39	81.15%
Shortage of land	6.52%		17.39%	10.14%
Shortage of improved fodder	2.17%		8.69	4.34%
Improper management	3.26%		4.34%	3.62%
Take to cope with the feed shortage				
Purchase concentrates	4.34%		6.52%	5.07%
Reduction of stock	6,52%		8.69%	7.24%
Purchase forage (rent grazing land	7.6%		2.17%	5.79%
Use crop residues	70.65%		65.21%	68.84%
Fodder trees	10.86%		17.39%	13.04%

4.1.17. Seasonal availability of feeds

According to this study, the livestock feeds were excess in the months of September (89.7%), October (89.5%) and November (74.4%). The assessable feeds during these months were natural pasture grazing, hay, crop residues and aftermath grazing. Feeds were adequately available in the months of December (56.4%), January (54.4%), June (44.1%), July (51.0%) and August (51.4%). This can be related to the availability of hay, crop residues and aftermath grazing in the months of December and January natural pastures in the months of June, July and August. Tesfaye (2008) reported that the shortage of feed began from the end of November and January. The same author reported that March and April were the driest months when the productivity of the natural pastures dwindles. In the current study, of the respondents indicated that form September to December Excess of feed availability from January to April Adequate of feed availability form May to June were classified as feed shortage months,. In these months, the availability of natural pastures, hay, crop residues and aftermath grazing were

reduced. The same result is reported by Tessema et al. (2003).

4.2. Estimated Available Feed Resources

4.2.1. Estimated Grazing Biomass

About 10.875 ha of grazing land were available in the two agro-ecologies of sampled households (Table18). Therefore, the total dry matter production from natural pastures (private and communal grazing areas) was 21.75 tons per year (10.875*2 tons/ha). The amounts of natural pastures produced by the respondents were estimated from the pastureland owned by respondents.

Table 18.Estimated grazing biomass from different land uses

Land use type	**Mid altitude**	**Low altitude**	**Total Area in(h)**	**Total DM Production (tones**
Grazing lands	8.5	2.375	10.875	21.75
Aftermath grazing	110	120	237	118.5
Forest lands	3	1.13	4.13	2.891
Fallow land	1.4		0.6	3.6
Total				**146.741**

4.2.2. Estimated crop residues

The total amount of DM from all crop residues produced by the sampled households was 4147.93 ton/year (Table 19). However, according to Adugna (1990), 10% of the crop residues were expected lost due to several factors. Therefore, 41.479 tons of dry matter of crop residue was obtained from the total crops produced in the study areas. The proportion of crop residues as animal feed was higher (86.4%) as compared to other feed types in the study areas which is in agreement with the study conducted by Yeshitila et *al*. (2008) who reported 78.72% of livestock

feed supply that derived from crop residues.

Table 19.Estimated crop residues in the study area

Types of crop residues	Crop yield, Quintal			Conversion factor	Crop residue Yield (tones')
	Mid altitude	Low altitude	Total		
Teff	23.4	14.3	37.7	1.5	56.55
Wheat	432	549.5	981.5	1.5	1472.25
Barley	65	41	106	1.5	159
Bean	4	3.69	7.69	1.2	9.228
Pea	1	1	2	1.2	2.4
Sorghum Stover	0.75	0.25	1	2.5	2.5
Maize	564	659	1223	2	2446
Total					**4147.928**

4.2.3. Estimated crop aftermath

The contribution of crop aftermath as a livestock feeding is great, especially when feed availability is limited to crop residues, hay and aftermath grazing. In the study areas, a total of 139.435 ha of land were covered by different crop types in the sampled households. About 69.7175 tons of feed was obtained per year from crop aftermath in the study area.

4.2.4 Estimated forest land biomass

In the study area, farmers used different forest land as source of feed for animals especially at times of drought and feed shortage. About 4.13 ha of land was covered by trees and shrubs which used as livestock feed. About 2.891tons of DM of feed was produced from forest land per year.

4.2.5. Estimated fallow land biomass

In the study area, the total area of land covered by fallow land was 2 ha. The conversion factor used to get total dry matter production from fallow land was 1.8 (FAO, 1987). A total of 3.6 tons of feed dry matter was produced from fallow land in the study area.

