ASSESSMENT OF LIVESTOCK FEED RESOURCES AND FEEDING SYSTEMS IN GOMBORA DISTRICT OF HADIYA ZONE, SOUTHERN, ETHIOPIA

M.Sc. Thesis

BY: MELAKU OSABO

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ASSESSMENT OF LIVESTOCK FEED RESOURCES AND FEEDING SYSTEMS IN GOMBORA DISTRICT OF HADIYA ZONE, SOUTHERN, ETHIOPIA

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A Thesis

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We, the thesis advisers have verified that the student has incorporated the suggestions and modifications given during the internal thesis is ready to be submitted. Hence, we recommend the thesis to be submitted for external defense.

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Decision /suggestion of department Graduate Council (DGC)

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Chairperson, DGC Signature Date

DEDICATION

To my father Osabo Keshebo, my mother Demekech Zegeye, my wife Mekdes Taddele, my brothers and sisters for their all-round and unconditional support in my life.

STATEMENT OF AUTHOR

I declare that this thesis is my own work and that all sources of materials used for the thesis have been duly acknowledged.This thesis has been submitted in partial fulfillment of the requirements for M.Sc degree at Jimma University,College of Agriculture and Veterinary Medicine and is deposited at the University library to be made available to users under 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.Brief quotations from this thesis are allowed without special permission provided that accurate Acknowledgment of sources is made.Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the Department of Animal Science or the Dean of the School of Graduate Studies when in his or her judgment the proposed use of the material is in the interests of scholarship.In all other instances,however,permission must be obtained from the author.

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BIOGRAPHICAL SKETCH

The Author, MelakuOsabo, was born on 5th of November 1985 inLemo district of Hadiya Zone, Southern Nations Nationalities and Peoples Regional State; Ethiopia.He attended his junior elementary school at Wachamo Junior and Secondary School (1995 to 2002), and his secondary school at Wachamo comprehensive secondary school from 2003 to 2006.He joined Ambo University in2007 and studied Animal Science and awarded B.sc. in Animal Production in 2009. After graduation, he was employed in Bureau of Agriculture and administration in Gombora District of Hadiya Zone and he worked there until he joined the School of Graduate Studies at Jimma University, College of Agriculture and Veterinary Medicine in September 2014 to pursue his M.Sc. degree in Animal Production.

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
AOAC	Association of Analytical chemists
BW	Body Weight
BNB	Blue Naile Basine
CP	Crude Protein
CSA	Central Statistical Agency
DM	Dry matter
EATA	Ethiopian Agricultural Transformation Agency
ESAP	Ethiopian Society of Animal Production
FAO	Food and Agricultural Organization
GWARDO	Gombora Woreda Agricultural and Rural Development Offce
HH	Household
JUCAVM	Jimma University College of Agriculture and Veterinary Medicine
ME	Metabolizable Energy
MOA	Ministry of Agriculture
NFE	Nitrogen Free Extract
SDDP	Smallholder Dairy Development Project
SNNPRS	Southern Nations Nationalities and Peoples Regional State
SPSS	Software package for social science
SSA	Sub Saharan African
TD	Trunk Diameter
TLU	Tropical Livestock Unit

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ABSTRACT

The study was carried out in Gombora district of Hadiya Zone,Southern Nations Nationalities and Peoples Regional State,Ethiopia with the objectives of assessing available livestock feed resource and feeding systems,determining annual feed balance and requirements in terms of dry matter,crude protein and metabolizable energy as well as identifying constraints and opportunity for livestock production in relation to feed availability.Field observation key informant discuss and structured questionnaire interview were employed to generate data.The study district was classified into low and mid land altitude-regions and 61 and 65 households were selected from low and midland altitude regions,respectively and interviewed.Data were collected and analyzed using statistical procedure for social sciences(SPSS)verion 20 (SPSS,2011).The results of study showed that crop-livestock production system was the dominant farming system in both altitude regions.The average livestock holding size per HH was 6.78±0.15TLU;and higher($P<0.01$*) for lowland than midland,with the TLU of 6.06±0.14cattle,2.04±0.06oxen,0.29±0.05bulls2.71±0.13 cows,0.71±0.06heifers,0.13±0.03calves,0.13±0.03sheeps,0.13±0.03goats,0.10±0.02donkeys,0.1± 0.03horses and 0.17±0.02mules.Cattle were kept for milk,draught,meat,income,calves and manure production.The major feed resources were crop residues 48.88% and grazing resources 33.64%,then fodder trees/shrubs 8.45%,non-conventional feeds 4.58% and cultivated improved forage 4.46%.Free grazing,late to grazing,stall feeding,tethering,supply feeing and hearding practices are major livestock feeding systems.The major constraints related to livestock feed were shortage of feed,shortage of grazing land,poor market access,lack of awareness on forage cultivation and poor feeding practices.The productivity is low due to feed shortage.The overall feed balance in terms of DM,CP and ME yield per year to a total TLU value of 854.35 was found to be 851t,60t and 7,200,000MJ respectively,with negative balance of 1097.98t,40.9t and 3,116,000MJ,respectively.Based on the findings of the present study,low output of livestock in Gombora district is linked with feed shortage.Therfore,adoption of alternative feed production technologies such as integrating improved forage,efficient feed utilization,urea treatment,also technical and institutional intervention would be very crucial to overcome the prevailing feed shortage problem.*

Keywords*: feed availability; feed balance; feeding practice; feed requirement, Hadiya, Ethiopia.*

1. INTRODUCTION

Majority of the world people are living in developing countries and depends directly or indirectly on livestock for their livelihoods (World Bank,2008;FAO,2009).Globally,livestock contributes about 40% to the agricultural gross domestic product (GDP) at global level and about 30% of the agricultural GDP in the developing world (World Bank,2009).Ethiopia is largely an agrarian country with over 90% of its population in rural area and agriculture in Ethiopia is the foundation of the country's economy,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).The livestock plays a vital role as source of food,family income,source of power and farm input,foreign exchange and contributes 15-17% of the total national GDP and 35-49% of agricultural GDP (Behnke and Metaferia,2011; EATA,2013).Ethiopia is a home for many livestock species,suitable for livestock production and have 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) overstocked natural pastures are highly overgrazed resulting in the elimination of nutritious plants,increase in unpalatable plant species and sever land degradations.

Gombora district,located in Hadiya Zone ,Southern Nations Nationalities and Peoples Regional State of Ethiopia is not exception to th is situation.In Gombora district livestock play an important role in livelihoods of rural population.However,there has been no research work conducted in the area of assessment of quantity and quality of available feed resources in relation to livestock requirement in the Gombora district.In addition,the balance between feed resources and livestock requirement,livestock feeding system,constraints and opportunities of livestock production in relation to the available feed resources needed to be documented.With these rationale and justification,the present study was aimed to undertake in Gombora district of Hadiya Zone,Southern Nations,Nationalities and Peoples Regional State of Ethiopia.The finding of this study will be a good reference sources for Gombora district agricultural officials and other researchers,development agents and stakeholders to design strategies.The data generated from this study,will help farmers to be valuable in livestock productivity and create awareness on livestock feed resources and feeding practices.

1.1 Objectives of the Study

- To assess the available feed resources and feeding systems of livestock in Gombora District of Hadiya Zone
- To determine the balance between the available feed resources and livestock nutritional requirements in terms of dry matter,crude protein and metabolizable energy in Gombora District of Hadiya Zone
- To identify the major livestock nutritional constraints and opportunities in terms of the available feed resources.

2. LITERATURE REVIEW

2.1 Livestock Feed Resources

Feed is the most important requirements for metabolic activities,maintenance,milk production, pregnancy and gain in body condition of livestock.For optimum livestock productivity,the available feed resource should match with the production systems practiced and the number of animals in a given area (Assefa *et al*.2013).The availability and relative importance of different feed resources varies from place to place and from time to time depending on agro-ecology,livestock production systems and seasons of the year.In Ethiopia small-holder livestock production system is characterized by low milk production,low growth rates,extended calving and lambing intervals and a relatively late age at maturity (Bereda *et al*.,2014).The major technical constraint to improving livestock production to meet the increasing demand for meat,milk and milk products in Ethiopia is feed shortage for livestock.At present inaduqate livestock nutrition is common problem all over Ethiopia negatively affecting the development of viable livestock industries (Tolera *et al*.,2012).In Ethiopia livestock feed resources are natural pasture,crop residue,improved forages,agro industrial by products and vegetable and fruit rejects of which the first two are quantitatively significant (Mengistu,2004;Tolera *et al*.,2012).The fast growing human population in most parts of Ethiopia increased the demand for cultivable land be used for crop production,resulting in reduction of grazing lands.This situation led to an increased dependency on poor quality crop residues as livestock feed (Alem *et al*.,2011).Feed,usually based on crop residue,grass and fodders are either not available in sufficient quantities due to fluctuating weather conditions or due to poor nutritional quality.Improved nutrition through adoption of cultivated forage and better crop residue management utilization can substantially raise livestock productivity.

2.1.1 Grazing of Natural Pasture

The productivity and nutritional quality of grazing natural pasture are influenced by several factors including ecological condition and management scheme.The ecological factor mainly includes climatic condition such as rainfall and soil type.The management scheme affecting productivity and nutritional quality of natural pasture include grazing intensity,season of grazing and stage of maturity of the plant.As pasture gets mature,it is characterized by high content of fiber and low protein content.Yihalem (2004) cited in (Mulu,2009) the more production of legume to the grass composition,the higher crude protein content of the mixed stand and bring better productivity on the animals.Abate (2008) pointed out the value of grazing land depnd on management schems and grazing intensity,due to poor management and over stocking the yield as well as quality of grazing land is very low.The dry matter produced from natural pasture 3 and 4-6tDM/hectare was reported from highlands and midland altitude regions on freely drained soil and seasonally water logged fertile areas respectively (Mengistu,1998).

2.1.2 Crop residues and Crop aftermath

Crop residues are by-products of crop production activities and represent important source of livestock feed in the mixed crop-livestock production system.Crop residues,mainly cereal crops are the major feed resource particularly during the dry period,but may not be significant in the rangeland dominated lowland areas of the country.However,in the area where rangelands are converted to croplands,crop residues are becoming the major feed sources for livestock.In the high lands,crop residues are obtained from wide variety of crops grown on subsistence farm holdings after harvesting of the grains for human consumption.The crop residues from cereals (tef,wheat,barley,maize and sorghum);pulses (faba beans,chicken peas,haricot beans and field peas) and oil crop productions provides considerable quantity of dry season feed supply in many farming systems of the country.The availability and amount of DM yield of crop residues is closely related to the farming system,the type of crops produced,the amount of grain production and intensity of cultivation (Mengistu,2004).In integrated crop-livestock production systems the potential of using crop residues for livestock feed is the greatest.As more and more land is put under crop production livestock feed becomes scarce and crop residues particularly cereal straws remain the major feed source for the animals particularly during the dry period of the year.Tolera *et al*.(2012) indicated that crop residues contribute about 50% of the total feed supply in Ethiopia.The species of the plant,agronomic practice used,soil,temperature and stage of maturity of the plants at harvest influence the chemical composition and palatability crop residues.Cereal straw and stovers are generally characterized by low nutrient,high fiber content,low digestibility and limited consumption by livestock.Whereas,pulse crops (grain legumes) represents good quality roughage because of their better content of crude protein,which ranges between 5-12% (Tolera,2008).Crop residues from leguminous crops have better quality than the residues from cereals.Residues from leguminous crops also contain less fiber and are high in digestible crude protein than crop residue from cereal grains (Aredo,1999;Bogale,2004).Crop aftermath grazing is also serve as important livestock feed sources after harvesting the crops especially,during dry season when the quantity and quality of available fodder from natural pasture declines radically.Livestock are allowe to graze on crop aftermath of wheat,tef,barley,sorghum and pulses after harvesting depending on availability of crop grown.In general,livestock owners used crop aftermath grazing to their livestock until almost the second short rain coming (Tonamo *et al*.,2015).

2.1.3 Fodder Trees and Shrubs

Fodder trees and shrubs are potentially protein supplement feeds for livestock.Leaves and fruits of fodder trees and shrubs used as supplements for ruminant animals in several regions of the world (Kechero *et al*.,2012).Most browse species have the advantage of maintaining their greenness and nutritive value throughout the dry season when grasses dry up and deteriorate in quality and quantity (Rangnekar,1992).Fodder trees and shrubs contain considerable amount of nutrients that are deficient in other dry period feeds including grasses,this indicating that fodder trees and shrubs could be used as livestock feeds (Ngodigha and Anyanwu,2009).Fodder trees and shrubs are generally rich in protein,vitamins and mineral elements and can be used as dry season feed sources and supplementary feeds in improving the nutritive value of poor quality grasses and crop residues.

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 residue and roughage feeds (straw,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,farmer's demonstration plots,dairy and fattening areas.Forage crops are commonly grown for feeding dairy cattle with oats and vetch mixture,fodder beet,elephants grass and desimodium species,Rhodes/Lucerne mixture,tree Lucerne,Phalaris or trifolium 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 Concentrate Feeds

Concentrates are low in crude fiber content but high in either protein,energy or in both protein and energy.Cereal grains are primary energy concentrate but low in crude protein.Energy concentrates used in animal feeding includes cereal grain (corn,sorghum wheat etc),cereal grain by-products (wheat bran and corn gluten meal),root and tubers (cassava,potatoes etc) and industrial by-products (molasses,citrus flesh and brewers by-products).Protein concentrates used in animal feeding includes oilseed meals (soybean,cottonseed,rapeseed,linseed,sunflower meals etc),grain legumes(beans and peans) and animal protein(meat meal,fishmeal's etc).Supplementry concentrate feeding is required when the pasture supply is inadequate in terms of either quantity or quality,also in time of feed shortages.Under the current Ethiopian conditions,the highest demand for supplementary concentrates feeding comes from modern dairy production and fattening animals (Mengistu,1998).

2.1.6 Non-Conventional feed Supplements

Non-conventional feed resources refer to feeds that have not been traditionally used for feeding livestock and are not commercially used in the production of livestock feeds.Non-conventional feeds vary according to the feeding habit of the community e.g.vegetable refusals;sugar cane leaves,Enset leaves,fish offal and etc are non-conventional feed types.Admassu (2008) who identified non-conventional feeds and it includes like residues of localdrinks,coffee,tela,fruits and vegetables leftover.Due to their low cost and availability of non-conventional feed resources such as by-products from local brewery and distillery are widely used by smallholder farmers (Nurfeta,2010).According to Negesse *et al*.(2009),non-conventional feeds could partially fill the gap in the feed supply,decrease competition for food between humans and animals,reduce feed cost,and to self-selficiency in nutrients from locally available feed sources.So important to examine for cheaper non-conventional feed resources that can improve intake and digestibility of low quality forages.

2.2 Nutirent require and Nutritive value

2.2.1 Nutirent require

Generally,livestock require nutrient for varius fancation for maintenance, growth, production and reproduction.Nutrition required for these functions are expressed in terms of energy,protein, minerals and vitamins.Energy is the fuel for all bodily processes breathing,walking,eating, growth,lactation,and reproduction.Maintenance energy is the fuel used to keep the animal alive without losing weight or giving milk.Streeter (2006) cited in (Wondatir,2010) Energy,protein, and digestibility of feeds are crucial in determining nutritional adequacy and feeding levels for different classes of livestock.Livestock productivity is a fancation of digestable feedintake which the absorbed feed nutrients are used for productive pourpose.Livestock requires feed nutrient for maintenance and production also for a work.Teka *et al*.(2012) the decline in CP content seize seriously affects the maintenance and production requirements of livestock.Firew (2007) cited in (Worku,2014) the lower nutrient contents reduce rumen efficiency,rumen micro-fauna and milk production performance.Lactating cows for example are unable to meet their nutritional requirements i.e.they lose weight and body condition during lactation due to high nutrient demand for milk production,hence feed nutrient is very crucial for optimal funcation.The amount of feed needed to meet maintenance requirements will vary with the type and quality of feed available.Energy,protein,and digestibility of feeds are central in determining nutritional adequacy and feeding levels for different classes of stock.The daily nutrient requairment per livestock for maintainance is shown (Table 1).

Table 1**.**Total daily nutrient requirement of livestock per species

Livestock	DM(kg)	CP(g)	ME(MJ)
Oxen	4.8	361.3	33
Bulls	4.8	361.3	33
Cows	4.4	227.8	29.7
Heifers	3.3	232	21.7
Calves	1.9	144	13
Sheep	0.65	53	4.3
Goats	0.64	49	5
Horses	5.3	400.4	27.6
Donkeys	2.5	192.5	14.9

Source: Kearl (1982) and McCarthy (1986).

2.2.2 Nutritive value

Limited feed supply and poor quality of the available feeds are the major constraints for optimal livestock productivity.Poor quality feeds and inadequate nutrition during dry periods,has been reported to be one of the most important constraints for livestock production in Ethiopia across all ecological zones.The problem of livestock feed both in quantity and quality is aggravated in arid,semi-arid and tropical regions with scarce and erratic rainfall that limits the growth of herbaceous species and biomass yield in rangelands.Thus,livestock in such regions have to survive on recurrent shortage of feed resources of insufficient nutritional value for most part of the year (Boufennara *et al*.,2012).Nutitive value of livestock feed varies in season and amoung specific individual plant species.Yayneshet *et al*.(2009) pointed that CP content of herbaceous plants in a semi-arid region of Ethiopia drastically declined towards the onset of the dry season.The difference among species in their nutitive value is assumed that,due to the variation in the genetic characteristics inherent to specific individual plant species (Teka et al.,2012).In all developing countries including Ethiopia,grains which form the bulk of concentrate feeds for livestock are in short supply and expensive,because the significance and use of grains as human food has more and more increased which causes the livestock industry to compete with humans for this resource.The use of non-conventional feedstuffs to decrease competition for food between humans and animals will reduce feed cost and contribute to self-sufficiency.It is essential to look for cheaper non-conventional feed resources that can complement available forages.In general,in terms of the nutritional value of livestoctk feeds (grass,crop stubble and non-conventional feed) are shown (Table 2).

Table 2.Nutritive values of livestock feed grass,crop stubble and non-conventional feeds

Feed types	DM	Ash	CP	MEMJ/kg	Authors
Pennisetum Purpureum	30.12	12.38	13.85	10.22	Mediksa *et al*.(2016)
Pennisetum pedicellatum	30.85	-	9.55	6.82	Asmare (2016)
Cynodon dactylon	91.50	9.90	9.3	7.67	Gelayenew (2012)
Chloris gayana	86.9	-	14.1	7.54	Kechero (2008)
Barley stubble	92.53	6.24	2.2	8.03	Wondatir (2010)
Wheat stubble	92.98	6.41	2.09	7.27	Wondatir (2010)
Tef stubble	93.30	9.87	1.79	7.48	Wondatir (2010)
Avocado peel	24.8	8.7	7.1	13.6	Negesse *et al*. (2009)
Banana peel	12.4	16.3	5.5	9.3	Negesse *et al*. (2009)
Mango peel	18.1	4.2	6.6	10.5	Negesse *et al*. (2009)
Papaya peel	11	13.8	24.1	9.9	Negesse *et al*. (2009)
Potato peel	24.7	5.3	8.3	10.4	Negesse *et al*. (2009)
Carrot peel	19.3	10.8	4.8	10.3	Negesse *et al*. (2009)
Cabbage peel	10.3	13.0	13.7	10.2	Negesse *et al*. (2009)
Coffee pulp	90.33	9.04	11.13	7.36	Wondatir (2010)
Bean hull	90.87	3.06	6.54	7.39	Wondatir (2010)
Pea hull	91.02	3.62	16.38	9.55	Wondatir (2010)
Atala	21.80	5.80	21	13.2	Wondatir (2010)

DM, dry matte; CP, crude protein; ME, metabolizable energy

2.3 Livestock Feeding System

In Ethiopia livestock feeding systems includes natural pasture,crop aftermath,hay and crop residues feeding.At present livestock grazing on permanent pasture lands and on crop aftermath after harvest is also common in many other places in Ethiopia (Desalew,2008).Feeding of livestock in different places differs depending on forage availability,climatic conditions,season of the year and type of animals (Teklu *et al*.,2011).The most common livestock production problem is attributed to seasonality in feed supply and poor nutritive value of the available feeds.Most of the available feed ingredients are often unable to provide even for the maintenance requirement of livestock Anderson (1987) cited in (Worku,2015).The use of improved forages and agro-industrial by products in rural livestock feeding is minimal,since most of the agro industrial by product are concentrated in uraban and peri-urbun areas (Benin *et al*.,2004; Mengistu,2005).

