FEED RESOURCES AND FEEDING PRACTICES OF DAIRY CATTLE IN DALE AND WONDOGENT DISTRICTS OF SIDAMA REGION.

M.Sc. THESIS

MISHAME ALEMAYEHU W/AB

HAWASSA UNVERSITY

COLLEGE OF AGRICULTUR HAWASSA, ETHIOPIA

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MISHAME ALEMAYEHU W/AB

MAJOR ADVISOR: ADUGNA TOLERA (PhD)

CO ADVISOR:-ABULE EBRO (PhD)

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HAWASSA UNIVERSITY

This is to certify that the thesis entitled **"Feed resources and feeding practices of dairy cattle in Dale and Wondogenet districts of Sidama Region** "submitted in partial fulfillment of the requirements for the degree of Master's with specialization in Animal Production, The Graduate Program of the School of Animal and Range Science, and has be carried out by Mishame Alemayehu Woldabe, under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the school.

Mishame Alemayehu		26/04/2023
Name of student	Signature	Date
Adugna Tolera		26/04/2023
Name of major advisor	Signature	Date
Name of CO- Advisor	Signature	Date
School head	Signature	Date
SGS Coordinator	Signature	Date

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I have great thank to dale and wondogent districts livestock development officer, development agents, the farmers in the study area and my friends and my family for their time contribution and conducive environment to conduct my study.

DEDICATION

This thesis is dedicated to my beloved family, my much-loved husband and my sw eet baby for giving and their affection, love and encouragement.

STATEMENT OF AUTHOR

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

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Name: Mishame Alemayehu Weldeabe Signature: _____

Data of submission: _____

Place College of agriculture, Hawassa University, Hawassa: _____

LIST OF AVRIVATION

ADF	Acid Detergent Fiber
ADL	Acid Detergent Lignin
AIBP	Agro Industrial by Products
AOAC	Association of Official Analytical Chemists
CP	Crude Protein
CR	Crop Residues
DM	Dry Matter
IVDMD	In vitro Dry Matter Digestibility
NDF	Neutral Detergent Fiber
NGO	Non-Governmental Organizations
TLU	Total Livestock Unit

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FEED RESOURCES AND FEEDING PRACTICES OF DAIRY CATTLE IN DALE AND WONDOGENT DISTRICTS OF SIDAMA REGION.

By Mishame Alemayehu

Major Advisor: Professor Adugna Tolera (PhD)

Co Advisor: Abule Ebro (PhD)

ABSTRACT

A study was conducted in Dale and Wondo Genet districts of Sidama region to assess feed resources and feeding practices of dairy Cattle. Household survey using structured questionnaire, focus group discussions, field observations and laboratory analyses were applied to generate the data. Feed samples were analyzed for dry matter (DM), crude protein (CP), ash, neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) contents and for determination of in vitro dry matter digestibility (IVDMD). Purposive sampling was used to select the respondents. A total of 140 respondents (Dale = 80 and Wondo Genet = 60) were purposely selected based on dairy cattle production potential and interviewed individually. The results indicated shortage of feed and land were the major dairy cattle production constraints in both districts of the area. The major feed resources available in the dry season include crop residues 37.1%, hay 25.1% and natural pasture 19.3%, whereas in wet season, 33.6% of the respondents feed their dairy cattle natural pasture, forage and pastures, non-conventional feed resources. Rotational grazing system was practiced highly on communal and private grazing land. The major crop residue used for dairy cattle feeding in both districts were maize stover, haricot bean straw, sugarcane tops, enset pseudo-stem and leaf and bean straws. Majority (85.7%) of respondents were utilizing crop residue for dairy cattle feeding in the study area. The major challenge of using crop residues was the collection and transportation of crop residues from crop land and storage. Private and communal grazing land and also cultivated land boundaries were the major sources of hay production. Desho grass, Elephant grass, Guatemala grass, Phalaris species, Rhodes grass, cow pea and pigeon pea were improved forage cultivated by the farmers in both districts and they can get seeds from government agricultural sectors and NGO. Land and seeds shortage were challenging improved forage production the study area. Residues of coffee, enset by products and banana pseudo-stem and leaf were used mostly as non-conventional feed in Dale district whereas banana pseudo-stem and leaf, enset by products and coffee residues were majorly practiced in Wondo Genet districts as non-conventional feed. Crop residues, purchased concentrate feeds and forage/green leaf and reduction of cattle were used to alleviate feed shortage in both study districts. Most of respondents were providing chopped crop residue for their animals. The highest crude protein contents were found in enset leaf (12.2%) than others feed types. The NDF content of most feed resources across districts was less than 65% and can be categorized as medium quality feeds. Development of improved forages integrated with the dominant farming system, efficient conservation and utilization of crop residue via different treatment options and maximizing the productivity of available individual and communal grazing pasture land using established improved technologies needs attention.