4.3. Estimated Annual Dry Matter Requirements for Livestock

4.3.1. Dry matter requirement of livestock in the study area

The DM requirement was calculated based on the daily DM requirement of 250 kg dual purpose tropical cattle (an equivalent to one TLU) for maintenance requirement that needs 6.25kg/day/animal or 2281 kg/year/animal or 2.28 tons /year/animal (Jahnke, 1982). Therefore, the total dry matter requirement of 673.92 TLU was 1536.5376 tons per year (poultry was excluded because of mono gastric nature of the animal).The current dry matter production obtained from natural pasture grazing, crop residues, crop aftermath grazing, forest and fallow land in the sampled households was 561.533 tons per year. The total dry matter produced per year in the study area, can only supply the animals for 4.38 Months. In the rest of the year, animals suffer from feed shortage. In Metema Woreda, the existing feed supply on a year round basis satisfies only 72.7% of the maintenance DM requirement of livestock (Tessema *et al*., 2003). Contrary to these results ,Endale(2015) reported the existing feed supply on a year around basis accounted for about 104.79% of the maintenance DM requirement of livestock per household in Meta Robiworeda, west shoa zone, Oromia regional state. In agreement to the current study, Bedasa (2012) also indicated that the annual dry matter production was below annual livestock requirements in the highlands of the Blue Nile basin.

4.4. Chemical Composition of Feeds

Determining the nutritional quality of livestock feed resource is very important to determine the nutritional needs of livestock in terms of energy and protein. Hence, sample feeds were collected from the study district and the samples were dried in the shade before being subsample and transported to the animal nutrition lab at Hawassa University. The following table 20 shows the chemical composition of major feeds in the study areas.

Figure 5.Feed sample processing for chemical analysis

The results of laboratory analysis of chemical compositions showed that the DM content of maize stover, teff straw, Barley straw, and Wheat straw were 87.87-73.10%, 88.02-88.6, 86.32-87.02% and 71.30-87.38%, respectively. The dry matter (DM) content of crop residues was above 80%, which corresponds with Sisay (2006). Crop residues had CP content of 4.38-4.97% and 2.84-3.20% in teff straw and maize stover, respectively. This result is lower than the range of FAO's (1984) recommendation, that the threshold value of feedstuffs for CP is between 7% and 8%, which is adequate for maintenance of livestock and above the minimum requirement for optimum rumen function (7.5%) suggested by Van Soest (1982). The results of the current study agree with the report of Seyoum and Fekede (2008) that cereal crop residues are normally characterized by low digestibility and energy value, which are both inherent in their chemical composition. The former contained lower CP compared to the later. The lower content of CP for crop residues may be compensated with strategic supplementation of protein feeds to improve cattle performance**.**

Table 20.Chemical composition of major feed resources in the study area

Types of feeds	Chemical composition											
	DM%		Ash%		CP%		NDF%		ADF%		ADL%	
	Agro-ecologies		Agro-ecologies		Agro-ecologies		Agro-ecologies		Agro-ecologies		Agro-ecologies	
	Low land	Mid land	Low land	Mid land	Low land	Mid land	Low land	Mid land	Low land	Mid land	Low land	Mid land
Maiz	87.87	73.10	8.20	9.25	3.20	2.84	74.4	73.1	65.8	44.3	69.8	5.72
Barley straw	87.03	86.32	10.90	10.28	5.96	4.58	68.85	65.80	39.06	38.28	5.55	38.28
Wheat	87.32	71.32	10.42	10.25	3.42	6.57	68.03	66.56	43.14	37.32	5.83	37.32
Teff	88.0	88.6	10.3	9.19	4.97	4.38	68.1	69.8	35.7	38.1	4.82	38.1
Natural grass	87.02	86.98	10.88	12.71	3.97	6.36	63.50	58.58	36.08	33.98	4.95	33.98
Desho		83.8		10.3		2.25		66.7		35.1		7.68
Elephant		84.2		10.5		3.29		61.1		32.8		8.64
Badana		78.6		13.5		14.0		34.4		22.2		9.25
Cordial Africana		83.25		23.22		11.13		36.53		36.53		11.36