2.3.1 Feed Availability and Source for Livestock feeding

Inadequate feed supply, both in terms of quantity and quality is the major constraint affecting livestock production in Ethiopia.The dry season is characterized by inadequacy of grazing resources as a result of which animals are not able to meet even their maintenance requirements and lose substantial amount of their weight.The use of grazing land resources has declined while the use of crop residues and purchased feed have generally increased (Benin *et al.*,2003).Under smallholder livestock production system,animals are dependent on a variety of feed resources which vary both in quantity and quality.The fibrous agricultural residues contributes a major parts of livestock feed especially in the populated countries where land is prioritized for crop cultivation.The availability and quality of forage are not favorable year round.As a result,the gains made in the wet season by the animals are totally or partially lost during the dry season (Mengistu,2003;Tolera *et al*.,2012).Cereal grain and cereal grain by-products,particularly fermentation residues from alcoholic drinks and beverages are abundant in most parts of the country.The feed resources availability for livestock feeding varies in different production systems of Ethiopia.The production systems and feed resources availability for livestock feeding in Ethiopia are persnted in (Table 3).

Table 3.Availability of different feed resources for livestock feeding in different production systems of Ethiopia.

Coffee-Enset system	Crop production system	Coffee-crop system	Pastoral, agro-pastoral system
Natural grazing/ Hay	Natural grazing/ Hay	Natural grazing/ Hay	Natural grazing
Cereal crop residue	Cereal/Pulse crop residue	Enset by-product	Standing hay
Oilseed cakes	Oilseed cakes	Sugar cane tops /leaves	Browse shrubs & trees
Enset by-product	Sugar tops /leaves	Root crop leaves and	
Sugar cane tops/leaves	Local brewery by-products	Laocal brewery by-products	
Root crop leaves	Molasses	Natural grazing	
Local brewery by-products	Milling by-products		
Molasses			
Milling by-products			

Sorce: Alemu (2009).

2.3.2 Livestock feed Management

Livestock producers implement feed management practices.The most feed management practices used in conservation of feed resources are hay making,traditionally conserved crop residues ,grazing in the form of standing hay.Hay is forage harvested during the growing period and preserved by drying (Gizachew,2012).Hay is the oldest and still the most important conserved method,despite its dependence on the presence of suitable weather at the time of harvest (Hassen *et al*.,2010).The increase in human population and the associated decrease in the size of the grazing land had guide farmers to use different forms of conservation practices.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.However,as both grasses and legume decline in quality at the dry season progresses,ways of preserving nutritive quality through haymaking during the rainy season may be advisable (Admassu,2008).Solomon (*et al.*,2008a) cited in Yadessa (2012) 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.According to

FAO(1997),annual and perennial grass from natural pasture consumed during the dry season and often at late stage of maturity together with the straw and stalk from cereal crops constitutes low quality forages,with high lignified cell wall and poor nitrogen.The quality of hay prepared varies with grass legume proportion,leaf to stem ratio and physiological development of the forage up on harvest (Gizachew,2012).The main aim of grazing management is to convert forage resources to animal products such as meat and milk in the most efficient way possible.To achieve this,it is necessary to supply the animals with high quantities and quality forage to ensure acceptable levels of animal performance.It is also important to ensure that the herbage is utilized effectively with low levels of wastage.All this must be done within the context of sustainable farming systems,to ensure that the grazing resources are maintained and that the management practices to not have unacceptable deleterious impacts on the environment,in terms of soil,water,air and wildlife habitats (Wright *et al*.,2002).

2.3.3 Livestock feeding Calendar

Livestock feeding calendar is an essential livestock management practice to use the available feed resources efficiently and to supply the livestock with high quantity and quality feed and to overcome feed shortage.Livestock feeding calendar varies depending on availability of the feed resources in the different months of the year (Mengistu,2003).Mohamed and Tedla (1995) identified three feeding periods and associated feeding strategies in the Central Highlands of Ethiopia,which also covers a significant part of the BNB.The first one is the main rainy season (June-September) when feed is adequate and livestock are under controlled grazing and crop residues supplement the green fodder from grazing and weeds.The second is the dry season (October-February) when feed from stubble grazing and crop residues gradually become available and depending on system farmers may practices open grazing on crop lands,communal grazing lands and in community forest areas and fallow lands.The last is the period starting from March to May,when feed supplies decline,although new re-growth may occur depending on the timeliness and amount of the short rains.In the last calendar period farmers may selectively feed productive animals (e.g.,milk cows and calf) on hay and conserved crop residues and grazing areas,crop and fallow land.

3 MATERIALS AND METHODS

3.1 Study site Description

3.1.1 Location

This study was conducted in Gombora District of Hadiya Zone, Southern Nations, Nationalities and Peoples Regional State (SNNPRS) of Ethiopia.Gombora District is located at about 259 km south of Addis Ababa and at a distance of 27km west of Hossana town.Gombora District is one of the 11 Districts of Hadiya Zone.Geographically the district lies between 7^0 49′ N latitude and 37^0 45′ E longitudes (Figure 1).Gombora district is bordered in the North by Gibe District,in the North East by the Misha District and on the South Soro District,in the East by the Lemo District and in the West by Yam special District and Jimma zone of Oromiya National Regional States.The total land area coverage is 48,325ha and comprises of a total of 23 rural Kebeles and 2 urban Kebeles.The administrative center of this District is Habicho(GWARDO,2011).

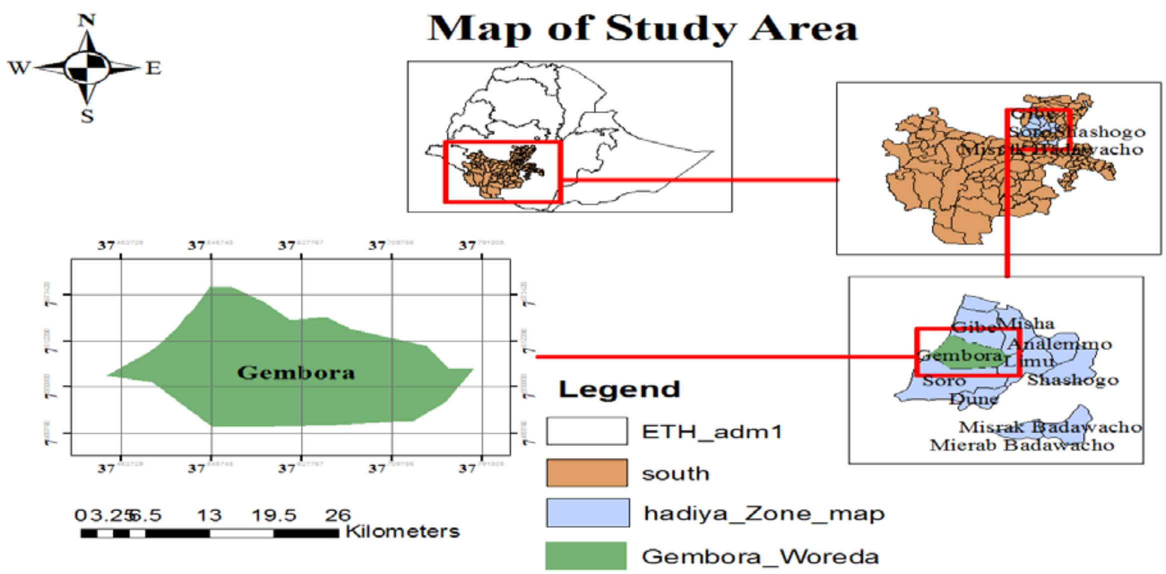

Figure 1.Study District

3.1.2 Topography and Climate

The study district is characterized by flat, moderately gentle and some steep in lowland.The altitude of the district ranges between1000 and 2400m.a.s.l. The lowland altitude ranges between 1000 and 1500m.a.s.l and covers about 46.5%,while as midland altitude ranges between 1501 and 2400m.a.s.land cover about 53.5% of the study district.The climatic condition was classified into two agro-ecological strata,namely lowland altitude /*kola*/ and midland altitude of /*woina-dega*/ moderate agro-ecology.The rainfall distribution is bimodal and occurs in two main seasons.The short rainy season (*Belg*) extend between January and April and the big rainy season (*Maher*) begin in May and ends in September.The mean minimum and maximum annual precipitation varies between 600mm and 2200mm.The mean minimum and maximum temptature is 15°C and 25°C, respectively (GWARDO, 2011).

3.1.3 Soil and Vegetation type

Soil of the study district has been classified into Red, Black and Brown.The soil types are Vertisol and Nitosol soil.The dominant soil type in the District is Vertisol, whichhave a very high water-holding capacity, but most of the water is tightly bound and difficult to manage when dry and very sticky when wet/rainy and tilling in the wet conditions leads to soil compaction(FAO, 2002). The distribution of natural forest is declining from time to time,due to human interference.Currently the common vegetation in the district includes:*Cordia africana,Oleaa africana,Acaciaabyssinica,Crotonmacrostac hyus,Ficus sur,Podocarpus falcatus,Ehertia cymosa,Maesa lancelata,Juniperus procera,Vernonia amygdalan,Albizia schimpernia* and others are also found as scattered in mostfarm land.Forages like elephantgrasses (*Pennisetumppurpureum*) and desho grass (*Pennisetum pedicellatum*) are found scatteredon individual farmsand used as feed resource or means of soil conservation (GWARDO, 2011).

3.1.4 Population and Farming system/Income

Total population of the district was 92,332 with 46,225 males and 46,107 females (CSA, 2007). The population density of the district is 270 persons per square kilometer (GWARDO,2011).In the district agriculture (crop and livestock production) is the most widely distributed and predominant primary economic activity.The major crops grown are cereals such as tef,wheat, maize,sorghum and minor crops are barley,and pulse crop bean and pea.Enset is another plant using for subsistence.The common livestock are cattle,goats,sheep,donkeys,horses,mules,poultry and bee colonies are kept for household consumption,income generation,draught power and other purposes.Fruits such as banana,papaya,avocado,mangon and vegetable such as tomato,carrot and cabbage are cultivated for household consumption and to some extent income generation (GWARDO,2011).

3.2 Sampling and Data Collection Procedure

3.2.1 Sampling procedure of Respondent households selection

The study district was purposively selected based on accessibility for study and representative characters of mixed crop and livestock production system.The district is categorized in two agro-ecological strata/altitude regions/lowland with altitude range between 1000m.a.s.l-1500m.a.s.l and midland with altitude range between 1501m.a.s.l-2400m.a.s.l.After all the Kebeles were grouped into the respective stratum,four Kebeles were randomly selected two Kebeles from each of the two altitude regions.Olewa and Ole two from lowland and Mahal gana and Gorta Kebeles from midland altitude regions were selected for this study and the list of the participating households were identified by systematic random sampling method from the two altitude regions based on farming system;having livestock of any breed and size,feed resources and feeding system/practices.Based on population proportion;31 and 30 household heads were selected from Olawa and Ole two kebeles (lowland altitude regions) and 33 and 32 household heads were selected from Mahal gana and Gorta Kebeles (midland altitude regions),respectively or 126 sample household heads were selected from the study district.List of households in each survey site were organized with the help of the chief of Kebeles/DA.The total sample size for household interview was carried out using probability proportional to sample size-sampling technique (Cochran,1977).

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

Where;

n_o = desired sample size Cochran's (1977) when population (HH) greater than 10,000

n_1 = finite population correction factors (Cochran's 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)

HH=household

3.2.2 Data collection Procedure

Data collection process involved a number of participatory steps and questionnaire survey method.Prior to questionnaire focus group discussions were done once in each kebeles of the study sites with elders,key informants and development agents in order to crosscheck data.The discussion was used to investigate and understand the general description of farming system, range of farm sizes,farm labor availability,livestock feed resources and feeding system, annual rainfall pattern,water availability,general description of livestock production,typs of animals rised 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,how available were necessary input-plastic,urea concentrates etc.,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,collected fodder:Proportion of diet,purchased feed;contributors to household income,milk production,sale of livestock,sale of crop production, seasonality of feed supply:overall seasonal availability-what was feed in different months and so forth.The questionnaires were close and open-ended questions.The pre-testing of questionnaire was employed with selected 20 farmers,10 farmers from each 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 assessment of livestock feed resource and feeding practices in the district.

3.3 Estimation of Dry Matter Yield of Available Feed resources

3.3.1 Dry Matter yield of Natural grazing

The total quantity of dry matter (DM) available in natural grazing was determined by multiplying the average value of grazing land holding with the per hectare DM yield of the natural pastures with conversion factor of 2tDM/ha/year (FAO, 1987).Amount of DM obtained from communal grazing land was factored into total communal grazing areas for each total households and their associate TLU suitable to graze on this land unit.

3.3.2 Dry Matter yield of Crop residue,Aftermath and Woody land

The quantity of available crop residues (DM basis) were estimated from the total crop yields of the households, which was obtained from questionnaire survey, according to conversion factor developed (FAO, 1987).The conversion factors are 1.5 for barley, wheat,tef (*Eragrostistef*); 2 for maize,1.2 for pulse and 2.5 for sorghum.The quantities of available DM in aftermath grazing were determined by multiplying the available land by the conversion factors of 0.5 and 0.7 for woody land grazing.

3.3.3 Dry Matter yield of Trees and Shrubs

The potential fodder yield of shrubs and trees were estimated by measuring stem diameter using measuring tape and applying the equation of Petmak(1983).Accordingly,leaf DM yield of fodder trees were predicted using the allometric equation of log W=2.24logDT-1.50,where W=leaf yield in kilogram of dry weight and DT is trunk diameter (cm) at 130 cm height.Similarly,trunk diameter (DT) could be obtained by DT=0.636C;where C=circumference in centimeter (cm).For the leaf DM yield of a shrubs this allometric equation was used log W=2.62logDS-2.46,where DS is the stem diameter in cm at 30cm height.In quantifying trees/shrubs feed resources from communal/individual household level property resources.

3.3.4 Dry Mater yield of Cultivated forage

The total amount of dry matter (DM) available in improved forage was detrmined by multiplying the average value of cultivated improved forage land holding with the per hectare DM yield of the improved forage with conversion factor of 8tDM/ha/year (FAO, 1987).

3.3.5 Estimating Non-conventional supplementary feeds

The quantity (DM basis) of non-conventional supplementary feed available for each household was obtained by interviewing the sample households during the questionnaires survey.

3.3.6 Estimation of Quality of Available Feed Resources

Review of available literature was used to describe the nutritive value of some feed resources. The proximate composition of feed samples for crop residues and fodder trees/shrubs was subjected to laboratory analysis following official procedure (AOAC,2005).The nutrition values (DM,CF,CP,EE and total Ash) were determined by according to AOAC (2005).Nitrogen free extract was detrmined on dry matter base,NFE = %DM - (%CF + %CP + %EE + %Ash) (McDonald *et al*.,2010).Metabolizable energy (ME) content of the available feedstuffs were determined from the following equation (Abate and Merey,1997) ME (MJ/kgDM) = $5.34-0.1365CF+0.6926NFE-0.0152NFE^2+0.0001NFE^3$ where;NFE = nitrogen free extracted;DM=dry matter;EE = ether extract/crude lipid;CP = crude protein;CF = crude fiber.

3.3.7 Estimation of Feed Supply and Requirement

Total quantity available DM from all feed resources were compared to the annual DM requirements of livestock population in the sampled households.Data of livestock population in the sample households were obtained from the interview of sample household respondents during the survey.To compare,the number of livestock population was converted into tropical livestock units (TLU) using the conversion factor of (Varviko *et al*.,1991).The DM requirements of the livestock population were calculated according to the daily DM requirements for maintenance of 250kg dual purpouse tropiaca cattle (an equvalent of one TLU) for minteainance according to (Kearl,1982).

Feed supply was estimated for dry matter (DM), crude protein (CP) metabolaizable energy (ME) contents.It is assumeatd that each tropical livestock unit (TLU) consume a feed dry matter 2.5% of its BW (6.25kgDM/day).A crude protein (CP) content of 70g/kg DM and 8.368MJ/kg DM diet was used for estimation (Winrock, 1992).Daily nurrient requirement of livestock were determined by according to Kearl (1982) and McCarthy (1986).

3.3.8 Ranking of the comparative value is considered by using descriptive statics with more frequency number and percent of the respondents in each rank by its proportion.

3.4 Statistical analysis

All the surveyed data were analyzed using statistical procedures for social science (SPSS) version 20 (SPSS,2011).Descriptive statistics (frequency,means, percentages and standard error) were used to analyze the result of the variable mixed crop-livestock production in the study district.Statistical variations for categorical data were tested by means of cross tabs with significant differences at $P<0.05$.The descriptive statistics for the numerical data were subjected to one-way analysis of variance (one-way ANOVA),using the general linear model procedure of SPSS.Levels of significance also considered at $P<0.05$.Analyzed data are presented by using table,figures,percentages,means and standard error.The appropriate statistical model used for this study was indicated below

$$Y_{ij} = \mu + \alpha_i + \Sigma_{ij}$$

Where; yij = quantity and quality of available feed resources

μ = overall mean

α_i = the effect of i^{th} location/agro ecology (i=1-2)

$\Sigma_{ij=}$ random error

4. RESULTS AND DISCUSSION

4.1 Household Characteristics

4.1.1 Sex,Age and Educational status of Respondents in the Study district

Sex,age and educational status of respondents are presented in (Table 4).In the study district from the total interviewed respondents majority 77.8% of respondents were mals, and the rest of respondents were females.The observation is comparable with (Guyo,2012) who pointed out in Burji district,Segn zuria zone southern Ethiopia majority 81% of sampled household respondents were mals,and the rest were females.Regarding to age of respondents,majority 92.1% of respondents were age group between 32-62 years old and 4.8% of respondents were age group between 28-31 years old as well as 3.2% of respondents were age greater than 62 year old.In the study district,from the total respondent household heads that attended primary,secondary,high school and higher education were 37,14.5,7 and 0.8%,respectively and the rest 41% of respondents were uneducated.According to Beriso *et al*.(2015) primary,secondary,high school and higher education were 22,33,33 and 2% respectively,and the rest about 10% of respondents were uneducated in Aleta chukko district of Sidama zone,southern Ethiopia.The result of the current study is similar with Duguma *et al*.,(2012) who pinted out in Dandi district,Oromia regional state of Ethiopia,42.3% of respondents had no education.The reason for uneducated percent in the study district was because of distance from school and socio-economic factors of the farmers.Therefore,basic education is need to the farmers in order to create understanding on livestock feed resource utilization and feeding practice.

Table 4. Sex, age and educational status of respondents in the study district

	Study area				
Properties	Lowland (N=61)	Midland (N=65)	Total (N=126)	χ^2	P-value
Sex					
Male	49 (80.3)	49 (75.4)	98 (77.8)		
Female	12 (19.7)	16 (24.6)	28 (22.2)		
Total	61 (100)	65 (100)	126 (100)	0.445	0.505
Age					
Age between 28-31	1(1.6)	5 (7.7)	6 (4.8)		
Age between 32-62	59 (96.7)	57 (87.7)	106 (92.1)		
Age greater than 62	1 (1.6)	3 (4.6)	4 (3.2)		
Total	61(100)	65 (100)	126 (100)	3.578	0.167
Educational status					
Uneducated	26 (43)	25 (39)	51 (41)		
Primary	23 (38)	24 (37)	47 (37)		
Secondary	9 (15)	9 (14)	18 (14.5)		
High school	3 (5)	6 (6)	9 (7)		
Higher education	0 (0)	1(1.5)	1 (.8)		
Total	61 (100)	65 (100)	126 (100)	1.961	0.751

Respondents;properties in low and midlad altitiude region no signicance difference p<0.05.