5. CONCLUSION

Regardless of agro-ecologies the major feed resources in the study areas were crop residues (such as wheat, barley straw tef straw and maize straw) and crop aftermath. Agro-industrial by products (wheat bran and noug cake), non-conventional feeds and improved forage were uncommon and rarely used in the study areas. Very commonly practiced feeding systems in the study areas were free grazing on private grazing land around the village, stall feeding (zero-grazing) and tethering around homestead on natural pastures. The total DM yield produced and required for the existing tropical livestock unit per household were found to be negatively balanced in the study areas. Currently, the total dry mater production from natural pasture grazing, crop residues, crop aftermath grazing and forest and uncultivated land in the sampled household was 1536.5376tons per year. The total dry matter produced per year in the study *area* can only fed the animals for only 4.38months. According to the opinion of the sampled households, in the rest of the year, animals suffer from feed shortage which resulted in weight loss, mortality and milk reduction. Even though, the available feed recourses were reported to be adequate only for about less than half of a year, the contribution of other feed resources, livestock feeding in the study areas constrained by shortage of land, lack of grazing land, concentrate feeds and occupation of communal grazing and for investment activities. As it was disclosed by majority of respondents, feed availability and seasonality were the most commonly occurring problems and constraints that might affect the development of the livestock production in the study areas. On the other hand, farmers have been adopting coping strategies with dry season feed scarcity using Purchase forage (rent grazing land concentrate feed, hay, non-conventional feeds, transferring stocks to relatives and reducing herd size.

6. RECMMENDATIONS

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- The use of improved forage as animal feed was not common in the study areas. Thus, provisions of extension services to farmers' about the importance of sown forage and forage developing strategies should be required.

- Training should be given on feeding practices and coping strategies of available feed resources such as use of urea treatment, mineral block and silage making, in order to improve the quality of feed in the study area.

- Attention is needed to design strategies to maximize the use of crop residues as feed than other alternative uses, such as by introduction of multipurpose trees as a source of fuel land construction wood and animal feed.
- Limiting the number of animals per head could be also important in order to balance the feed supply and requirement of dairy cattle.
- The livestock population of the respondent needs a total 561.533 tons of DM feed per year for maintenance requirement alone but the current production (1536.5376tone of DM/yr.) can only support for 4.38months. Therefore, alternative feed production technologies such as development of improved forages, efficient feed utilization technologies (e.g. Provision of chopper) and natural pasture land improvement measures should be under taken.
- The contribution of improved forage in livestock feed was very low. To alleviate this problem, nursery sites should be established in potential kebeles of the Woreda so that dissemination and utilization of these seedlings will be practical.
- Since the production, productivity, transportation, storage and utilization efficiency of the available feed was low, further research and development works should be designed to increase the production, and productivity of the animals.

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8. APPENDICES

8.1. Appendix Tables

Appendix Tables 1 mean of land holdings in the study areas

Parameter	Agro-ecologies			
Land holding (ha)	Mid altitude (Mean ±SE)	Low altitude (Mean ±SE)	Over all (Mean ±SE)	p-value
Cultivated (Food crop production) land	1.11±0.06^{ns}	1.2±0.03^{ns}	1.15±0.04	1.1
Grazing land	0.14±0.02^{a}	0.33±0.03^{b}	0.23±0.05	0.01
Homestead land	0.21±0.02ns	0.14±0.02^{ns}	0.12±0.02	0.16
Forest and woodland	0.06±0.06^{ns}	0.07±0.01^{ns}	0.06±0.03	0.46
Fallow land	0.02±0.06^{a}	0.01±0.01^{b}	0.01±0.03	0.00
Total land holding	1.44±0.06^{a}	1.75±0.11^{b}	1.6±0.28	0.00

Appendix table 2.Conversion of Livestock number to Tropical Livestock Unit (TLU)

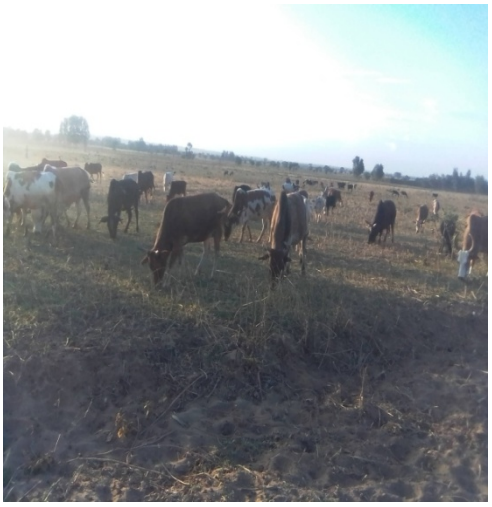
Animals Species	Tul
Cow	0.7
Oxen	1
Heifer	0.5
Calves	0.02
Bulls	1
Sheep	0.1
Goat	0.1
Donkey	0.5
Horse	0.8
Mule	0.7

Poultry	0.01

8.2. Appendix Pictures

A B

Appendix picture 1Elephent grass (picture A)Desho grass (picture B).