4.1.2 Average Family size and Age categories in the Study district

Average family size and age categories in the study area is presented in (Table 5).According to the interviewed respondents,in the study district the average family size was 6.97±0.17 households with 3.35±0.13 males and 3.45±0.12 females.The present result was slightly comparable with (Worku,2015) who pointed out the overall average family size of 6.65 in Sekota district of Waghimra zone,Ethiopia.Also the result is higher than 5.6 that was reported by Duguma et al.(2012) in Dandi district,Oromia regional state,Ethiopia and (CSA ,2011) national average in rural area 4.9 per household.The reason for higher family number relative with national average in rural area might be due to lack of awareness for family planning.The number of mean age between 15-65 year was lower (P<0.01) for midland than lowland altitude region (4.32±0.09 < 4.77±0.14).The number of mean age above 65 year was 0.42±0.06 in the study district.

Table 5. Average family size and age categories in the study district

Characteristics	Lowland (N=61)		Midland (N=65)		Overall (N=126)		
	Mean	%	Mean	%	Mean	%	P-value
Family size	7.15 ± 0.28	100	6.80 ± 0.19	100	6.97 ± 0.17	100	0.297
Male	3.62 ± 0.15	51	3.35 ± 0.13	49	3.48 ± 0.10	50	0.180
Female	3.54 ± 0.16	49	3.45 ± 0.12	51	3.49 ± 0.10	50	0.640
Age category							
Age < 15 years	2.15 ± 0.35	29	1.89 ± 0.2	29	2.02 ± 0.19	29	0.495
Age 15-65	4.77 ± 0.14[a]	68	4.32 ± 0.09[b]	66	4.54 ± 0.08	67	0.006
Age > 65	0.33 ± 0.07	5	0.51 ± 0.09	7	0.42 ± 0.06	6	0.121

N, number of respondents; [a,b], means with different superscripts in the row are significantly different P<0.05;SEM,standard error of means;P, probability of obtaining observed result.

4.1.3 Farming System and Income Source

In the study district according to all respondents mixed crop-livestock production system was dominant farming system and it was used as means of major income source.Only 22% of the respondents obtain income in addition from off-farm activity from cart-donkey and sale of honey (Figure 2).This observation is in agreement with Estefanose *et al*.(2014) and Gecho *et al*.(2014) they pointed out that majority of farmers in many regions of Ethiopia are earning the livelihoods from mixed crop and livestock production systems.Livestock species kept by the farmers comprises cattle,sheep,goat,equines and chcken.Cattle were considerably the dominant livestock species.Farmers practice a cereal dominant cropping system with tef,maize and sorghum followed by wheat and to some extent enset and barley in low altitude region.Where as tef and wheat are dominant then maize,barley,sorghum,bean and pea in midland region as well as enset grown in mid altitude region.This result is similar with Duguma *et al*.(2012) and Abera *et al*.(2014) who pointed out crop-livestock production system was dominant farming system in Danid district of Oromia regional state and Meskan district of Gurage zone southern Ethiopia, respectively.

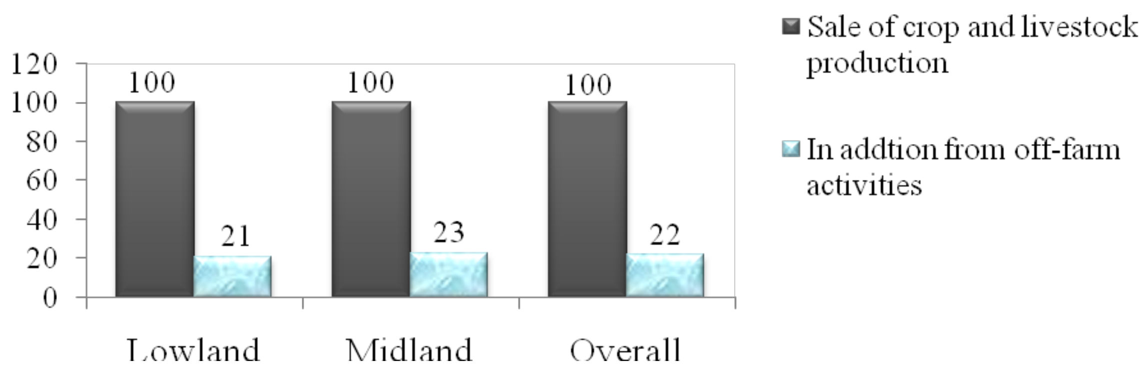

Figure 2. Income sources of respondents in the study district

4.1.4 Land holding and Utilization pattern

In the study district,land is the most important assets that respondents heavily depend on to maintain their household from any sort of crisis and to secure everything they need through crop and livestock production.Land holding and utilization pattern of respondents in Gombora district is presented in (Table 6).According to respondent households;overall average land holding was 3.13±0.06 hectare per household.Comparable,in high land areas of Amhara national region farmers owned on average land of 3.3ha (Alemayehu *et al*.,2009).The overall average land holding was lower than the value of 3.67ha that reported by (Guyo and Tamir,2014) pointed out in Burji district of Segen Zuria Zone,southern Ethiopia.However,the present finding is higher than the national average of 1.18ha (CSA,2011).The mean value of land holding was higher ($P<0.01$) for lowland than midland altitude regions ($3.37 \pm 0.08 > 2.91 \pm 0.08$).Regarding to land utilization pattern 77.46,14.35,7.26 and 0.93% of land were engaged by crop land,natural grazing land,woody grazing land and cultivated forage land respectively.Majority 77.46% of land was occupied by cropland and only 14.35% of land covered by natural grazing land.Comparable,in

Dandi district of Oromia regional state,Ethiopia from the total land,majority 63.2% of land was crop land and only 28% was grazing land where pastureland holding was reducing considerably (Duguma *et al*.,2012).

Table 6. Average land holding size and utilization percent in the study district

Land types	Lowland(N=61)	Midland(N=65)	Overall(N=126)		
	Mean + SEM	Mean + SEM	Mean + SEM	%	P-value
Crop aftermath	2.44 ± 0.08	2.37 ± 0.08	2.40 ± 0.06	77.46	0.519
Natural grazing	0.33 ± 0.06[a]	0.03 ± 0.02[b]	0.17 ± 0.03	14.35	0.000
Woody land	0.07 ± 0.03	0.02 ± 0.02	0.04 ± 0.02	7.26	0.152
Cultivated forage	0.007214 ± 0.04	0.02592 ± 0.03	0.04976 ± 0.02	0.93	0.055
Overall mean	3.37 ± 0.08[a]	2.91 ± 0.08b[b]	3.13 ± 0.06	100	0.012

N, number of respondents; [a,,b], means with different superscripts in the row are significantly different P<0.05;SEM,standard error of means;P,probability of obtaining observed result.

4.1.5 Livestock holdig pattern

The livestock holding pattern of respondents in Gombora district is presented in (Table 7).In the Gombora district,livestock production was very important component of mixed farming system and well integrated with crop production,which consists:-cattle,sheep,goats and equines.Also poultry and bees were important species kept in the study district.The results of this study revealed that,there was significant difference in livestock holding between the two-studied altitude regions.The average livestock holding per household was higher (P<0.01) for the lowland than midland altitude region (7.25±0.24 TLU > 6.34±0.16 TLU).The average number of cattle was higher (P < 0.001) for the lowland than midland altitude region (6.57±0.23 TLU > 5.57±0.15TLU).Also the average number of cows were higher (P<0.05) for the lowland than midland altitude region (2.98±0.20 > 2.42 ± 0.15).The reason for difference in livestock holding might be associated with that farmers in the lowland altitude region have relatively better natural grazing land holding size than midland altitude regions.Likewise,the average number of sheep kept per household was higher(P<0.01) for midland than lowland altitude regions (0.22±0.05 TLU > 0.05±0.03 TLU).The average number of goats kept per household was higher (P<0.05) for lowland than midland altitude regions (0.20±0.05 > 0.06±0.03).The variation might be due to suitability of weather conditions.The average livestock holding per household in the study district was (6.78±0.15).The finding of present study is smaller than the value of 9.43±0.73 and 10.65±0.38 that reported by (Assefa and Nurfeta,2013) in Adami Tullu Jiddo Kombolcha district,Ethiopia and Gurmessa *et al*.(2015) in highland and midland area of Horro and Guduru district of Oromia regional state,western Ethiopia, respectively.

Table 7.Average number of tropical livestock unit (TLU) per sampled household

			Overall(N=126)	
Livestock	Lowland(N=61)	Midland(N=65)	Mean+SEM	P-value
Oxen(TLU)	2.11 ± 0.08	1.97 ± 0.09	2.04 ± 0.06	0.266
Bulls(TLU)	0.34 ± 0.07	0.23 ± 0.05	029 ± 0.05	0.222
Cows(TLU)	2.98 ± 0.20^{a}	2.42 ± 0.07^{b}	2.71 ± 0.13	0.042
Heifers(TLU)	0.80 ± 0.09	0.62 ± 0.08	0.71 ± 0.06	0.154
Calves(TLU)	0.18 ± 0.05	0.08 ± 0.04	0.13 ± 0.03	0.105
Cattle(TLU)	6.57 ± 0.23^{a}	5.57 ± 0.23^{b}	6.06 ± 0.14	0.000
Sheep(TLU)	0.05 ± 0.03^{b}	0.22 ± 0.05^{a}	0.13 ± 0.03	0.006
Goat(TLU)	0.20 ± 0.05^{a}	0.06 ± 0.03^{b}	0.13 ± 0.03	0.023
Donkey(TLU)	0.08 ± 0.04	0.11 ± 0.04	0.10 ± 0.02	0.626
Horses(TLU)	0.11 ± 0.04	0.14 ± 0.04	0.13 ± 0.03	0.692
Mule(TLU)	0.11 ± 0.04	0.22 ± 0.05	0.17 ± 0.02	0.132
Total livestock (TLU)	7.25 ± 0.24^{a}	6.34 ± 0.16^{b}	6.78 ± 0.15	0.002

N, number of respondents; ^{a,b}, means with different superscripts in the row are significantly different P<0.05; SEM, standard error of means; P,probability of obtaining observed result.

4.1.6 Objective of Livestock production

The objective of livestock keeping in the study district is presented in (Table 8).According to interviewed respondents households,milk production,draught power,meat production,calf production,income generation and manure production are the objectives of livestock keeping in the order of importance.They sale animals and utilize animal sales for different purposes for instance for agricultural input,payment of taxes and school fees.In the study district,based on the respondents,milk production,draught power and meat production are primary objectives about 72,69 and 51% of the respondent households in the study district ranked first,second and third for milk production,draught power and meat production respectively,followed by calf production 39%,income generation 34% and manure production 81%,which ranked fourth,fifth and sixth respectively.Comparable,in Fogera district,north western Ethiopia livestock were rearing for milk production;draught power and meat production were the major part of the overall agricultural activity (Abate,2008).The observation is also accordance with Duressa *et al*.(2014) and (Wondatir,2015) who pointed out livestock were kept for milk and calf production,drought power,meat production,income generation and manure production in Diga district of Oromia regional state of Ethiopia and Hawassa zuria district,southern Ethiopia respectively.

Table 8. Respondents percent and rank for the purpose of livestock production

	Ranking order						Rank
Objectives	1st	2nd	3rd	4th	5th	6th	
Milk	91(72)	35(28)	0(0)	0(0)	0(0)	0(0)	1st
Meat	0(0)	4(3)	64(51)	35(27)	17/14	6(5)	3rd
Calf production	0(0)	0(0)	26(21)	49(39)	41(32)	10(8)	4th
Draught	35(28)	87(69)	3(2)	1(1)	0(0)	0(0)	2nd
Income	0(0)	0(0)	32(25)	40(31)	44(34)	10(10)	5th
Manure	0(0)	0(0)	0(0)	0(0)	24(19)	102(81)	6th

Numbers out and in the bracket, indicate frequency and proportion of respondents respectivly

4.2 Livestock Feed Resources

The feed resources that utilized for livestock in the study district are grazing land resources,crop residues,fodder trees/shrubs,non-conventional feed resources and cultivated forages grass are the existing livestock feed resources (Figure 3).Among the feed resources,crop residues and grazing resources are the major utilized and contribute the largest source of feed to liestock,which is the case in most developing countries (Sere *et al*.,2008).The result of this study is also similarly with Estefanos *et al*.(2014) who reported that crop residue and grazing resources were the major livestock feed resources in highlands of Harerge,eastern Ethiopia.Fodder trees/shrubs,non-conventional feeds and cultivated forages grass were also utilized by 81,51.5 and 21% of respondents in the study district,respectively.However respondents did not cultivate improved forages due to lack of awareness.

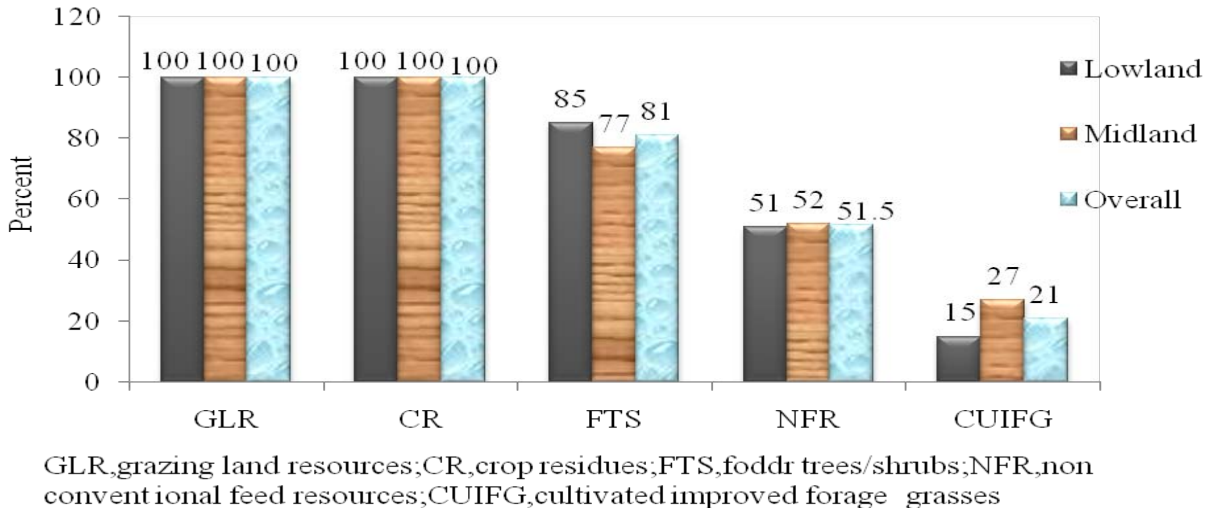

Figure 3.Available livestock feed resources and utilization percent

4.2.1 Grazing land Resources and Dry matter yield

In the study district according to interviewed respondents,natural grazing,crop aftermath grazing and woody land grazing were the existing livestock grazing resources (Table 9).From these grazing land resources,majority (78.18%) of land was crop aftermath,where as the minority 14.48 and 7.33% of land was natural grazing and woody land grazing respectively.The present study is similar with Duguma *et al*.(2012) who reported in Dandi district Oromia regional state of Ethiopia;the majority 63.2% of land was crop aftermath land.According to all respondent households description,natural grazing land size and quantity dry matter yield produced from natural grazing was decreasing due to increasing population and expansion of cropping land for production of human food.The average natural grazing land holding size was higher($P<0.01$) for lowland than midland altitude regions(16.61ha >11.61ha).The overall average natural grazing land holding size in the study district was 14.11ha.The total part of natural grazing land was only 14.48% which was too low.This was because of high demand for cropping land aimed at increasing the production of human food of plant origin.Similar study was reported by Kassahun *et al*.(2015) who pointed out due to expansion of food crop land in the study area grazing land was reducing in high and mid altitude areas of Horro and Guduru districts of Oromia regional state,western Ethiopia.The average dry matter yield of natural grazing land was higher(P<0.01) for the lowland than midland altitude regions(33.22t>23.25t).The overall average dry matter yield from natural grazing land in the study district was 28.23t.The variation in natural grazing land holding size might be associated with that farmers in lowland altitude region have greater natural grazing land holding size than midland altitude regions.The average crop aftermath land holding size in low and midland altitude regions was 74.94 and 77.38ha,respectively or 76.16ha in the study district.The average dry matter yield from crop aftermath land in low and midland altitude regions was 37.84 and 38.83t,respectively or 38.34t in the study district.The average size of woodland was higher (P<0.05) for lowland than midland altitude regions (10.23ha>4.01ha). The overall average woody land was 7.14ha in the study district (Table.10).The average dry matter yield from woodland in low and midland altitude regions was 7.04 and 2.96t respectively or 5t in the district.The average dry matter production from total grazing land resource in low and midland altitude regions was 78 and 65t, respectively or 71.5t in the study district.

Table 9. Average grazing land (ha), dry matter yield (t) and utilization percent in study area

Grazing land in ha	Mean value		Overall (N=126)			
	Lowland (N=61)	Midland (N=65)	Mean	SEM	%	P-value
Natural grazing land(ha)	16.61[a]	11.61[b]	14.11	0.33	14.48	0.001
Crop aftermath(ha)	74.94	77.38	76.16	1.53	78.18	0.511
Woody land(ha)	10.26[a]	4.01[b]	7.14	0.65	7.33	0.041
Total grazing land(ha)	102.04	93.01	97.52	1.37	100	0.082
Dry matter yield(t)						
Natural grazing land(t)	33.22[a]	23.25[b]	28.23	0.67	39.44	0.001
Crop aftermath(t)	37.84	38.84	38.34	0.94	53.57	0.940
Woody land(t)	7.04	2.96	5.00	0.55	6.98	0.067
Total grazing land(t)	78[a]	65[b]	71.5	1.118	100	0.028

N; number of respondents; [a,b,] means with different superscripts in the row are significantly different P<0.05;SEM,standard error of means; P, probability of obtaining observed result.

4.2.1.1 Status of Grazing land

Respondents in the study district expressed that,the status for natural grazing land was declining in relation to this,overall 75.4% of respondents declared that the reason for declining natural grazing land was increasing demands for crop cultivation (Table 10).The result of the current study is similar with Duguma *et al*.(2011) who pointed out in Benshangul-Gumuz region,western Ethiopia,grazing pastureland was decaling from time to time due to expansion of cropland.This study is also in accordance with the report of Altaye *et al*.(2014) pointed out in Metekel zone,northwest Ethiopia where majority of farmer described that there was a decreasing trend of grazing area because of covering grazing land to crop fields.

Table 10. Perception of Respondents on status of natural grazing land and reason for change

Status of grazing land	Lowland (N=61)	Midland (N=65)	Overall (N=126)	χ^2	P-value
Increasing	0 (0)	0 (0)	0 (0)		
Decreasing	60 (98.4)	64 (98.5)	124 (98.4)		
No change	1 (1.6)	1 (1.5)	2 (1.6)		
Total	61 (100)	65 (100)	126 (100)	0.002	0.964
Decreasing reason					
Increasing cropping	47(77)	48(73.8)	95(75.4)		
Increasing population	2 (3.3)	2(3.1)	4(3.2)		
Both	12 (19.7)	15 (23.1)	27(21.4)		
Total	61(100)	65(100)	126(100)	0.217	0.897

N=number of respondents; properties in low and midland altitude region no significance difference $P<0.05$.

4.2.2 Dry Matter production of Crop residues

Crop residues were one of the dominant feed resources in Gombora district especially during the dry season of the year.This was witnessed by all respondents in the study area.Crop residues were produces from different crops.The estimated dry matter produced per year per household from crop residues that exist in the study district is presented in (Table 11).The estimated average dry matter yield from crop residues that exist in both altitude regions of the study district was 3.09 and 3.32t in low and midland altitude regions,respectively or 3.21t in the study district.The average dry matter yield of crop residues from tef and maize produced per year per household in the study district was higher ($P<0.001$) for the lowland than midland altitude region,the average DM yield from tef (1.56t > 0.91t);maize (0.97t > 0.46t) consequently.The variation might be due to ecological factor and farming system,farmers in the lowland altitude region dominantly cultivate crop tef and maize,then sorghum,wheat and barely.Likewise,the average DM yield from crop residues wheat and barley produced per year per household was higher ($P<0.01$) for the midland than liwland altitude regions,the average DM yiled from wheat (1.69t>0.02t); barley(0.23t>0.05t) respectively.This was because crops such as:-wheat and tef are dominant in midland,followed by maize,barley,bean and pea.The crop residues from tef and wheat are dominant,as compering with others crop residues.The result is comparable with the report of Duguma *et al*.(2012) who pointed out in Dandi district,Oromia regional state of Ethiopia.On the other hand dissimilar with (Wondatir,2010) who pointed out the highest crop residue yield was from maize then from wheat and barley around Ziway.In general crop residues contribute higher percent bout 48.88% as camper to other feed types.Comparably,Tolera *et al*.(2012) pointed that in Ethiopia crop residues contribute about 40-50% of the total feed supply.

Table 11. Estimated average dry matter yield (t) of crop residues per year per sampled household

Crop residues that exist in both low and midland regions		Tef	Wheat	Maize	Sorghum	Barley	Total
Mean value	Lowland (N=61)	1.56[a]	0.02[b]	0.97[a]	0.15	0.05[b]	3.09
	Midland (N=65)	0.908[b]	1.69[a]	0.46[b]	0.05	0.23[a]	3.32
Overall(N=126)	Mean	1.23	0.88	0.71	0.09	0.14	3.21
	SEM	0.05	0.08	0.05	0.03	0.03	0.07
	P-value	0.000	0.000	0.000	0.530	0.003	0.109
Crop residues that exist only in midland altitude region		Area (ha)	Yield (t)	Conversi on factor	DM yield (t)		
	Pea	3.45	4.4	1.2	5.28		
	Bean	3.55	5.6	1.2	6.72		
	Total	7	10		12		

N=number of respondents; [a,b,] means with different superscripts in the row are significantly different P<0.05; SEM, standard error of means; P, probability of obtaining observed result.

4.2.3 Dry Mater production of Fodder Trees/Shrubs

In the study district according to the interviewed respondent households description,cattle and sheeps selected the most palatable grasses during the wet season,while goats browsed on trees and shrubs.However,in the dry season when the grazing and other feed resources were at their poorest condition,livestock browse young twigs and leaves of fodder trees and shrubs.According to the interviewed respondent households,the list of major brows species that identified as locally important are presented in (Table 12) where the scientific names,percent of respondent,parts taken by the animals and the animal groups that most favored the feed are indicated.Totally,eight indigenous brows were identified.

Table 12. Major fodder trees/shrubs, selected as important livestock feed resources

	Local name	Scientific name	N (%)	Parts consumed	Species of livestock
LL	Wedesha	*Cordia africana*	34(56)	L,T	Cattle,Sheep,Goat
	Ulaga	*Ehretia cymosa*	22(36)	L,T	Cattle,Shep,Goat
	Odaa	*Ficus sur*	10(16)	L,T	Cattle,Shep,Goat
	Girara	*Acacia abyssinica*	16(26)	L,T	Cattle, Goat
	Xumuniga	*Albiza schimpernia*	13(23)	L,T	Cattle,Sheep,Goat
ML	Wedesha	*Cordia africana*	33(51)	L,T	Cattle,Sheep,Goat
	Kawada	*Maes lancelata*	9(14)	L,T	Cattle,Sheep,Goat
	Wera	*Olea africana*	27(42)	L,T	Cattle, Goat
	Heba	*Vernonia amygdalina*	20(31)	L,T	Cattle,Sheep,Goat
	Xumuniga	*Albiza schimpernia*	14(22)	L,T	Cattle,Sheep,Goat

LL, lowland; ML, midland; N, number of respdents; %, percent; L, leaf; T, tiwing

The dry matter production of fodder trees and shrubs varied in species of the trees and shrubs in the area.The high number of trees and shrubs in the area,result in high dry matter yield in the area.In the study district average biomass dry matter yield of fodder trees/shrubs were range from 1.25-15kg per trees/shrubs(Table 13).The average biomass dry matter yield of fodder trees and shrubs were varied in type of species,the higher biomass dry matter yield was recorded in tree *Cordia africana* (15kg) while the lower biomass dry matter yield was recorded in shrub *Albizia schimpernia* (1.25Kg).This variation might be due to the availability and growth pattern of the species.Geta *et al*.(2014) reported that biomass yield of per tree/shrub was about 24.55kg tree/shrub and 958.76kg/tree in Wolayita zone,southern Ethiopia.The dry matter production of fodder trees/shrubs was estimated 75.63-108.75kg/ha and 77.82-106.63kg/ha in cultivated and uncultivated land edible by livestock in the study district.The estimated dry matter yield of fodder trees/shrubs are presented in (Table 13).

Table 13. Estimated average dry matter yield (kg) of per fodder tree/shrub in low and midland altitude regions of the study district.

Study site	Fodder trees/shrubs		Biomass	Species category
Lowland	Local name	*Scientific name*		
	Wedesha	*Cordia africana*	14.5	Tree
	Ulaga	*Ehretia cymosa*	14.4	Tree
	Odaa	*Ficus sur*	14.38	Tree
	Girara	*Acacia abyssinica*	13.75	Tree
	Xumuniga	*Albizia schimpernia*	1.2	Shrubs
Midland	Wedesha	*Cordia africana*	15	Tree
	Wera	*Olea africana*	14.38	Tree
	Heba	*Vernonia amygdalina*	6.25	Shrub
	Xumuniga	*Albizia schimpernia*	1.2	Shrub
	Kowada	*Maesa lancelata*	13.75	Tree

Source: Petmak (1983)

4.2.4 Dry Matter production of Improved cultivated forages

Forage have a role,they use as additional feed for crop residus and natural grass,when availability is limited.In the study district,only 21% of respondent households cultivated improved forage but most of the respondents did not cultivate forage.According to the respondent households only 0.85 and 1.56ha of land was cultivated by improved forage in low and midland altitude regions,respectively or totally 1.21ha in the district which is too low (Table 14).The reason for low forage cultivation was lack of farmers perception.Similar observation was reported by Duguma e*t al*.(2012) in Dandi district,Oromia regional state,central Ethiopia and (Yadessa,2015) in Meta Robi district,west shewa zone,Oromia regional state of Ethiopia.The average cultivated forage land was higher ($P<0.01$) for midland than low land altitude regions (1.56ha>0.85ha).The difference might be due to farmers perception to cultivate forage.The average dry matter yield per year from cultivated forage was higher ($P<0.01$) for midland than lowland (12t > 6.5t).The difference might be farmers perception to cultivate forage.The overall average dry matter yield per year from cultivated forage in the study district was only 9.25t this was because of most of the farmers did not establish and utilize improved forages.The observation is similar with (Wondatir,2010) who pointed out in the Highland producton system,only 13% of the respondents grow improved forage,most of them did not cultivate and utlize improved forage as animal feed.

Table 14. Average cultivated forage land (ha) and dry matter yield(t) per year in the study district

Cultivated improved forage grass land (ha) and yield (t)	Lowland (N=61)	Midland (N=65)	Overall (N=126)		
			Mean	SEM	P-value
Land (ha)	0.85^{b}	1.56^{a}	1.21	0.03	0.007
Dry matter (t)	6.5^{b}	12^{a}	9.25	0.25	0.008

N, number of respondents; ^{a,b}, means with different superscripts in the row are significantly different P<0.05; SEM, standard error of means; P, Probability of obtaining observed result.

4.2.5 Estimated Dry mater production of Non-conventional feeds

According to interviewed respondent households, overall 51.5% of respondents in the study district practices non-conventional feed left over, vegetable and fruits reject supplemntry feeding for their lactating cows and oxen that used to plow cultivation land instead of concentrate mixture.The estimated average dry matter contribution of non-convenstional feed supply per year in lowland and midland altitude regions from house leftover was 1.05 and 0.85t/year,respectively or 0.95t/year in the study district,from vegetable reject was 0.77 and 1.35t/year,respectively or 1.05t/year in the study district,from fruit reject was 11.20 and 4.15t/year,respectively or 7.53t/year in the study district (Table 15).The contribution of feed supply from fruit reject was higher (P<0.05) for lowland than midland (10.75±0.75t/year > 4.3±1t/year).The difference might be due to farmers perception.The total average contribution of non-conventional feed supply was higher(P<0.05) for lowland than midland altitude regions (13.00±1t/year > 6.50±0.5t/year).The overall total average contribution was 9.75t/year in the study district (Table 16).The present study is comparable with (Worku,2014).who reported in kersa malima woreda farmers supplement their lactating cow only with non-convectional feed traditional liquor residue tella atella instead of concentrate mixture.

Table 15. Estimated average dry matter production of non-conventional feed (t) per year in the study district

Non-conventional feed	Lowland (N=61)	Midland (N=65)	Overall (N=126)	P-value
House leftover	1.05 ± 0.15	0.85 ± 0.25	0.95 ± 0.13	0.564
Vegetable reject	0.77 ± 0.55	1.35 ± 0.25	1.05 ± 0.30	0.425
Fruit reject	10.75 ± 0.75^{a}	4.30 ± 1.00^{b}	7.53 ± 1.93	0.036
Total	13.00 ± 1^{a}	6.50 ± 0.50^{b}	9.75 ± 1.93	0.028

N, number of respondents; ^{a,b},means different superscripts in the row are significantly different P< 0.05; SEM, standard error of means; P, Probability of obtaining observed result.

4.3 Feeding System and Feeding priority of Livestock

Livestock feeding system and feeding priority of livestock in the study district is presented in (Table 16).According to interviewed respondent households,free grazing,late to grazing,stall feeding,tethering,supply feeding and herding are the existing feeding system in the study district.Based on the accessibility of livestock feeding system majority 81% of respondents practices free grazing on grazing land and crop stable lands and also ranked first for free grazing,for the reason that in dry season after crop harvesting livestock could be controlled easily.The observation of this study is similar with Tonamo *et al*.(2015) and Assefa *et al*.(2014) they pointed that free grazing system was the dominant and commonly practiced system in Essera district of Dawuro zone,southern Ethiopia and Diga district of Oromia region of Ethiopia, respectively.Late to grazing or following schedule and stall feeding system were ranked second and third by 65 and 70% of respondents,respectively this is because late or following schedule grazing and stall feeding practice were also better to manage and efficient utilization of feed resource.The observation is asimilar with Bogale *el al*.(2008) who reported that farmers in Sinana sub district of Bale highlands,commonly practices stall feeding of straw for their livestock.Respondents also practices tethering,herding and supplementary feeding in the study district.Comparable to the current study in Essera district of Dawuro zone,southern Ethiopia farmers practices tethering mainly in cropping season (Tonamo *et al*.,2015).According to Estefanos *et al*.(2014) herding was practiced mainly during dry season in high lands of harerge,estern Ethiopia.As well as (Worku,2014) pointed out in kersa malima woreda farmers supplement their lactating cow only with non-convectional feed traditional liquor residue tella atella instead of concentrate mixture.In the study district livestock feeding priority was depends on feed availability and production objectives,when a cows were at milking stage,they give priority for milking cows,also when oxen were employed more for plow cultivation land and get less access to grazing on pasture,then priority was given to oxen.Concerning to feeding priority about 79 and 62% of respondents ranked first and second for milk cows and oxen and then for calves and pregnant cow.Comparative study was reported by (Bpogale,2008) who reported that during peak times of cultivation farmers give priority for oxen in bale high lands of Ethiopia.

Table 16. Respondents percent and rank for available livestock feeding system and priority given to livestock feeding

	Ranking orer						Rank
Feeding system	1st	2nd	3rd	4th	5th	6th	
Stall feeding	0(0)	37(29)	88(70)	1(1.6)	0(0)	0(0)	3rd
Free grazing	105(81)	6(4.5)	4(3)	1(0.8)	0(0)	0(0)	1st
Late to grazing	17(14)	83(65)	34(27)	0(0)	0(0)	1(0.8)	2nd
Tethering	1(0.8)	0(0)	0(0)	37(29)	74(58)	1(0.8)	4th
Supply feeding	6(5)	2(1.5)	0(0)	30(24)	28(23)	0(0)	5th
Herding	0(0)	0(0)	0(0)	0(0)	1(0.8)	43(34)	6th
Feeding priority							
Milking cow	105(79)	21(16)	0(0)	0(0)			1st
Oxen	21(16)	67(62)	17(15)	21(17)			2nd
Pregnant cow	3(2)	0(0)	35(28)	88(69)			4th
Calves	4(3)	29(22)	72(56)	21(13)			3rd

Numbers out and in the bracket, indicate frequency and proportion of respondents respectivly

4.3.1 Yearly Availability of Livestock feed Resources

Yearly availability of livestock feed resources are presented in (Table 17).In the study district respondents classify months of the year according to feed resource availability for their livestock. According to the respondent households, natural pasture was feed throughout the year with the months Jun-November were good in availability and December and May were fair in availability. Similar observation was reported by Duressa *et al.* (2014) natural pasture consists the main source of animal feed throughout the year with maximum availability Jun-December.

Likewise,for cultivated forage grass Jun-November were good in availability and December and May were fair in availability. Also, months November-January were good in availability while as February-April were fair in availability for crop residues feeding. Months November-December were good while as October was fair for crop aftermath grazing. On the other hand, March-May were good while as November-February and Jun were fair for supply feed and fodder trees/shrubs in the study district.

Table 17. Availability of the major feed resources over the months of the year

Feeds	Sep	Oct	Nev	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Natural razing	Ga	Ga	Ga	Fa	-	-	-	-	Fa	Ga	Ga	Ga
Crop residue	-	-	Ga	Ga	Ga	Fa	Fa	Fa	-	-	-	-
Aftermath	-	Fa	Ga	Ga	-	-	-	-	-	-	-	-
Cul. forage	Ga	Ga	Ga	Fa	-	-	-	-	-	Ga	Ga	Ga
Supp. feed	-	-	Fa	Fa	Fa	Fa	Ga	Ga	Ga	Fa	-	-
Tree/shrus	-	-	Fa	Fa	Fa	Fa	Ga	Ga	Ga	Fa	-	-

Ga = good in availability, Fa = fair in availability and - = poor in availability, Cul=cultivated, Supp = supplementary

4.3.2 Yearly poor Availability of Livestock feed Resources

Yearly poor availability of livestock feed resources are presented in (Figure 4).Regarding to poorly availability of livestock feed resources in the study district about 87% of respondents explained for the months January-April were livestock could not obtain enough feed and the livestock require supplementary feed during these months.Also 86% of respondents explained for months February-April in these months livestock could not obtain enough feed.On the other hand 85% of the respondents explained for months December-May,livestock could not obtain enough feed.The observation is slightly accordance with Tonamo *et al*.(2015) who reported that critical months of feed shortage were January to March and February to April respectively in the Essera district of Dawuro zone,Southern Ethiopia.

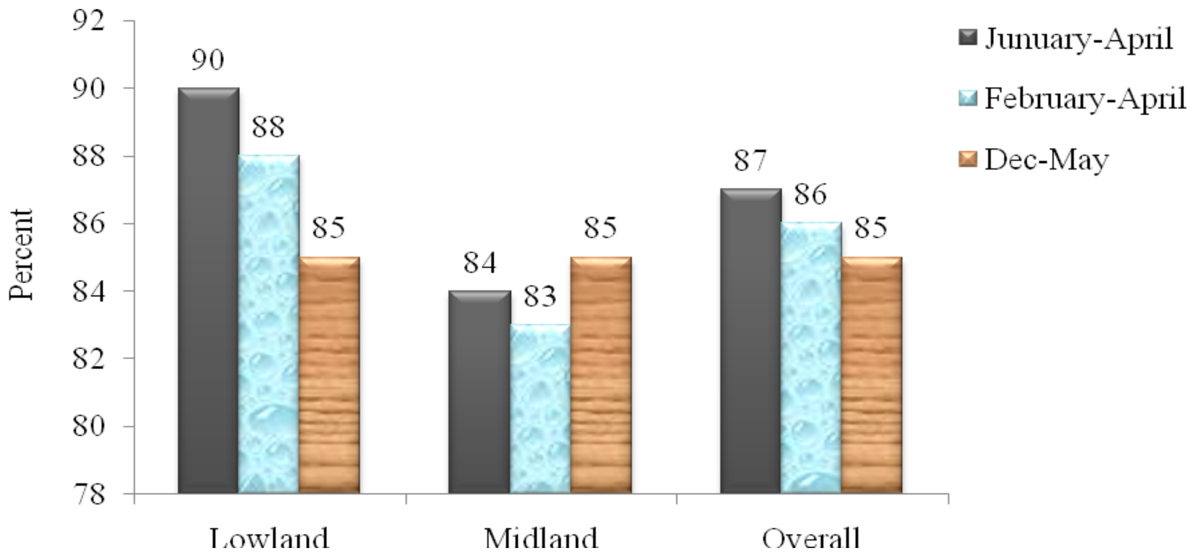

Figure 4. Yearly poor availability of livestock feed resources

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 prepared for laboratory analysis in JUCAVM animal nutrition laboratory.

4.4.1 Chemical composition of Crop residues

The chemical composition of crop residues in lowland altitude region range from 93 - 94.67% DM,6.67 - 9% Ash,37.66 - 42% CF,2 - 2.33% CP,1 - 2% EE,42 - 44.3% NFE and 5.33 - 8.33 ME MJ/kg.Likewise,the chemical composition of crop residues in smidland altitude region range from 91.33 - 94% DM,6 - 8% Ash,37 - 40% CF,2.33 - 5% CP,1 - 2% EE,42 - 44.33% NFE and 5.67 - 8.33 MEMJ/kg respectively (Table 18).

Table 18.Chemical composition of major crop residues in low and midland altitude regions

Lowland	Tef	Wheat/Kubisa	MaizeBH660	Sorghum	
% DM	95	94	93	93	
% Ash	8	9	7	6.67	
% CP	2.33	2	2	2	
% CF	39	42	37.66	37.67	
% EE	2	1	2	1.33	
% NFE	43	42	43.86	44.3	
MEMJ/kg	7	5.33	7.67	8.33	
Midland	Tef	Wheat/Digalo	MaizeBH540	Sorghum	Barley
% DM	93	94	92	91	94
% Ash	7.33	8	6	6	7
% CP	4	2.33	2.67	3.33	5
% CF	37.67	40	36.67	37	37
% EE	1.67	1	2	1.33	1
% NFE	43	42	44	43.67	43
MEMJ/kg	6.67	5.67	8.33	7	7

DM, dry matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen free extract; ME, metabolizable energy

4.4.2 Chemical composition of Crop residues that exist in both altitude regions

The chemical composition for crops that exist both in low and mid altitude regions of the study district are presented in (Table 19).The chemical composition of DM,Ash,CF,CP,EE,NFE and ME content of tef in lowland altitude region was 94.67%,8%,39%,2.33%,2%,43% and 7MEMJ/kg respectively,where as in midland altitude region was 93%,7.33%,37.67%,4%,1.67 %,43.33% and 6.67MEMJ/kg respectively.The DM content of tef was higher ($P<0.01$) for lowland than midland (94.67 > 93).The CF content of tef was higher ($P<0.05$) for lowland than midland altitude region.The CP content of tef was higher ($P<0.01$) for midland than lowland altitude region (4 > 2.33).The variation in DM,CF and CP content of crop residue tef might be due age or harvesting stage.The overall mean value of chemical composition of crop residue tef was 93.83% DM,7.67%Ash,38.33%CF,3.17%CP,1.83% EE,43.17%NFE and 6.83 MEMJ/kg respectively.The DM content of crop reside tef is slightly similar with the value of 93.54% reported by (Gebremichael,2014).The DM content of crop reside tef was higher than the value of 92.09% the CP content of crop reside tef is slightly lower than the value of 4.26% and the Ash content of crop reside tef is nearly similar with the value of 7.89% that reported by (Tonamo *et al*.,2015).