A B

Appendix picture 2 free grazing of livestock in the study area picture A and B

A

Appendix picture 3Teff straw and Maize-Stover stacked outside the shed in the study area (picture A)

A B

Appendix picture 4Feed sample processing for chemical analysis (picture **A)** Collocated sample (picture B**)**

The questionnaire used to collect household level data

The information obtain from this interview questionnaire will be used only for academic purpose and the personal information will be kept confidential. Therefore, kindly request you to feel free in answering the questionnaire. Thank You.

General Information

Woreda name_____Keble name_____Village name _____

Name of Enumerator_____ Date_____/_____/_____

1. Household Characteristics (Include all persons living permanently in the household and taking food from the same kitchen)

Name of the house hold head_

Age of house hold head (yrs.)1.≤302.31-293.40-

494.50-595.≥603- Family size_____. Sex

1. Male2.Female_____

Maritalstatus1.Married2.Single3.Widow4.Divorced5.other_

Educationalstatus of the household 1.Illiterate 2.ReadandWrite 3.Secondary 4. College and above

Agroecology1.Mid_altitude2.Low_altitude

2. Land holding and land use system

No	Types of land use	Total(hectare)
1	Cultivated(Food crop production)land	
2	Grazing land	
3	Homestead land	
4	Forest and wood land	
5	Unused land(Fallow land)	
6	Crop Residues	
8	Other Feed Resources	

3. Major crops grown and estimated yields in last year

Type of crop	Area covered in 'Hectare'	Estimated grain yield(quintal)	Remarks

Wheat			
Barley			
Teff			
Bean			
Pea			
Oilseed			
Sorghum			

Types of animals	Total Number of animals	Types of animals	Total Number of animals
Cows		Goat	
Oxen		Donkey	
Bull		Horse	
Heifer		Mule	
Calves		Bee colony	
Sheep		Others(specify)	

4. Type and number of livestock you have

5. Livestock feed resource

A. Grazing land

1. Is there communal grazing land in your area? A. Yes B. No

2.What is the type of communal grazing land in the area ?A. Open grass land B. Tree covered grass land C. Bush land grass land D. Swampy or any other specify.

3. Do you have private grazing land? A. Yes B. No If yes, what type?

A. Open grassland B. Tree covered grassland C. Bush land grassland D.Swampy or any others

The size of private grazing land---------- ha

4. In what form are you using the natural grazing lands you have?

1. Continuous grazing2.Rotational grazing3.Cut-and-carrysystem4.Other (specify):

5. Is the grazing resource adequate to your Livestock?(A)Yes(B)No

If No what measures do you take alleviate this problem?

(A) Purchase concentrates (B) Purchase forage (rent grazing land) (C) Use crop residues (D) Preserve any feed during high abundance (E) Undergo destocking programmer (F) others (specify)

1.What are the causes of grazing land deterioration?

A. Decrease in the size of land B. Drought problem C. Overstocking D. Weeds dominated

E. Overstocking and drought F .Over stocking and decrease in the size of land

2. What are the constraints related to grazing land utilization?1. Burning 2.Weed 3.drought

4. Overgrazing

6. Improved forage and pasture crops

1. Do you have sufficient access to improved forage seed/planting materials? 1. Yes2. No

2. If yes what is you resource of forage planting material? 1. Agriculture office

2. NGO 3.Researchcenters 4.Purchase from other farmers/marke5. Others (specify)_____

3. Did you saw any forage crop last year or this year A. yes B. no

If yes mention the type of forage crops cultivated with their area coverage.

No	Species of forage crops Area	Area coverage(ha)
1		
2		
3		

If you do not produce improved forages, what are there on behind?

1. Shortage of land 2.Shortage of planting material3 Lack of awareness 4. Financial problem

7. Crop residue

1. Which crop residue is your dominant feed? 1. Teff straw 2.Barley straw 3.Pea straw

4. Wheat straw 5.Bean straw 6.Other (specify):_____

_____

2. How do you store crop residues? A. Stacked outside B. Stacked underside.
Others (specify)

3. What is the source of crop residues? A) Purchased B) produced on farm C) obtained as gift D. other (specify) _____

4. If purchased what is the estimated price per bale or kg ?I its ---------- Birr

5. The amount of feed purchased_____kg or ton?

6. When do you start feeding crop residues?(A) Soon after collection (B) One month after

(C)Two months later(D) Over two months.