In the same way DM,Ash,CF,CP,EE,NFE and ME content of sorghum in lowland was 93 %, 6.67%,37.67%,2%,2%,44.3% and 8.33MEMJ/kg,respectively whereas in midland altitude region was 91.33%,6%,37%,3.33%,1.33%,43.67% and 7MEMJ/kg,respectively.The DM content of sorghum was higher ($P<0.01$) for lowland than midland altitude region (93>91.33).The CP content of sorghum was higher ($P<0.05$) for midland than lowland altitude region (3.33 > 2).The variation in DM and CP content in sorghum stover might be due to age or harvesting stage.The overall mean value chemical composition of sorghum stover was 92.17% DM,6.33% Ash,37.33% CF,2.67% CP,1.67% EE,43.98% NFE and 7.67 MJ/kg respectively.The DM and CF content sorghum stover was higher than the value of 33.4% and 31.8% respectively,and the Ash and EE content are slightly similar with the value of 6.8% and 1.5% respectively also CP and NFE content were lower than the value of 6.8% and 53.1% respectively that reported by (Iqbal *et al*.,2015).

Table 19. Chemical composition of crop residues that exist both altitude regions of the study district

Crop res/sto	Study area	% DM	% Ash	% CF	% CP	% EE	% NFE	MEMJ/kg
Tef residue	Lowland	95^{a}	8	39	2.33^{b}	2	43	7
	Midland	93^{b}	7.33	37.67	4^{a}	1.67	43.33	6.67
	Overall mean	93.83	7.67	38.33	3.17	1.83	43.17	6.83
	Overall SEM	0.401	0.211	0.333	0.401	0.167	0.167	0.167
	P-value	0.007	0.116	0.016	0.007	0.374	0.374	0.374
Sorghum stover	Lowland	93^{a}	6.67	37.67	2^{b}	2	44	8.33
	Midland	91.33^{b}	6	37	3.33^{a}	1.33	43.67	7
	Overall mean	92.17	6.33	37.33	2.67	1.67	43.98	7.67
	Overall SEM	0.401	0.211	0.211	0.333	0.211	0.307	0.422
	P-value	0.007	0.116	1	0.016	0.116	0.101	0.116

DM, dry matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen free extract; ME, metabolizable energy; ^{a,b},means with different superscript in the column are significantly different $P<0.05$;SEM,standard error of means;P,probability of obtaining observed result.

4.4.3 Chemical composition of Fodder Trees and Shrubs in the study district

The chemical composition of Crop residues in lowland altitude region range from 91-94% DM,7.67-15% Ash,27-35.67% CF,11-12.67% CP,2-5% EE,24-43% NFE and 5-7.99 MEMJ/kg respectively.Likewise,the chemical composition of crop residues in midland altitude region range from 90-94.67% DM,6-11% Ash,28-34.67% CF,12-15% CP,2-4% EE,27-42.67% NFE and 5-7.67 MEMJ/kg respectively(Table 20).

Table 20. Chemical composition of fodder trees/shrubs in low and midland altitude regions

Lowland	*C.africana*	*F.sur*	*E. cymosa*	*A. abyssinica*	*A. schimpernia*
% DM	91	94	90	92	92.67
% Ash	13	10	15	9	7.67
% CP	12.67	11.67	15	11	11.33
% CF	35.67	27	30.67	27	28
% EE	5	2	5	2	3.67
% NFE	25	43	24	42	43
MEMJ/kg	6	7.33	5	7	7.99
Midland	*C.africana*	*O. africana*	*M.e. lancelata*	*V.amygdalina*	*A. schimpernia*
% DM	90	91	93	94.67	93
% Ash	11	10	6	8	7.33
% CP	13	14	12	14	15
% CF	34.67	35	30	28	25.67
% EE	3	4	2	2	2
% NFE	28	27	42	42.67	43
MEMJ/kg	6.33	5	6.67	7.33	7.67

DM, dry matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen free extract; ME, metabolizable energy

4.4.4 Chemical composition of Fodder Trees/Shrubs that exist in both altitude regions

Chemical composition of fodder trees/shrubs that exist in both lowland and midland altitude regions are presented in (Table 21).The DM,Ash,CP,CF,EE,NFE and ME content of *C.africana* in lowland were 91%,13%,12.67%,35.67%,5%,25.33% and 6 MJ/kg respectively.where as DM,Ash,CP,CF,NFE and ME content of *C.africana* was 90%,11%,13%,34.67%,3%,28% and 6.33MJ/kg respectively.The Ash and EE content of *C.africana* was higher ($P<0.05$) for lowland than midland altitude (13>11;5>3) respectively.Similarly,NFE content of *C.africana* was higher ($P<0.05$) for midland than lowland altitude (28>25.33).The variation in Ash,EE and NFE of *C.africana* in the study area might be due to age or agro-ecological factors.The overall mean value chemical compostion of *C.africana* was 90% DM,12% Ash,37.33% CF,13% CP, 4% EE,26.67% NFE and 6.17 MEMJ/kg respectively.The DM,Ash and CP content of *C.africana* is lower than the value of 94.31%,14.11% and 15.55% respectively,that reported by Geta *et al*.(2014) in south Wolayta zone,Ethiopia.The DM content of *C.africana* is similar with the value of 90.1% and lower than the value of Ash 14.5% and CP 17.7% that reported by Shenkute *et al*.(2012) in the Mid Rift Valley of Ethiopia.

In the same way:DM,Ash,CF,CP,EE,NFE and ME content of *A.schimpernia* in lowland was 92.67%,7.67%,28%,11.33%,3.67%,42.33% and 7MJ/kg while as in midland was 93%,7.33%, 25.67%,15%,2%,43% and 8.33 MJ/kg respectively.The CP content of *A.schimpernia* was higher ($P<0.001$) for midland than lowland altitude (15>11.33).Likewise:The CF and EE content of *A.schimpernia* was higher ($P<0.01$) for lowland than midland altitude (28 > 25.67;3.67 > 2) respectively.The variation in CP,CF and EE in fodder *A.schimpernia* might be due to its age.The average chemical compostion of *A.schimpernia* in the study district was 93% DM,7.7% Ash, 26.83% CF,13.17% CP,2.83% EE,42.67% NFE and 7.67 MEMJ/kg respectively.The DM content of *A.schimpernia* was higher than the value of 90%,the CP content was lower than the value 28.9% and the Ash,EE and ME content of *A.schimpernia* is slightly similar with the value of 7.7%,3.1% and 8.5MJ/kg respectively that reported by Yoseph *et al*.(2015) in Jimma zone Ethiopia.

Table 21.Chemical composition of fodder trees/shrubs that exist in both altitude regions of the study district

Feed type	Study district	%DM	%Ash	%CP	%CF	%EE	%NFE	MEMJ/kg
C.africana	Lowland	91	13^{a}	12.67	35.67	5^{a}	25^{b}	6
	Midland	90	11^{b}	13	34.67	3^{b}	28^{a}	6.33
	Overall mean	90	12	13	35.17	4	26.67	6.17
	Overall SEM	0.307	0.516	0.258	0.307	0.516	0.667	0.31
	P-value	0.01	0.025	0.23	0.101	0.026	0.016	0.643
A. schimpernia	Lowland	92.7	7.67	11^{b}	28^{a}	3.67^{a}	42.33	7
	Midland	93	7.33	15^{a}	25.67^{b}	2^{b}	43	8.33
	Overall mean	93	7.5	13.17	26.83	2.83	42.67	7.67
	Overall SEM	0.258	0.224	0.833	0.543	0.401	0.333	0.422
	P-value	0.230	0.500	0.000	0.002	0.007	0.374	0.116

DM,dry matter;CP,crude protein;CF,crude fiber;EE,ether extract;NFE, nitrogen free extract; ME,metabolizable energy;^{a,b},means with different superscript in the column are significantly different P < 0.05;SEM,standard error of means; P,probability of obtaining observed result.

4.5 Feed Nutrient Supply

In the study district from all feed types,totally about 851t of feed dry matter,60t crude protein and 7,200.00MJ metabolizable energy produced per year (Table 22).Regarding to a total supply of feed nutriments,considerably largest average dry matter supply was from crop residues 104t/year and then from gtrazing feed resources 71.50t/year.The average contribution of feed dry matter per year from crop residues was higher (P<0.05) for midland than lowland altitude regions (113.5t>94.5t) and the average contribution of feed dry matter yield per year from grazing resources was higher (P<0.05) for lowland than midland altitude regions (78t > 65t).The average contribution of dry matter yield per year from fodder trees/shrubs in low and mid altitude regions was 21 and 15t,respectively or 18t in the study district.The average contribution of dry matter yield per year from non-conventional feed was higher (P<0.05) for lowland than midland (13t>6.5t) and also the average contribution of dry matter yield per year from cultivated

forage grasses was higher($P<0.01$) for midland than lowland (12.00t > 6.50t).The overall average dry matter contribution of non-conventional and cultivated forage per year in the study district was 9.75 and 9.25t respectively.The total average contribution of feed dry matter per year in lowland and midland altitude regions was 213 and 212.5t,respectively or 212.75t in the study district.The largest average contribution of CP per year in the study district was from crop residues 7.25t and then from grazing resources 5t.The average contribution of CP per year from fodder trees/shrubs,non-conventional feed and cultivated improved forage grasses was 1.25,0.75 and 0.75t respectively.The total average contribution of CP per year in lowland and midland altitude regions was 14.5 and 15.5t respectively,or 15t in the district.The largest contribution of ME was produced from crprop residues 862,500MJ and then from gazing resource 587,500MJ.
The average contribution of ME energy per year from fodder trees/shrubs,non-conventional feeds and cultivated forage grasses was 150,000MJ;87,500MJ and 87,500MJ respectively.The contribution of ME energy per year from crop residues was higher($P<0.05$) for midland than lowland altitude regions (950,000MJ >775,000MJ) and likewise the contribution of ME per year from grazing resources was higher($P<0.05$) for low land than midland (650,000MJ>525,000MJ). The total average contribution of ME per year in the district was 1,800,000MJ.In terms of overall availability and contribution to livestock feed supply,crop residues 48.88% and grazing resources 33.65% were the major available livestock feed resources followed by fodder trees and shrubs 8.45%,also non-conventional feeds 4.58% and cultivated improved forage grasses 4.46% have undersized contribution.The result is in agreement with (Assefa and Nurfeta,2013) they reported that from all available feed resources produced,in Adami Tullu Jiddo district of Oromia regional state of Ethiopia,the higher feed dry matter 74.57% produced was from crop residues.According to Tolera *et al*.(2012) crop residues contribute to about 40-50% of the total feed supply in Ethiopia.Wolde *et al*.(2014) also reported that,the major feed for fatting animals and use as basal diet are crop residues and natural pasture in central southern Ethiopia.

Table 22. Feed resources category and their nutrient DM (t), CP (t) and ME (MJ) supply in the study sites

Nutrias	Feed supply	Mean in the study sites		Overall		
		Lowland	Midland	Mean	SEM	P-value
DM	Grazing resources(t)	78.00[a]	65.00[b]	71.50	1.118	0.028
	Crop residue(t)	94.50[b]	113.50[a]	104.00	1.768	0.033
	Fodder tree & Shrubs(t)	15.00	21.00	18.00	0.707	0.051
	Non-conventional feeds(t)	13.00[a]	6.50[b]	9.75	0.559	0.028
	Improved forage grass(t)	6.50[b]	12.00[a]	9.25	0.250	0.008
	Total DM Supply(t)	213.00	212.50	212.75	4.100	0.957
CP	Grazing resources(t)	5.50	4.50	5.00	0.354	0.293
	Crop residue(t)	6.50	8.00	7.25	0.250	0.095
	Fodder tree & Shrubs(t)	1.50	1.00	1.25	0.250	0.423
	Non-conventionalfeeds(t)	1.00	0.50	0.75	0.250	0.423
	Improved forage grass(t)	0.50	1.00	0.75	0.250	0.423
	Total CP supply(t)	14.50	15.50	15.00	0.354	0.293
ME	Grazing resources(MJ)	650,000[a]	525,000[b]	587,500	0.250	0.038
	Crop residue(MJ)	775,000[b]	950,000[a]	862,500	0.250	0.020
	Fodder trees &Shrubs(MJ)	175,000	125,000	150,000	0.354	0.293
	Non-conventional feeds(MJ)	100,000	75,000	87,500	0.250	0.423
	Improved forage grass(MJ)	50,000	125,000	87,500	0.250	0.095
	Total ME supply(MJ)	1,800,000	1,800,000	1,800,000	0.707	1

DM, dry matter; ME, metabolizable energy; CP, crude protein; t, ton; [a,b] means with different superscript in the row are significantly different at P<0.05;SEM, standard error of means,P, probability of obtaing observed result.

4.5.1 Estimated Nutrient balance

The estimated nutrient balance of livestock feed in the study district is presented in (Table 23). According to the result found in this study,the estimated available feed nutrient supply interms of dry matter was 426 and 425tDM/year in low and midland regions,respectively or 851tDM/year in the study district,whereas,the estimated available feed nutrient requirement was about 1008.88 and 940.103tDM/year,in low and midland regions,respectively or 1948.98tDM/year in the study district.The estimated nutrient balance in terms of dry matter was -582.88 and -515.103tDM/year in low and midland altitude regions,respectively or -1097.98tDM/year in the study district.The overall feed balance in terms of DM yield per year to a total TLU value of 854.35 showed that 1948.98tDM/year was required,whereas,dry matter produced was 851tDM/year with negative balance of 1097.98tDM/year.The total CP produced and required was 60 and 100.9t/years.The total metabolizable energy produced and requirement was 7,200,000 and 10,266,000MJ/year with negative balance of 3,116,000MJ/year.Hence the annual utilizabanle feed dry matter satisfied only 43.66% of what is required per annul,the remain about 56.34% of feed dry matter additionally required to satisfy the requirement of livestock.The annual utilizable crude protein and metabolizable energy was 59.46 and 70.13%,respectively and about 40.54% crude protein and 29.7% metabolizable energy was additionaly required.The persent study is comparable with Wondatir *et al*.(2011) who pointed that the existing feed supply at Debre Birhan,on a year-round basis satisfies only 64% of the maintenance dry matter requirement of the animals per farm.Similarly,the total available crude protein and metabolizable energy in the same area satisfy only 66% and 81% of the total livestock requirement per farm on a yearly basis.On the outher hand,the persent study is contradictory with (Mulu,2009) who pointed out that in Bure Woreda, Amhara Regional state of Ethiopia,the existing feed dry matter supply and livestock requirement was sufficient,on a year round basis accounted for about 104.79% of the maintenance DM requirement.The reason for positive balance mght be small livestock number.

Table 23.Estimated annual livestock feed nutrient supply,rerquirement and balance of supply and reuirment

Annual estimated nutrient	Study area	TLU	DM(t)	CP(t)	ME(MJ)
Nutrient supply	Lowland	442.25	426	29	3,600,000
	Midland	412.1	425	31	3,600,000
	Total	854.35	851	60	7,200,000
Nutrient rerquirement	Lowland	442.25	1008.88	52.36	5,314,000
	Midland	412.1	940.103	48.54	4,952,000
	Total	854.35	1948.98	100.9	10,266,000
Balance of nutrient supply and requirement	Lowland	442.25	-582.88	-23.36	-1,714,000
	Midland	412.1	-515.103	-17.54	-1,353,500
	Total	854.35	-1097.98	-40.90	-3,116,000

DM, dry matter; CP, crude protein; ME, metabolizable energy

4.6 Constraints for Livestock production Relation to Feed availability

Constraints for production in the study district is presented in (Table 24).The result of this study show that feed shortage is the major constraint for livestock production in relation to feed availability identified by most of the respondents in the study district.This was witnessed by overall 75% of the respondents.Respondents in the study district explained that,increment in crop land at the expense of grazing land,shortage of land for forage production,decrease grazing land and resulted in livestock feed shortage.Accordingly,feed shortage got the first rank and also 63% of respondents ranked second for land shortage to cultivate forage due to increasing demand for cropping.In agreement to this particular study (Assefa and Nurfeta,2013);Altaye *et al*.(2014) and Duguma *et al*.(2013) pointed out feed shortage was the major constraint for livestock production in Adami Tulu Jiddo Kombolch,Central Ethiopia;Metekel zone,northwest Ethiopia and Ginchi watershed shade area Oromia regional state as well as (Wondatir,2010) reported that the major constraint for livestock production in and around Debre Birhan of Ethiopia was found to be feed shortage which is associated with expansion of cultivation of grazing lands for food crop production.Poor market access to purchase feed was also one of the major constraints of livestock production and it was ranked third by 44% of respondents in the study district.The observation is slightly similar with Dejene *et al*.(2014) among the dominant factors contributing to feed shortage in terms of both quantity and quality in Ethiopia was the poor feed marketing system characterized by poor market information,localized markets and limited premium price for quality.About 53% of respondents in the study district ranked forth for shortage of water at dry season.Similarly,Worku (2014) reported comparable results in Kersa Malima woreda of Oromia regional state Ethiopia.Lack of awareness also ranked fifth major constraint in relation to feed resource availability for livestock production and this was witnessed by 53% of respondents in the study district.Lack of awareness on livestock husbandry practices including forage cultivation,poor feeding practice,poor storage and utilization were the existing constraints.The observation is also in agreement with (Yadessa,2015) who reported in Meta Robi district of west shows zone,Oromia regional state of Ethiopia.

Table 24. Respondents percent and rank for constraints of livestock production

Constraints of livestock production	Ranking order					Rank
	1st	2nd	3rd	4th	5th	
Feed shortage	92(75)	30(24)	2(2)	2(1)	0(0)	1st
Lack of awareness	2(2)	6(5)	34(28)	17(17)	67(53)	5th
Land shortage	29(23)	79(63)	15(11)	3(2)	0(0)	2nd
Poor market access	0(0)	10(8)	5(44)	35(26)	26(19)	3rd
Scarcity of water at dry season	0(0)	0(0)	22(15)	67(53)	37(28)	4th

Numbers out and in the bracket, indicate frequency and proportion of respondents respectivly

4.6.1 Consequence of Feed shortage

In the study district among the interviewed respondent household heads,about 85 and 86.5% of the respondents ranked first and second for weight loss and milk yield reduction,respectively in association with feed shortage in terms of quantity and quality meaning that performance of livestock was highly linked to feed shortage in the study district.This observation is in line with (Wondatir,2010) who reported that weight loss and milk yield reduction was the result of feed shortage in and around Ziway,Oromia regional state,Ethiopia.About 95% of the respondents also gave third rank for no sign of estrus due to feed shortage (Table 25).

Table 25.Respondents percent and rank for outcome of feed shortage on livestock performance

	Ranking order			
Parameters	1st	2nd	3rd	Rank
Poor body condition	107(85)	15(12)	4(3)	1st
Milk yield reduction	15(12)	109(86.5)	2(1.5)	2nd
No sign of estrus	4(3.5)	2(1.5)	120(95)	3rd

Numbers out and in the bracket, indicate frequency and proportion of respondents respectivly

4.6.2 Strategy to alleviate Feed shortage

Respondents in the study district use different methods to alleviate feed shortage.About 86% of respondents in the study district store and used crop residues to alleviate feed shortage.This study is inline with (Wondatir,2010) who point out that in and around Ziway farmer store and use crop residues to feed their livestock for the time of feed shortage.Similarly,about 81% of respondents in the study district used fodders trees/shrubs,about 51.5% of the respondents used non-convensional feed,and very few 21% of respondents used cultivated improved forage grass,as well as only 8% of respondents used conserved hay grass to alleviate feed shortage (Table 26)

Table 26.Respondents percent of strategy to alleviate livestock feed shortag

Store crop residue	Lowland	Midland	Total	χ^2	P-value
	52(85.2)	57(87)	109(86.5)		
Total	61(100)	65(100)	126(100)	0.161	0.688
Conserve hay	6(7)	4(4)	10(8)		
Total	61(100)	65(100)	126(100)	0.308	0.579
Fodder trees/shrubs	52(85)	50(77)	102(81)		
Total	61(100)	65(100)	126(100)	1.414	0.234
Cultivate forage	9(15)	18(27)	27(21)		
Total	61(100)	65(100)	126(100)	3.129	0.077
Supply feed	31(51)	34(52)	65(51.5)		
Total	61(100)	65(100)	126(100)	0.028	0.867

Respondents properties in lowland and midland altitude region no significance difference $P<0.05$.

4.6.3 Storage System of Crop residues

Respondents in the study district used crop residues for home consumption of their livestock after harvesting and collection of the grain,and used different conservation methods.Among the interviewed respondent households 66% of respondents use storage house to conserve crop residues and 56% of respondents stock outside.Also 27% of respondents stock in shelter,as well as 21% of respondents in the study district bail outside (Figure 5).The study is comparative with (Wondatir,2010) who reported that farmers around Ziway store crop residue as hay for drought oxen for the duration of plowing period.

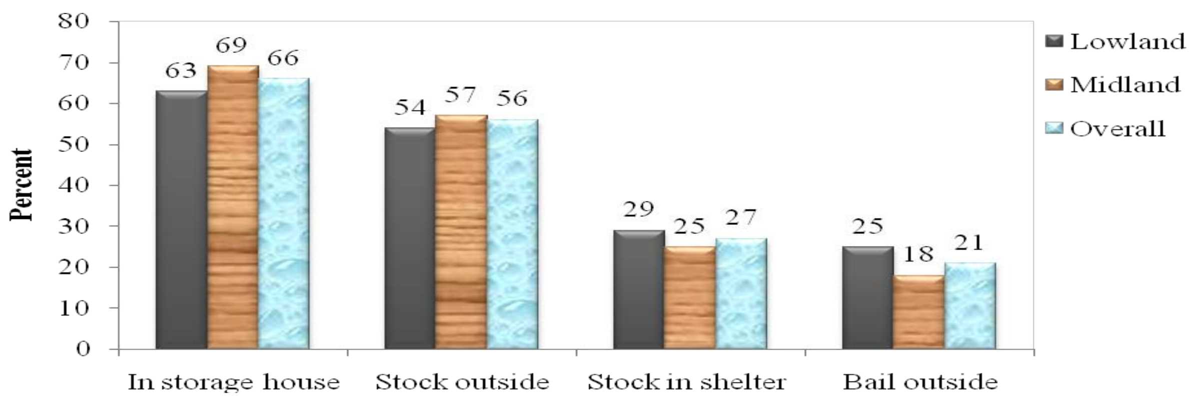

Figure 5. Storage systems of crop residues

4.7 Opportunity for Livestock production Relation to Feed availability

In the study district,regarding to opportunity for livestock production in relation to feed resources availability:crop residues,grazing resources,non-conventional feed and cultivated improved forage grasses were relatively the existing opportunities for livestock feeding in the order of importance (Table 27).The study district was high in cereal crop production potential especially,tef,wheat,maize,sorghum and barley.This represent availability or large quantities of crop residues after crop harvest are potential feed resources,therefore providing extension services to the farmers about encouraging proper storage,efficient utilization,post harvest management and urea treatment is condtion is suitable to cultivate improved forage if awareness created to the farmers great opportunity that could be used for enhancing the productivity of the livestock and use to overcome feed shortage problem during the times of scarcity.Also climatic and biological soil conservation practices in the study district was also another opportunity to cultivate improved forage.

Table 27.Respondents percent and rank for opportunity in relation to livestock feed resources availability

	Ranking order					Rank
Opportunity	1st	2nd	3rd	4th	5th	
Crop residues	112(89)	14(11)	0(0)	0(0)	0(0)	1st
Grazing resources	14(12)	112(88)	0(0)	0(0)	0(0)	2nd
Fodder trees/shrubs	0(0)	0(0)	89(71)	11(9)	2(1.5)	3rd
Non-conventional feed	0(0)	0(0)	24(19)	39(31)	2(2)	4th
Cultivated forage grasses	0(0)	0(0)	5(4)	12(9)	10(8)	5th

Numbers out and in the bracket, indicate frequency and proportion of respondents respectivly

5 CONCLUSIONS AND RECOMMENDATION

5.1 Summary and Conclusion

The study was carried out in Gombora district of Hadiya Zone,Southern Nation Nationalities and Peoples Regional State,Ethiopia with the objectives of assessing available feed resources and feeding systems,determining annual feed balance and requirements in terms of dry matter,crude protein and metabolizable energy as well as identifying constraints and opportunities for livestock production in relation to feed resource availability.The study district was stratified in to low and midland altitude regions based on altitude differences.Structured questionnaire was prepped to collect data from sample households.The feed samples collected from both regions were subjected to evaluate nutritional quality,which was determined in JUCAVM animal nutrition laboratory.The results of this study show that mixed crop-livestock production system was the dominant farming system in the study district.Livestock serves as a source of milk,drought power,meat,replacement stock,income sources and manure production.Major available livestock feed rsources were crop residues 48.88%,grazing resources 33.64%,fodder trees/shrubs 8.45%,non-conventional feeds 4.58% and cultivated forage grasses 4.46%.The nutrional quality is low,the crude protein content of crop residues range from 2-5%, while crude protein content in fodder trees and shrubs ranged between 11-15%.The estimation of available feed resource shows that there was shortage of feed supply in the study district.The estimated total dry matter requirement was 1948.98tDM/year,where as the estimated supply was 851tDM/year,with negative value of 1097.98tDM/year,which covers only about 43.66% of the total dry matter requirement and 56.34% of feed dry matter was additionally required to satisfy the requirement of livestock.The total crude protein requirement was 100.9 t/year,while the amount supplied was 60t/year with the negative value of 40.9t/year.The total metabolizable energy required was 10,266,000MJ,while as the estimated supply was 7,200,000MJ with the negative value of 3,116,000MJ.Therefore;feed shortage is one of the major constraint that limit the development and expansion of livestock production in the study district.Also other reasons for feed shortage in the study district were land shortage,lack of awareness on husbandry practices including forage cultivation;poor storage system and poor feeding practices and poor market access to purchase feed.Based on the results of this study,the following recommendations need to be forwarded:

5.2 Recommendation

- The shortage of feed would be tackled through adaption of alternative feed production and utilization technologies such as extension of integrating improved forage crop, efficient feed utilization and conservation.
- Crop residues with low nutritional value constitute the major portion of feed resources in the study district.Therefore to improve digestibility,applying urea treatment,improving harvesting time and storage system would be important.To facilitate this,situation of transport and credit facilities are very essential.
- Fodder tree and shrubs were better regarding to nutritional value as compared with other available feed resources in the study district therefore;creating awareness to farmer would be important regarding to utilization of fodder trees/shrubs.
- Strengthen the fodder development practices in the study district by providing strong extension services and follow up training relating to strategic feeding practices would be important.
- In general,technical and institutional intervention would be very essential to alleviate the prevailing constraints to livestock production in relation to feed resource availability.

6. REFERENCES

Abate, A.L.and Mayer, M., 1997.Prediction of the useful energy in tropical feeds from proximate composition and in vivo derived energetic contents. Metabolizable energy. Small Ruminant Research, **25(1)**:51-59.

Abate, A., 2008.Effect of nitrogen fertilizer and harvesting stage on yield and quality of natural pasture in Fogera District, North Western Ethiopia (Doctoral dissertation, Haramaya University).

Abera, M., Tolera, A., and Assefa, G., 2014. Feed resource Assessment and Utilization in Baresa Watershed, Meskan Woreda, Gurage Zone, and Southern Ethiopia.

Admassu, Y., 2008.Assessment of livestock feed resources utilization in alaba woreda, southern Ethiopia.

Admassu, Y., Zewdu, T. and Tegegne, A., 2008.Availability of livestock feed resources in Alaba Woreda, Southern Ethiopia.ESAP Proceedings.

Alem, M., Tamir, B.and Kurtu, M.Y., 2011.Feed utilisation of Ethiopian Highland lambs on a basal diet of Eleucine coracana straw and supplemented with variously sourced protein mixed with wheat bran. Tropical animal health and production, **43(1)**:115-120.

Alemayehu, Y., Tegegne, A.and Kurtu, M.Y., 2000.Chemical composition and nutritive value of major available feed resources in three peasant associations of the Awassa Woreda.

Alemu, Y., 2009.Nutrition and feeding of Sheep and Goat.In: Ethiopian sheep and Goat Production Improvement Program, pp: 106-159.

Altaye, S.Z., Kassa, B., Agza, B., Alemu, F. andMuleta, G., 2014.Smallholder cattle production systems in Metekel zone, northwest Ethiopia.Res.J. Agric.Environ. Manage, **3(2)**:151-157.

AOAC (Association of Analytical chemists), 2005.Official methods of analysis of the official analytical chemists,2 vol.18 Edition.Horwitz W, Ed. Association of Official Analytical Chemists (AOAC) Arlington, V A,USA.

Aredo, T.A., 1999.The role of crop residues as livestock feed resources in semi-arid areas of Adami Aulu district, Ethiopia (Doctoral dissertation, University of Nairobi).

Asmare, B., 2016. Evaluation of the Agronomic, Utilization, Nutritive and Feeding Value of Desho grass (Pennisetum pedicellatum) (Doctoral dissertation, Jimma University).

Assefa, D.and Nurfeta, A., 2013.Assessment of feed resource availability and livestock production constraints in selected Kebeles of Adami Tullu Jiddo Kombolcha District, Ethiopia.African Journal of Agricultural Research, **8(29)**: 4067-4073.

Assefa, F., Ano T, Aba T and Ebrahim Z 2015 Assessment of improved forage types and their utilization in Shashogo Woreda, Hadiya zone, Southern Ethiopia.Global Journal of Animal Science, Livestock Production and Animal Breeding, **3(6)**:227-230.

Behnke, R.and Metaferia, F.2011.The contribution of livestock to the Ethiopian economy part II.IGAD LPI Working Paper 02-11.Addis Ababa, Ethiopia: IGAD Livestock Policy Initiative.

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

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(1)**:166-194.

Bereda, A., Yilma, Z.and Nurfeta, A., 2014.Dairy Production System and constraints in Ezihya District of the Gurage Zone, Southern Ethiopia.Global Veterinaria,**12(2)**: 181-186.

Boggle, S., 2004.Assessment of livestock production system and feed resource base in Sinana Dinsho district of Bale highlands, Southeast Oromia (Doctoral dissertation, M. Sc. Thesis. Alemaya University, Alemaya, 60-64).

Bogale, S., Melaku, S.and Yami, A., 2008.Potential use of crop residues as livestock feed resources under smallholder farmers conditions in Bale highlands of Ethiopia.Tropical and Subtropical Agroecosystems,**8(1)**: 107-114.

Boufennara, S., Lopez, S., Bousseboua, H., Bodas, R. and Bouazza, L., 2012.Chemical composition and digestibility of some browse plant species collected from Algerian arid rangelands. Spanish journal of agricultural Research, **10(1)**: 88-98.

CSA (Central Statistical Agency), 2011.Ethiopian Demographic and health survey:55

CSA (Central Statistical Agency), 2013/14.Agricultural sample survey.Statistical bulletin 573, Addis Ababa, Ethiopia.

Dejene,M.,Bediye,S.,Alemu,D.,Kitaw,G.,Kehaliw,A.,Assefa,G.and Tadesse,G.,2014.Livestock Feed Marketing in Ethiopia:Challenges and Opportunities for Livestock Development.Journal of Agricultural Science and Technology.A,4(2A).

Desalew, T., 2008.Assessment of feed resources and rangeland condition in Metema district of north Gondar zone, Ethiopia (Doctoral dissertation, Haramaya University).

Diressie, H.T., 2011.Crop residue management and farm productivity in smallholder crop-livestock system of dry land North Wollo, Ethiopia (Doctoral dissertation, Wageningen University).

Duguma, B., Tegegne, A.and Hegde, B.P., 2012.Smallholder livestock production system in Dandi district, Oromia Regional State, central Ethiopia. Read and write, **20**: 25-6.

Duguma, B., Getachew, E., Azage, T.and Hegde, B.H., and 2013.Farmers perceived livestock production constraints in Ginchi watershed area: Result of participatory rural appraisal.International Journal of Livestock Production**, 4(8)**: 128-134.

Duressa,D.,Kenea,D.,Keba,W.,Desta,Z.,Berki,G.,Leta,G.and Tolera,A.,2014.Assessment of livestock production system and feed resources availability in three villages of Diga district Ethiopia.

EATA (Ethiopian agricultural transformation agency), 2013.Innovations to help our country grow.EATA.Addis Ababa, Ethiopia.

Ergano, K., Duncan, A., Adie, A., Tedla, A., Woldewahid, G., Ayele, Z., Berhanu, G. and Alemayehu, N., 2010. Multi-stakeholder platforms strengthening selection and use of fodder options in Ethiopia: Lessons and challenges.

Eshete, G., 2002. An assessment of feed resources, their management and impact on livestock productivity in the Ginchi watershed area (Doctoral dissertation, MSc. Thesis. Alemaya University of Agriculture, Alemaya).

Estefanos,T.,Tesfaye,A.,Feyisa,H.,Gashaye,W.,Tatek,W.,Tesfaye,K.and Osho,T.,2014.Traditionl cattle production in the highlands of Hararge: Case study for East and West Zones of the high lands of Harerge, Eastern Ethiopia. Basic Res. J. Agric. Sci. Rev, **3(12)**: 122-130.

FAO (Food and Agriculture Organization of the United Nations), 1987.Master Land Use Plan, Ethiopia: Range /Livestock Consultancy.Report Prepared for the Government of the people's Democratic Republic of Ethiopia based on the work of L.Mayer,AG/ETH/82/010 Technical Report, FAO, and Rome.

FAO (Food and Agriculture Organization of the United Nations), 1995.FAOSTAT.PC Data Base. Food and agriculture Organization, Rome, Italy.

FAO (Food and Agricultural Organizations), 1997.Roughage utilization in Warm climate.In: FAO Animal Production and Animal Health paper.135p.

FAO (Food and Agriculture Organization), 2002.FAO/UNESCO Digital Soil Map of the World and derived soil properties. Land and Water Digital Media Series #1 rev 1.FAO, Rome

Firaw, T.and Getnet, A., 2010.Feed resource assessment in Amhara national regional state. Ethiopia sanitary and phytosanitary standards and livestock and meat marketing program (SPS-LMM).Ethiopia: USAID.

Gebremichael, B., 2014.Characterization of available feed resources in South Gonder zone, Ethiopia.Journal of Agriculture and Biodiversity Research, **3(8)**: 126-136.

Gecho, Y., Ayele, G., Lemma, T., and Alemu, D., 2014.Rural household livelihood strategies: Options and determinants in the case of Wolaita Zone, Southern Ethiopia.

Gelayenew B.A. ,2012.Assessment of livestock feed resources, seasonal chemical composition and in sacco dry matter degradability of major forage species in Abobo woreda, Gambella Regional State, Ethiopia.MSc Thesis,Hawassa University,Ethiopia.

Geta,T.,Nigatu,L.and Animut,G.,2014.Evaluation of potential yield and chemical composition of selected indigenous multi-purpose fodder trees in three districts of Wolayta Zone,Southern Ethiopia.World Appl.Sci.J,**31(3)**: 399-405.

Gizachew, A., 2012.Comparative Feedlot Performance of Washera and Horro sheep fed different roughage to concentrate ratio.An MSc.thesis submitted to the school of graduate studies Haramaya University.

Gurmessa,K.,Tolemariam,T.,Tolera,A.,Beyene,F.and Demeke,S.,2015.Feed resources and livestock production situation in the highland and mid altitude areas of Horro and Guduru Districts of Oromia Regional State,Western Ethiopia.Science,Technology and Arts Research Journal,**4(3)**:111-116.

Guyo, S., 2014.Assessment of cattle husbandry and marketing practices in burji woreda,segen zuria zone of snnprs,ethiopia (Doctoral dissertation,AAU).

Guyo,S.and Tamir,B.,2014.Assessment of Cattle Husbandry Practices in Burji Woreda,Segen Zuria Zone of SNNPRS,Ethiopia.Int.J.Technol.Enh.Emer.Eng.Res,**2(4)**: 11-26.

Hassen,A.,Ebro,A.,Kurtu,M.and Treydte,A.C.,2010.Livestock feed resources utilization and management as influenced by altitude in the Central Highlands of Ethiopia.Livestock Research for Rural Development, 22(12).

Iqbal,M.A.,Akbar,N.,Khan,H.Z.and Abbas,R.N.,2015.A study on feed stuffs role in enhancing the productivity of milch animals in Pakistan-Existing scenario and future prospect.Global Veterinaria,**14(1)**: 23-33.

Kearl, L.C., 1982.Nutrient requirements of ruminants in developing countries.International Feedstuffs Institute.

Kechero, Y., 2008. Effect of seed proportions of Rhodes grass (Chloris gayana) and white sweet clover (Melilotus alba) at sowing on agronomic characteristics and nutritional quality. Livestock Research for Rural Development, 20(28), p.15.

Kechero,Y.,A,Becker.,J.M,Rothman.,E.S,Dierenfeld.,B,Marescau.,Bosch,W.,Hendriks,G.P.J. Janssens.,2012.Amino acid profile of salivary proteins and plasmatic trace mineral response to dietary condensed tannins in free-ranging zebu cattle (Bos indicus) as a marker of habitat degradation.Livestock Science,**144(3)**:275-280.

Kechero, Y., Tolemariam, T.and Haile, A., 2013.Characteristics and Determinants of Livestock Production in Jimma Zone/Southwestern Ethiopia. African Journal of Basic & Applied Sciences, **5(2**): 69-81.

Kechero, Y.and Janssens, G.P., 2014.The Impacts of Imbalances of Feed Supply and Requirement on Productivity of Free-Ranging Tropical Livestock Units: Links of Multiple Factors. African Journal of Basic & Applied Sciences, **6(6)**:187-197.

Matouš, P., Todo, Y.and Mojo, D., 2013.Roles of extension and ethno-religious networks in acceptance of resource-conserving agriculture among Ethiopian farmers. International Journal of Agricultural Sustainability, **11(4)**:301-316.

McCarthy, G., 1986.Donkey Nutrition.In D.Elisabeth and M.B.E.Svedsen (eds).The Professional haondbook of Donkey.Sidmouth (UK).248pp.

McDonald, P., J.F.D. Greenhalgh, C.A. Morgan, R. Edwards, Liam Sincliar and Robert Wilkinson, 2010.Animal nutrition. 7 ed. Prentice Hall, NY, USA.

McIntire, J, D.Bourzat and P.Pingali, 1992.Crop Livestock Interaction in Sub-Saharan Africa. Regional and Sectoral Studies Series. The World Bank, Washington, DC.246p.