7. In what form do you feed your crop residue? A) Whole B) chopped
C) treated D)mixed with other feeds

D) other(specify:_____

8. What are the Problems related to crop utilization? A. Collection and transportationB. Feeding

C. Storage

8. Crop aftermath

1. Do you graze your field after harvesting crops?(A)Yes (B)No

2. How many cropping season do you have per annum? Encircle one of it. A, one B, two C, Three

3. Do you irrigate and produce crops?(1)Yes (2)No

4. If yes how many hectares and how many times perannum?:Haand:_____times.

5. Do you give any other feeds to your animals while grazing on the aftermath? (A)Yes (B)No,

6. If yes what type of feed given? A. crop residue B.hay C. Concentrate

9. Agro industrial by–products

1. Do you use any agro industrial by-products? (1)Yes (2) No

2. If yes what is the name? 1. Nug cake 2.Oilseedcake 3.Wheat bran

10. Feeding Practices of Livestock

Type of feed	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Private grazing												
Communal Grazing												
Cereal crop residue												
Pulse crop residue												
Cut-and carry												
Weeds from crop lands												
Stubble grazing												

Concentrate												
Salt												
Others(specify)												

1. What do you feed Livestock at different months

Is there a problem of feed shortage for Livestock? 1. Yes 2.No

2. What measures do you take to cope with the feed shortage?

A. Purchase concentrates B. Purchase forage (rent grazing land) C a use crop residues D. Reduction of stock E. fodder trees F. Other (specify) -------

3.What is the reason of animal feed shortage? A. Shortage of rain/irrigable Water B. shortage of land C. shortage of improved fodder D. Improper management

4. What type of herding management do you have for your livestock?

Management type	Cows
1. Grazing	
2.Tethering	
3.Stall feeding	
4.Others (specify)	

1. Crop residues and Hay management practice (Feeding systems)?

5. What is the feeding priority of the available feed?

A. crop residues B.hay C. forage D. concentrate

6. How do you classify months of the year according to feed availability

Feed availability	Months(Tike"√"if applicable)

	Sep	Oct	No	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Excess											
Adequate											
Shortage											
Adequate											
Shortage											

11. Feed collection, transportation and storage

1. What is the appropriate time for cutting to make hay? 1.before blooming2.at blomming
   3.after blomming
2. Do you conserve/store Feeds for your animals?
   (A) Yes (B) No If yes, which type of feed do you conserve/store?

Types of feed	Tick one or more''√''	Rank
Hay		
Crop residues		
Improved forage		

3. If you are not preserving hay either from pasture or crop residues, what are the reasons?

(A) Inadequacy (B) Labor shortage (C) lack of awareness (D) Other, specify

4. Do you transport feeds in your area? (A) Yes (B) No

5. If yes what is the transporting system for the different feed categories (A) Human back (B) Donkey or horse (C) Car (D) Others (Specify) ----------

6. What problems do you have in transporting livestock feeds? (A) No road access--(B)--Bulkiness of the feed (C) Absence of transporting facilities (D) Others, Specify

A: Questionnaires for Group discussion

A. Farmers

Name of kebele _____

_____

What are the major feed resources livestock in the village?

2. How do you see the availability of natural feed resources in the area (trend in the last five years)? _____

2. What problems are you facing in livestock feed production, management, transportation and storage? (Rank them) What problems did you observe in improved forage production and management?

a. Natural Pasture b. Crop residue c. Agro industrial By-products d. Others_____

1. Types of ownership of grazing lands?

_____which is most abundant? (For instance communal, private and sub-divisions of them if they exist)

2. What problems did you encounter in gazing land utilization and management of different to ownership types?(Rank them) _____

_____

3. What administrative measures do you follow to solve problem related to grazing land?

4. Do you get extension services on animal feeds production, management, utilization and improvements? _____

5. How frequent do you get extension services on different kinds of feed resources (Consider each feed category separately? a. Natural

Pasture b Crop residue c. Agro industrial byproducts d. others.....

This is the end of the group discussion of the survey. Thank the unselected farmers for their time and explain how this information will be used.

B. Extension agent/Livestock expert

1. As an extension agent/Livestock expert, what are the major problems in animal feed production, management, transportation, storage and utilization?

a. Natural Pasture b. Crop residue c. Agro industrial By products d. Others

2Are there any other organizations in your area working on animal feeds production, management and marketing? _____

If any who are they? _____

What are they doing? _____

3. Did you get trainings on animal feed management?

Who give you the training? _____

And are you satisfied with the training? _____

1. What limitations you observed of farmers concerning feed production, management, transportation, storage and utilization? _____

a. Natural Pasture b. Crop residue c. Agro industrial By products d. Others_____

2. How many improved forage species are found in your area? _____

What is the source? _____How is their use by the communities? _____

1. What to do to improve livestock feed shortage?

_____

_____

Questionnaire complete .Thank the participants for their time