Mediksa, T., Urgie.and Animut, G., 2016.Effects of Different Proportions of Pennisetum Purpureum Silage and Natural Grass Hay on Feed Utilization, Milk Yield and Composition of Crossbred Dairy Cows Supplemented with Concentrate Diet.

Mekoya, A., Oosting, S.J., Fernandez-Rivera, S.and Van der Zijpp, A.J., 2008.Farmers' perceptions about exotic multipurpose fodder trees and constraints to their adoption.Agroforestry systems, **73(2)**: 141-153.

Mengistu, A., 1998.Natural Pasture Improvement Study Around Smallholder Dairy Area. MOA, SDDP, Addis Ababa, Ethiopia.

Mengistu, A., 2002.Forage production in Ethiopia: a case study with implications for livestock production.Forage production in Ethiopia: a case study with implications for livestock production.

Mengistu, A., 2003.Country pasture/forage resources profiles: Ethiopia.Food and Agriculture United Nations (FAO).http://www.fao.Org/ag/agp/agpc/doc/counprof/Ethiopia.htm (Accessed on January 30, 2008).

Mengistu, A., 2004.Participatory innovation and research lesson for livestock development.In: Proceedings of the 12th Conference of the Ethiopian Society of Animals Production (ESAP), August 12-14, 2004, Addis Ababa, Ethiopia.

Mengistu, A., 2005.Feed resource base of Ethiopia: limitation and opportunities for integrated development.pp 250-259.In: Participatory Innovation and Research: Lesson for Livestock

Development.Proceeding of the 12th Annual Conference of Ethiopian Society of Animal Production (ESAP), Volume II Technical papers.12-14 August, Addis Ababa, Ethiopia.

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

Mohamed-Saleem, M.A. and Tedla, A., 1995. Feed improvement to support intensification of ruminant production systems in the Ethiopian highlands.pp.296-306.

Mulu, S.B., 2009. Feed resources availability, cattle fattening practices and marketing system in Bure Woreda, Amhara Region, Ethiopia (Doctoral dissertation, Mekelle University).

Negussie, F., 2015.Effects of Different Feeding Regimes on the Performance of Blackhead Ogaden Sheep (Doctoral dissertation, Haramaya University).

Negesse, T., Makkar H.P.S, Becker K., 2009. Nutritive value of some non-conventional feed resources of Ethiopia determined by chemical analyses and an *in vitro* gas method. Animal Feed Science and Technology.154 **(26):** 204–217

Ngodigha, E.M. and Anyanwu, N.J., 2009.Fodder potential ranking of selected multi-purpose trees and shrubs through degradation studies with rumen fistulated N'dama steers.Journal of Animal and Veterinary Advances, **8(6)**:1233-1236.

Nurfeta A, 2010.Feed intake, Digestibility, Nitrogen utilization and Body weight change of sheep consuming wheat straw supplemented with local agricultural and agro-industrial by products. Trop Anim Health Prod **42**: 815-824.

Petmak, M.V., 1983. Primary productivity, Nutrient cycling and organic matter turn over of Tree plantation after Agricultural Intercropping practices in Northeast Thailand (Doctoral dissertation, Ph D Thesis, University of thePhilippines).

Rangnekar, D.V.and Speedy, A., 1992.Fodder trees as a renewable energy source for biomass gasification. Legume Trees and Other Fodder Trees as Protein Sources for Livestock:

Proceedings of the Fao Expert Consultation Held at the Malaysian Agricultural Research and Development Institute (MARDI) in Kuala Lumpur, Malaysia,14-18 October 1991,**(102)**:309.

Ruane, J.and Sonnino, A., 2011.Agricultural biotechnologies in developing countries and their possible contribution to food security. Journal of Biotechnology, **156(4)**:356-363.

Seré, C., Ayantunde, A., Duncan, A., Freeman, A., Herrero, M., Tarawali, S. and Wright, I., 2008. Livestock production and poverty alleviation-challenges and opportunities in arid and semi-arid tropical rangeland based systems. In Multifunctional grasslands in a changing world, Volume 1: XXI International Grassland Congress and VIII International Rangeland Congress, Hohhot, China, 29 June-5 July 2008. Guangdong People are Publishing House.

Shenkute,B.,Hassen,A.,Assafa,T.,Amen,N.and Ebro,A.,2012.Identification and nutritive value of potential fodder trees and shrubs in the mid rift valley of Ethiopia.J Anim Plant Sci, **22**:1126-1132.

Teka, H**.,** Madakadze, I.C., Angassa, A. and Hassen, A., 2012. Effect of seasonal variation on the nutritional quality of key herbaceous species in semi-arid areas of Borana, Ethiopia.Indian J. Anim. Nutr, **29(4**): 324-332.

Teklu,B.,Negesse,T.and Angassa,A.,2011.Effect of farming systems on livestock feed resources and feeding systems in Benishangul-Gumuz region,western Ethiopia.International Research Journal of Agricultural Science,**1(1)**: 20-28.

Tolera, A., 2008. Feed resources and feeding management: A manual for feedlot operators and development workers. Ethiopia Sanitary & Phytosanitary Standards and Livestock & Meat Marketing Program (SPS-LMM) Report. 38pp.

Tolera, A., Yami, A. and Alemu, D., 2012. Livestock feed resources in Ethiopia: challenges, opportunities and the need for transformation. Addis Ababa: Ethiopian Animal Feed Industry Association, pp.37-46.

Tonamo,A.,Tamir,B.and Goshu,G.,2015.Assessment of Cattle Feed Resources;Chemical Composition and Digestibility of Major Feeds in Essera District,Southern Ethiopia.Science, Technology and Arts Research Journal,**4(2)**: 89-88.

Varviko, T., (1991): Nutritional constraints of improved smallholder milk production in the Ethiopian high lands: the Selale experience: in proceedings of the fourth national livestock improvement conference, 13-15 November, 1991, Addis Ababa, Ethiopia: pp 45-50.

Winrock International Institute for Agricultural Development, 1992.Assessment of Animal Agriculture in Sub-Saharan Africa.Winrock Morrilton, Arkansas.

Wolde, S., Bassa, Z.and Alemu, T., 2014.Assessment of cattle fattening and marketing system and constraints affecting cattle fattening in Central Southern Region of Ethiopia.African Journal of Agricultural Research,**9(41)**:3050-3055.

Wondatir, Z., 2010. Livestock production systems in relation with feed availability in the highlands and central rift valley of Ethiopia.

Wondatir, Z., Mekasha, Y. and Wouters, B., 2011. Assessment of productive and reproductive performance of dairy cattle nexus with feed availability in selected peri-urban areas of Ethiopia. Journal of Cell and Animal Biology, **5(15):** 308-315.

Worku, K., 2014.Assessment of dairy cattle feed resources and milk yields under smallholder farmers in Kersa Malima Woreda (Doctoral dissertation, AAU).

Worku, Z., 2015.Assessment of Livestock Production Practices and Feed resources in Peri Urban and Rural areas in Waghimra Zone Sekota District, Ethiopia (Doctoral dissertation, Haramaya University).

World Bank, 2008.The Livestock Sector in the World Development Report 2008:Re-assessing the Policy Priorities by G.Pica, U.Pica-Ciamarra, and J.Otte FAP, PPLPI Working Paper RR Nr 08-07**,** August 2008.

World Bank, 2009.Minding the stock: Bringing public policy to bear on livestock sector development. Report No.44010-GLB.The World Bank, WashingtonD.C., USA.

Wright, I.A., Zervas, G.and Louloudis, L., 2001.The development of sustainable farming systems and the challenges that face producers in the EU. Publication-European Association for Animal Production, **106**:27-38.

Yadessa, E., 2015.Assessment of feed resources and determination of mineral status of livestock feed in Meta Robi District, West Shewa zone, Oromia Regional State, Ethiopia (Doctoral dissertation, Ambo University).

Yayneshet, T., Eik, L.O.and Moe, S.R., 2009.Seasonal variations in the chemical composition and dry matter degradability of exclosure forages in the semi-arid region of northern Ethiopia. Animal Feed Science and Technology, **148 (1**):12-33.

Yoseph, K., Kechero, Y.and Tolemariam, T., 2015.A Disparity Effect of Polyethylene Glycols on Comparative Feed Efficiency and Growth Performance of Sheep and Goats Fed High Tannin Diet. **15 (6):** 570-578.

Zereu, G.and Lijalem, T., 2016.Status of improved forage production, utilization and constraints for adoption in Wolaita Zone, Southern Ethiopia.Livestock Research for Rural Development. Volume 28, Article # 78.Retrieved December 15, 2016, from http://www.lrrd.org/lrrd28/5/zere 28078.htm.

Appendix 7

Appendix Table 1. Conversion factor for estimation of the amount of crop residues and by products produced from

Different crops and land	Conversion factor
Wheat	1.5
Tef	1.5
Barley	1.5
Maize	2
Sorghum	2.5
Bean	1.2
Pea	1.2
Crop aftermath	0.5
Fallow land	1.8
Woody land	0.7
Improved forage	8
Grazing land	2

Source (FAO,1987).

Appendix Table 2. Conversion factor to tropical livestock unit (Live weight and TLU)

	Local breed		Cross breed	
Type of livestock	Live weight	TLU	Live weight	TLU
Cow	250	1	380	1.5
Heifer	125	0.5	150	0.6
Ox/young bull	250	1	300	1.2
Calve	50	0.2	50	0.2
Shoat	22	0.1		
Horse/Mule	200	0.8		
Donkey	90	0.4		

Source :(Varviko, 1991).

Appendix Table 3. Respondents sex, age and educational status in the study district

Appendix chi-square Table 3.1.Sex of respondents

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.445	1	0.505
Continuity Correction	0.205	1	0.651
Likelihood Ratio	0.446	1	0.504
Linear-by-Linear Association	0.441	1	0.506

Appendix Chi-square Table 3.2**.**Age of respondents

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.578	2	0.167
Likelihood Ratio	3.865	2	0.145
Linear-by-Linear Association	0.374	1	0.541
N of Valid Cases	126		

Appendix chi-square Table 3.3. Educational status of respondents

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.916	4	0.751
Likelihood Ratio	2.32	4	0.677

Appendix Table 4. Family size, sex and age

		Sum of Squares	Df	Mean Square	F	Sig.
Family size	Between Groups	3.801	1	3.801	1.096	0.297
	Within Groups	430.072	124	3.468		
	Total	433.873	125			
Total meal	Between Groups	2.279	1	2.279	1.821	0.18
	Within Groups	155.189	124	1.252		
	Total	157.468	125			
Total female	Between Groups	0.283	1	0.283	0.22	0.64
	Within Groups	159.209	124	1.284		
	Total	159.492	125			
Totally age < 15year	Between Groups	2.05	1	2.05	0.467	0.495
	Within Groups	543.918	124	4.386		
	Total	545.968	125			
Total age 15–65year	Between Groups	6.299	1	6.299	7.89	0.006
	Within Groups	99.002	124	0.798		
	Total	105.302	125			
Total >65year	Between Groups	1.018	1	1.018	2.441	0.121
	Within Groups	51.689	124	0.417		
	Total	52.706	125			

Appendix Table 5. Average land holding pattern of respondents per household in the study area

		Sum of Squares	df	Mean Square	F	Sig.
Crop land	Between Groups	0.17	1	0.17	0.419	0.519
	Within Groups	50.188	124	0.405		
	Total	50.357	125			
Private pasture land	Between Groups	2.778	1	2.778	22.393	0.000
	Within Groups	15.381	124	0.124		
	Total	18.159	125			
Woody land	Between Groups	0.079	1	0.079	2.081	0.152
	Within Groups	4.722	124	0.038		

	Total	4.802	125			
Cultivated forage grass land	Between Groups	0.002	1	0.002	3.74	0.055
	Within Groups	0.054	124	0.000		
	Total	0.056	125			
Total land	Between Groups	3.73	1	3.73	6.444	0.012
	Within Groups	71.77	124	0.579		
	Total	75.5	125			

Appendix Table 6. Average number of Tropical Livestock Unit per household in study district

		Sum of Squares	df	Mean Square	F	Sig.
TLU of oxen	Between Groups	0.666	1	0.666	1.249	0.266
	Within Groups	66.135	124	0.533		
	Total	66.802	125			
TLU of bulls	Between Groups	0.405	1	0.405	1.509	0.222
	Within Groups	33.309	124	0.269		
	Total	33.714	125			
TLU of cows	Between Groups	8.577	1	8.577	4.235	0.042
	Within Groups	251.137	124	2.025		
	Total	259.714	125			
TLU of heifers	Between Groups	1.111	1	1.111	2.055	0.154
	Within Groups	67.024	124	0.541		
	Total	68.135	125			
TLU of calves	Between Groups	0.336	1	0.336	2.669	0.105
	Within Groups	15.632	124	0.126		
	Total	15.968	125			
TLU of cattle	Between Groups	31.755	1	31.755	13.632	0.000
	Within Groups	288.856	124	2.329		
	Total	320.611	125			
TLU of goat	Between Groups	0.575	1	0.575	5.324	0.023
	Within Groups	13.393	124	0.108		
	Total	13.968	125			
TLU of sheep	Between Groups	0.869	1	0.869	7.79	0.006
	Within Groups	13.837	124	0.112		
	Total	14.706	125			
TLU of donkeys	Between Groups	0.021	1	0.021	0.238	0.626
	Within Groups	10.836	124	0.087		

	Total	10.857	125			
TLU of horses	Between Groups	0.018	1	0.018	0.157	0.692
	Within Groups	13.951	124	0.113		
	Total	13.968	125			
TLU of mules	Between Groups	0.319	1	0.319	2.3	0.132
	Within Groups	17.181	124	0.139		
	Total	17.5	125			
Total TLU	Between Groups	25.912	1	25.912	9.567	0.002
	Within Groups	335.865	124	2.709		
	Total	361.778	125			

Appendix Table 7.Average grazing land size (ha) and dry matter yield (t)

Appendix ANOVA table 7.1.Average grazing land size (ha) in the study district

		Sum of Squares	df	Mean Square	F	Sig.
Crop land	Between Groups	0.17	1	0.17	0.419	0.519
	Within Groups	50.188	124	0.405		
	Total	50.357	125			
Natural grazing land	Between Groups	2.778	1	2.778	22.393	0.000
	Within Groups	15.381	124	0.124		
	Total	18.159	125			
Woody land	Between Groups	0.079	1	0.079	2.081	0.152
	Within Groups	4.722	124	0.038		
	Total	4.802	125			
Total grazing land	Between Groups	6.371	1	6.371	10.846	0.001
	Within Groups	72.836	124	0.587		
	Total	79.206	125			

Appendix ANOVA Table 7.2. Dry matter yield (t) from grazing land in the study district

		Sum of Squares	df	Mean Square	F	Sig.
DM(t) crop aftermath	Between Groups	0.267	1	0.267	1.672	0.198
	Within Groups	19.773	124	0.159		
	Total	20.04	125			
DM(t) privet pasture	Between Groups	10.635	1	10.635	45.435	0
	Within Groups	29.024	124	0.234		
	Total	39.659	125			

DM(t) woody land	Between Groups	0.01	1	0.01	0.405	0.526
	Within Groups	2.919	124	0.024		
	Total	2.929	125			
DM(t) grazing resource	Between Groups	5.771	1	5.771	21.629	0
	Within Groups	33.086	124	0.267		
	Total	38.857	125			

Appendix Table 8. Perception of respondents on status of natural grazing land and reason for change

Appendix chi-square Table 8.1.Perception of respondents on status of natural grazing land in the study district

	Value	Df	Asymp.Sig.(2-sided)
Pearson Chi-Square	0.002	1	0.964
Likelihood Ratio	0.002	1	0.964
Linear-by-Linear Association	0.002	1	0.964
N of Valid Cases	126		

Appendix chi-square Table 8.2.Perception of respondents for decreasing/change in grazing land

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	0.217	2	0.897
Likelihood Ratio	0.218	2	0.897
Linear-by-Linear Association	0.201	1	0.654
N of Valid Cases	126		

Appendix Table 9. Estimated average dry matter yield (t) of crop residue per year per household

		Sum of Squares	df	Mean Square	F	Sig.
DM(t) from tef residue	Between Groups	13.62	1	13.620	59.922	0.000
	Within Groups	28.184	124	0.227		
	Total	41.804	125			
DM(t) from wheat residue	Between Groups	88.182	1	88.182	480.255	0.000
	Within Groups	22.768	124	0.184		
	Total	110.95	125			
DM(t) from maize	Between Groups	8.047	1	8.047	27.648	0.000
	Within Groups	36.088	124	0.291		

Stover	Total	44.135	125			
DM(t) from sorghum	Between Groups	0.323	1	0.323	3.808	0.053
	Within Groups	10.534	124	0.085		
	Total	10.857	125			
DM(t) from barley	Between Groups	1.038	1	1.038	8.941	0.003
	Within Groups	14.391	124	0.116		
	Total	15.429	125			
Total DM (t)	Between Groups	1.589	1	1.589	2.606	0.109
	Within Groups	75.625	124	0.610		
	Total	77.214	125			

Appendix Table 10. List of fodder trees/shrubs species identified as livestock feeds in the study district

ML	No	Local name	Scientific. name	Type	Livestock species	Editable	No/% of R
	1	Wera	*Olea africana*	Tree	Cattle,Goat,Sheep	L,T	27(42%)
	2	Heba	*V. amygdalina*	Shrub	Cattle,Goat,Sheep	L,T	20(31%)
	3	Wedesha	*C.africana*	Tree	Cattle,Goat,Sheep	L,T,F	33(51%)
	4	Ulaga	*E.cymosa*	Tree	Cattle,Goat,Sheep	L,T	3(4%)
	5	Odaa	*F. sur*	Tree	Cattle,Goat,Sheep	L,T,F	2(3%)
	6	Kowada	*M.e. lancelata*	Tree	Cattle,Goat,Sheep	L,T	9(14%)
	7	Abokado	*Persea americana*	Tree	Cattle,Goat,Sheep	L,T	6(9%)
	8	Dimbaba	*Phoenix recilnata*	Tree	Cattle,Goat,Sheep	L,T	2(3%)
	9	Xumuniga	*A.Schimpernia*	Shrub	Cattl,Goat,Sheep	L,T	14(22%)
LL	1	Ulaga	*E.cymosa*	Tree	Cattle,Goat,Sheep	L,T	22(36%)
	2	Wedesha	*C.africana*	Tree	Cattle,Goat,Sheep	L,T,F	34(56%)
	3	Girara	*A.abyssinica*	Tree	Cattle,Goat,Sheep	L,T	16(26%)
	4	Mandee	*A.gummifera*	Tree	Cattle,Goat,Sheep	L,T	2(3%)
	5	Odaa	*F.sur*	Tree	Cattle,Goat,Sheep	L,T,F	10(16%)
	6	Xumuniga	*A.schimpernia*	Shrub	Cattle,Goat,Sheep	L,T	13(23%)
	7	Qamalhaqa	*Celtis africana*	Tree	Cattle,Goat,Sheep	L,T	3(5%)
	8	Qilixoo	*F.vasta*	Tree	Cattle,Goat,Sheep	L,T	2(3%)
	9	Dimbaba	*Phoenix recilnata*	Tree	Cattle,Goat,Sheep	L,T	3(5%)
	10	Abokado	*Persea americana*	Tree	Cattle,Goat,Sheep	L,T	5(8%)

LL, Lowland; ML; Midland; R, Respondents, %, percent and No, number.

Appendix Table 11. Average cultivated forge grass land and dry mater yield

GLM univariate analysis of variance Table 11.1.Average cultivated forge grass land (ha) in the study district

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.507	1	0.507	144.612	0.007
Error	0.007	2	0.004		

Appendix GLM univariate analysis of variance Table 11.2.Dry mater yield (t) from cultivated forge grass

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	30.250	1	30.250	121.000	0.008
Error	0.500	2	0.250		

Appendix Table 12.Estimated average dry matter yield (t) of non-conventional feed resources

Appendix ANOVA Table 12.1.Estimated average dry matter (t) production of hose leftover per year in the study district.

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.04	1	0.04	0.471	0.564
Error	0.17	2	0.085		

Appendix ANOVA Table 12.2.Estimated average dry matter yiled (t) of vegetable rejection per year in the study district.

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.360	1	0.360	0.986	0.425
Error	0.730	2	0.365		

Appendix ANOVA Table 12.3**.**Estimated average dry matter (t) production of house leftover per year in the study district.

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	41.603	1	41.603	26.626	0.036
Error	3.125	2	1.563		

Appendix ANOVA Table 12.4.Estimated average dry matter (t) production of total non-conventional feed per year in the study district.

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	42.25	1	42.25	33.8	0.028
Error	2.5	2	1.25		

Appendix Table 13. Feed resources category and their supply (DM (t), CP (t) and ME (MJ) in study sites

Appendix Table 13.1.Dry mater yield of feed resources

Appendix GLM univariate analysis of variance Table 13.1.1**.**Dry mater yield (t) from grazing resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	169	1	169	33.8	0.028
Error	10	2			

Appendix GLM univariate analysis of variance Table 13.1.2.Dry mater yield (t) from crop residue resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	361	1	361	28.88	0.033
Error	25	2			

Appendix GLM univariate analysis of variance Table 13.1.3.Dry mater yield (t) from fodder trees/shrubs

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	36	1	36	18	0.051
Error	4	2			

Appendix GLM univariate analysis of variance Table 13.1.4.Dry mater yield (t) from non conventional feed

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	42.25	1	42.25	33.8	0.028
Error	2.5	2			

Appendix GLM univariate analysis of variance Table 13.1.5.Dry mater yield (t) from forage grass resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	30.25	1	30.25	121	0.008
Error	0.5	2			

Appendix GLM univariate analysis of variance Table 13.1.6 .Dry mater yield(t) from total feed resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.25	1	0.25	0.004	0.957
Error	134.5	2	67.25		

Appendix Table 13.2. Crude protein yield of feed resources

Appendix GLM univariate analysis of variance Table 13.2.1. Crude protein yield (t) from grazing resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1	1	1	2	0.293
Error	1	2			

Appendix GLM univariate analysis of variance Table 13.2.2.Crude protein yield (t) from crop residue

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2.25	1	2.25	9	0.095
Error	0.5	2			

Appendix GLM univariate analysis of variance Table 13.2.3.Crude protein yield (t) from fodder trees/shrubs

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.25	1	0.25	1	.423
Error	0.5	2			

Appendix GLM univariate analysis of variance Table 13.2.4.Crude protein yield (t) from non conventional feed

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.25	1	0.25	1	0.423
Error	0.5	2			

Appendix GLM univariate analysis of variance Table 13.2.5.Crude protein yield (t) from forage grass

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.25	1	0.25	1	0.423
Error	0.5	2			

Appendix GLM univariate analysis of variance Table 13.2.6.Crude protein yield (t) from total feed resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1	1	1	2	0.293
Error	1	2			

Appendix table 13.3.Metabolizable energy of feed resources

Appendix GLM univariate analysis of variance Table 13.3.1.Metabolizable energy (MJ) from grazing resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	6.25	1	6.25	25	0.038
Error	0.5	2	0.25		

Appendix GLM univariate analysis of variance Table 13.3.2 Metabolizable energy (MJ) from crop residue

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	12.25	1	12.25	49	0.02
Error	0.5	2	0.25		

Appendix GLM univariate analysis of variance Table 13.3.3 Metabolizable energy (MJ) from fodder trees/shrubs

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1	1	1	2	0.293
Error	1	2			

Appendix GLM univariate analysis of variance Table 13.3.4 Metabolizable energy (MJ) from non conventional feeds

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	0.25	1	0.25	1	0.423
Error	0.5	2			

GLM univariate analysis of variance Table 13.3.5 Metabolizable energy (MJ) from forage grass

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2.25	1	2.25	9	0.095
Error	0.5	2			

GLM univariate analysis of variance Table 13.3.6 Metabolizable energy (MJ) from total feed resources

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	4.441E-015[a]	1	4.441E-15	0.000	1
Error	4	2			

Appendix Table 14. Chemical composition of feed resources

ANOVA Table 14.1Chemical compositions of crop tef residues in lowland and midland altitude regions of the study district.

		Sum of Squares	df	Mean Square	F	Sig.
% DM	Between Groups	4.167	1	4.167	25.000	0.007
	Within Groups	0.667	4	0.167		
	Total	4.833	5			
% Ash	Between Groups	0.667	1	0.667	4.000	0.116
	Within Groups	0.667	4	0.167		
	Total	1.333	5			
% CF	Between Groups	2.667	1	2.667	16.000	0.016
	Within Groups	0.667	4	0.167		
	Total	3.333	5			
% CP	Between Groups	4.167	1	4.167	25.000	0.007
	Within Groups	0.667	4	0.167		
	Total	4.833	5			
% EE	Between Groups	0.167	1	0.167	1.000	0.374

	Within Groups	0.667	4	0.167		
	Total	0.833	5			
% NFE	Between Groups	0.167	1	0.167	1.000	0.374
	Within Groups	0.667	4	0.167		
	Total	0.833	5			
MEMJ/kg	Between Groups	0.167	1	0.167	1.000	0.374
	Within Groups	0.667	4	0.167		
	Total	0.833	5			

Appendix ANOVA Table 14.2.Chemical composition of common crop residue sorghum in mid and lowland altitude regions of the study district the district

		Sum of Squares	df	Mean Square	F	Sig.
% DM	Between Groups	4.167	1	4.167	25.000	0.007
	Within Groups	0.667	4	0.167		
	Total	4.833	5			
%Ash	Between Groups	0.667	1	0.667	4.000	0.116
	Within Groups	0.667	4	0.167		
	Total	1.333	5			
%CF	Between Groups	0.000	1	0.000	0.000	1.000
	Within Groups	1.333	4	0.333		
	Total	1.333	5			
%CP	Between Groups	2.667	1	2.667	16.000	0.016
	Within Groups	0.667	4	0.167		
	Total	3.333	5			
%EE	Between Groups	0.667	1	0.667	4.000	0.116
	Within Groups	0.667	4	0.167		
	Total	1.333	5			
%NFE	Between Groups	1.500	1	1.500	4.500	0.101
	Within Groups	1.333	4	0.333		
	Total	2.833	5			
MEMJ/kg	Between Groups	2.667	1	2.667	4.000	0.116
	Within Groups	2.667	4	0.667		
	Total	5.333	5			

Appendix ANOVA Table 14.3.Chemical composition of fodder tree *Cordia africana* in mid and lowland agro-ecology of the study district the district

		Sum of Squares	df	Mean Square	F	Sig.
%DM	Between Groups	1.5	1	1.5	4.500	0.101
	Within Groups	1.333	4	0.333		
	Total	2.833	5			
%Ash	Between Groups	6	1	6	12.000	0.026
	Within Groups	2	4	0.5		
	Total	8	5			
%CF	Between Groups	1.5	1	1.5	4.5	0.101
	Within Groups	1.333	4	0.333		
	Total	2.833	5			
%CP	Between Groups	0.667	1	0.667	2	0.230
	Within Groups	1.333	4	0.333		
	Total	2	5			
%EE	Between Groups	6	1	6	12	0.026
	Within Groups	2	4	0.5		
	Total	8	5			
%NFE	Between Groups	10.667	1	10.667	16	0.016
	Within Groups	2.667	4	0.667		
	Total	13.333	5			
MEMJ/kg	Between Groups	0.167	1	0.167	0.25	0.643
	Within Groups	2.667	4	0.667		
	Total	2.833	5			

Appendix ANOVA Table 14.4.Chemical composition of fodder shrubs *Albizia Schimpernia* in mid and lowland agro-ecology of the study district the district

		Sum of Squares	df	Mean Square	F	Sig.
%DM	Between Groups	0.667	1	0.667	2.000	0.230
	Within Groups	1.333	4	0.333		
	Total	2.000	5			
%Ash	Between Groups	0.167	1	0.167	0.500	0.519
	Within Groups	1.333	4	0.333		
	Total	1.500	5			
%CP	Between Groups	20.167	1	20.167	121.000	0.000
	Within Groups	0.667	4	0.167		

	Total	20.833	5			
%EE	Between Groups	4.167	1	4.167	25.000	0.007
	Within Groups	0.667	4	0.167		
	Total	4.833	5			
%CF	Between Groups	8.167	1	8.167	49.000	0.002
	Within Groups	0.667	4	0.167		
	Total	8.833	5			
%NFE	Between Groups	0.667	1	0.667	1.000	0.374
	Within Groups	2.667	4	0.667		
	Total	3.333	5			
MEMJ/kg	Between Groups	2.667	1	2.667	4.000	0.116
	Within Groups	2.667	4	0.667		
	Tota	5.333	5			

Appendix Table 15.Respondents strategies to alleviate feed shortage of livestock

Appendix chi-square Table 15.1.Respondents percent for storage of crop residue to alleviate feed shortage of livestock

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.161	1	0.688
Continuity Correction	0.02	1	0.888
Likelihood Ratio	0.161	1	0.688
Fisher's Exact Test			
Linear-by-Linear Association	0.16	1	0.689
N of Valid Cases	126		

Appendix chi-square Table 15.2.Respondents percent for hay making to alleviate feed shortage of livestock

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.308	1	0.579
Continuity Correction	0.051	1	0.822
Likelihood Ratio	0.31	1	0.578
Fisher's Exact Test			
Linear-by-Linear Association	0.305	1	0.581
N of Valid Cases	126		

Appendix chi-square Table 15.3.Respondents percent for utilization of fodder trees/shrubs to alleviate feed shortage of livestock

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.414	1	0.234
Continuity Correction	0.925	1	0.336
Likelihood Ratio	1.428	1	0.232
Fisher's Exact Test			
Linear-by-Linear Association	1.402	1	0.236
N of Valid Cases	126		

Appendix chi-square Table 15.4.Respondents percent for utilization cultivated forage grass to alleviate feed shortage of livestock

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.129	1	0.077
Continuity Correction	2.407	1	0.121
Likelihood Ratio	3.184	1	0.074
Fisher's Exact Test			
Linear-by-Linear Association	3.104	1	0.078
N of Valid Cases	126		

Appendix chi-square Table 15.5.Respondents percent for utilization supply feed to alleviate feed shortage of livestock

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.028	1	0.867
Continuity Correction	0.000	1	1
Likelihood Ratio	0.028	1	0.867
Fisher's Exact Test			
Linear-by-Linear Association	0.028	1	0.868
N of Valid Cases	126		

AppendixTable 16. Questionnaires used to collect data on research thesis

16.1. Questionnaires used to collect data on research thesis in assessment of livestock feed resources and feeding system in Gombora district.

1. General information

1.1 Date of the interview___________________

1.2 Region____________, Zone____________, District______________, Kebele_______________

1.3 Household name_______________________Sex________M/F, Age______________years.

1.4 Level of education: a.uneducated,b.Primary School,c.Secondary School,d.High School, e.Higher education,encircleit it.

2. Household characteristics

I. Family size: age in year and sex "fill in the blank spaces"

2.1. Children<15 year-old M_______F________, Adult 15-65 year-old, M________F________, Needy>65year-old M___________F __________

2.2. What is your farming activity? A.Livestock production, b.crop production.c, a & b encircle it.

II Livestock holding

1. Fill in the table number of cattle that you have

Cattle type	Local	Cross	Exotic	Total	Cattle type	Local	Cross	Exotic	Total
	No	No	No			No	No	No	No
Lactating cows					Female calves				
None lactating					Male calves				
Heifers					Bulls				
					Steers				
Total									

2. Fill in the blank space milk production per day in liter/cow __________ total milk production in liter/day ______________

2.1. Age at first calving (month) ____________, calving interval (month)

2.2. Age at first lambing (month)_________________, kidding(month)___________________

2.3. Age at first parturition of donkey__________, horse_____________________

3. How do you house your livestock? a. Separately in corral (cage /confine), b.Mixed in shed/store, c.Separately in store, d.In the farmer's house mixed with people, e. Other specify _________________________________

4. Fill in the table number of sheep/goat that you have

Small ruminant	Sheep	Number	Goat	Number
	Lamb		Kids	
	Young		Young	
	Mature		Mature	
Total				

5. Fill in the table number of equine that you have

Equines	Donkey	Number	Horses	Number	Mule	Number
	Calf		Calf		Calf	
	Young		Young		Young	
	Mature		Mature		Mature	
Total						

6. Fill in the table number of poultry that you have

Poultry	Hens	pullets	Cockerel	Total
No				

7.What are the objectives of livestock keeping? a.Milk, b.Meat, c.Draught, d.Manure, e.Income,f. Replacement stock, g. All.

8. What is the annual income source? A.Sale of crop and livestock production, b.Off-farm activity, c, a & b, encircle it.

9. Are there any organizations, which assist you in livestock production? Yes / No if yes, list the name of organizations.____

9.1. What type of development interventions to be made to enhance the performance of livestock?

1. Veterinary services, 2.Reproduction, Others____

10. What are the major opportunities for livestock production in relation to feed availability in your study district? Please indicate the potentials/opportunities that you have: in relation to feeds availability

1.______________________2,___________________3.____________________,4_______________

11. What are the major problems/constraints that affect livestock production in relation to feeds availability? 1.________________,2.__________________,3. _________________, 4.__________________

12. Do you have access to veterinary services? Yes / No

If yes, what type of veterinary services? Governmental or Private Vet.Clinic, underline one/both,

if No, Why? ____

13. Did any animal die last/this year, if so what were/are the reasons for the death? Number of died Cattle______, Sheep______, Goat_______Equines______reasons______________________

14. At which season do you face feed shortage for your livestock? a. At short rainy season, b. At long rainy season, c. a & b,d. All time, encircle it.

14.1. What are the reasons for feed shortage? a, land shortage,b.lack of awareness on forage production and feeding system,c.Poor market access to purchase feed,encircle it.

14.2 What are consequences of feed shortage? a.Weight loss,b.Milk yield reduction.Mortality,d, all,if others,specify____

14.3. What are the coping mechanisms to the problems that face in your livestock production in relation to feed availability ? 1. Store crop residue, 2.Preserve hay grass, 2. Planting improved forage grass, 3.use fodder tree and shrub, 4.Use supply feed, 5, all, if others, specify __________________________

III. Land holding and use pattern

1. Fill in the table crop type and cropland in hectare (ha) that you have

No	Crop type	Land (ha)	Yield(quintal)	No	Crop type	Land (ha)	Yield(quintal)
1				4			
2				5			

3	6

1.1.What are the major crops cultivated in your farm? Rank 1st ______________,2nd ______________,3rd ,______________4th______________,5th________________,6th______________7th___________

2. Grazing land use pattern

2.1. Do you have enough grazing land for your livestock? Yes or No, if yes

2.1.1. Is there grazing land in your district? Yes/No if yes, is it a. Open grassland, b.Tree covered, c. Bush land, encircle for that you have

2.1.2. What is the status? Decreasing or increasing, if decreasing, what is the reason for decreasing?____

2.1.3. Fill in the table the hectare of grazing land and rank major grazing land that use to graze livestock in order of importance.

No	Grazing land	Private	Communal	R/k	No	Grazing land	Private	Communal	R/k
1	Natural grassland				4	Forest/wood land			
2	Cropping aftermath				5	Others			
3	Fallow land				6	Total land			

3. Feed resource and feeding system

3.1. What is livestock feed resources and feeding system in your district? Tick (√) one or all that you have and rank in order of importance/cover

No	Feed resource	Rank	No	Feed resource	Rank
1	Grazing pasture		5	Tree/shrubs	
2	Crop residue		6	House leftover	
3	Improved forage grass		7	Supplementary feed	
4	Hay		8	Silage/urea treated	
No	**Feeding system**	**Rank**	**No**	**Feeding system**	**Rank**
1	Stall feeding		4	Tethering	

2	Free grazing	5	Herding
3	Late feeding	6	Others

3.2. Do you use supply feed for you livestock? Yes/No, if yes list feed type and amount in kg

No	Feed type	Amount in kg	No	Feed type	Amount in kg
1			3		
2			4		

3.3. Which type of feeding system do you use on the pasture? a. Free grazing, b. Late grazing, and c.Stall feeding, d. all, if others specify ____

3.3.1. If stall feeding, do you feed as a fresh or preserved? if as preserved, when do you use it? a. During dry season, b. At any time, c. a and b, encircle it

3.3.2. Which type of grazing system that you apply during wet season? a. Herded, b.Unherded, c. In closer, d.Tethered, e.Free grazing, encircle it

3.4. Are you experienced in haymaking? Yes / No if No, what is the reasons? a. Shortage of land, b. Lack of animals, c.Lack of awareness, d.All, encircle it

3.4.1. How long will the preserved feed be enough to your livestock? _______________________

4. Do you plant improved forage grass, legumes or trees? Yes or No if yes, fill in the table the hectare of land

No	Improved forage type	Hectare (ha)
1		
2		
3		

4.1. If No why? a. Land shortage, b. Lack of forage seed, c. Lack of awareness, encircle it

5. Have you provide fodder tree or shrub to your livestock? Yes / No

5.1. If yes, name locally or in Amharic and then measures the diameter of fodder tree or shrub, accordingly the importance that you have

Name trees____Cerconfrance (cm) _______

Name shrubs____ Cerconfrance (cm) _______

6. Do you conserve crop residues as hay? Yes or No if yes,when do you use it,a.At dry and wet time.b.At any time,c.soon after collection,d.one/tow month after,e.when grazing resource decline and encircle one or all

6.1. How do you conserve crop residue? a. In storage house, b. Stack outside b. Stack under shelter, c. Baled outside, encircle it.

6.2. What are the major crop-residues produced in your district? and rank them 1st, 2nd…

Straw/Stover	Wheat	Teff	Maize	Barley	Sorghum	Bean	Pea	Others
Rank								

6.3. When do you start feeding of conserved crop residue for your livestock?

a. At the dry and wet season,b.Soon after collection,c.One/two month after collection. At any time, encircle it

6.4. How long will the conserved feed crop residue be enough to your livestock? ______________

6.5. Do you use any other crop as animal feed during feed shortage time? Yes or No, if yes list

____

6. 6.Which months of the year shortage of feed become more severe? ________________________

6.7. Are you experienced straw treatment with urea? Yes / No if no, what is the reasons?

a. Shortage of money to purchase urea, b.Lack of tools, c.Lack of awareness, d.All encircles it.

6.8. Is there any variation according to crops that you grow in relation to animal feeds? Yes or No if yes, which crop residues have more preference by each livestock

	Type of crop residue						
Livestock	Wheat	Teff	Maize	Barley	Sorghum	Bean	Pea
Cattle							
Sheep							
Goat							
Equine							

7. Do you graze your livestock in your aftermath and fallow land? Yes or No, if Yes,

8.1. How long will your animals graze on the aftermath land? ______________________________

8.2. How long will your animals graze on the fallow land? _________________________________

9. How many cropping season do you have per annum? a.1, b.2, c. 3, encircle it

10. Do you give feeds to your animals while grazing on the aftermath and fallow land? Yes or No, if yes tell type of animal that prioritize

Number	Type of animals	Rank	Number	Type of animals	Rank
1					
2					
3					

11. Do you use non-conventional feed resources? Yes or No, if yes fill in the table the name of feed type and amount in kg.

Number	Feed type	Amount in kg	Number	Feed type	Amount in kg
1					
2					
3					

12. Tick (√) in the months that have feed resource availability in year round for livestock

Feeds	Jan	Fe	Ma	Apr	May	Jun	Jul	Aug	Se	Oct	Nov	Des
Grazing land												
Forage grass												
Hay												
Crop residue												
Aftermath												
Fallowing												
Tree/shrub												
Supply feed												