Ker word: *Feed resources, feed practices, dairy cattle, dale, wondogent*

1. INTRODUCTION

1.1 Background information and Justification

Livestock production is an important part of the farming systems in Ethiopia and plays a vital role in the livelihood of the majority of the people (Yeshitila *et al.,* 2008). This could be further emphasized by the fact that feed accounts for 60-70% of the costs associated with livestock production. Currently, the livestock subsector supports and sustains livelihoods for 80% of the rural population. Although the high livestock population and current favorable environmental conditions, the existing livestock output of the country is little (Samson and Frehiwot, 2014). This is associated with several complex and interrelated factors such as inadequate feed and nutrition, widespread diseases, the poor genetic potential of local breeds, market problems, marketing, and infrastructure (Friat and Haben, 2020).

Livestock feed resources are classified as natural pasture, crop residue, improved pasture, and forage, agro industrial by-products, and other by-products like food and vegetable refusal, of which the first two contribute the largest feed type (Bizelew *et al.*, 2016 and Sefa, 2017). Animals depend mainly on natural pastures for their feed requirements. Natural pastures that provide more than 90% of the livestock feed are generally very poorly managed (Bikila and Tigist, 2016). Due to poor management and overstocking, natural pastures are highly overgrazed resulting in severe land degradation, loss of valuable species, and dominance by unpalatable species.

The role of natural pasture grazing as a major livestock feed resource is diminishing from time to time due to shrinking grazing land size (Yayneshet, 2010). The use of native hay is limited in coverage and it is better in terms of its feeding value than crop residues if timely cut, proper handling and storage measures are applied. Even during years of good rainy season, forage is not sufficient to feed livestock in the highlands for reasons associated with restricted grazing land and poor management (Melese *et al.,* 2014). A basic shortcoming of the natural grasslands as a source of feed for ruminant livestock is their low production of dry matter due to a combination of the negative effects of inadequate rainfall and soil nutrients. The seasonality of plant growth, which is a reflection of the annual rainfall distribution pattern, further restricts the availability of herbage for the grazing animal to four or five months of the wet season over most of the natural grasslands and the low quality of the herbage is another shortcoming of natural grassland (Ulfina *et al.,* 2013). As a

result of increasing crop production, currently crop residues represent the largest amount of livestock feed and it provide 10 to 15% of the national intake of feed by livestock and in some areas the estimate is up to 50% (Alemayehu, 2003). In selected wheat based crop- livestock production systems of the Ethiopian highlands, the contribution of crop residues and aftermath grazing account for 70% of the total feed supply, while native pasture accounts for only 30% of the total feed supply.

Feed scarcity of both quantitative and qualitative dimensions is the major bottleneck for the promotion of the 1livestock sub-sector in the country. Much of the available feed resources is utilized to support maintenance requirement of the animals with little surplus left for production. There is marked seasonality in quantity and quality of available feed resources due to various environmental determinants drought, frost etc., (Jimma *et al.*, 2016). In this regard, dry matter (DM) and crude protein (CP) supplied with different feed resources are blowing the requirements with negative balance (Yisehak and Geert, 2014. The decreasing status of livestock particular cattle against epidemic diseases could be referred to a low supply of dietary proteins reflected in the immune response. According to Zewdie (2010), assessment of the quantity and quality of available feed resources in relation to dairy cattle requirement has not been yet well addressed in most livestock production areas of the country.

There is also little study done in study area in dairy cattle available feed resources, feed and feeding practices. Most of the study indicates natural pastures, crop residues, improved forage and non-conventional feeds are the main feed resources in the study area. Similarly the management and utilization methods of available feed resources and quality of available feed of the area are not yet well described for the dairy cattle rearing households of the study area. Feed resource assessment and its quality are important to diagnose the problems and suggest intervention measures to be taken by farmers and policy makers. In this context, the primary focus needs to identify the existing feed resources, utilization practices during wet and dry season improving the existing management system and to alleviate the feed shortage without dairy production disturbance especially during dry season.

Therefore, the study was done by the following objectives.

1.2 Objectives of the study

- To assess feed resources availability and dairy cattle feeding practieses in the study area.
- To determine nutritional value of the major feed resources of the study area.

2. LITERATURE REVIEW

2.1 Feed availability and sources in Ethiopia

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

2.1.1 Natural pasture

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

2.1.2 Crop residue

Cereal crop residue, pulse crop residue, oil plants crop residue, roots and tubers crop residue are the major crop residues which are fibrous by products of different plant crops. They are cereals crop residues (teff, barely, wheat, maize, sorghum and millet); pulse crop residues (faba beans, chicken peas, haricot beans, field peas and lentils), oil crop residues and rejected vegetables are providing a considerable quantity of dry season feed supply in many farming systems of the country. The crop residues are important in fulfilling feed gaps during periods of acute shortage of other feed resources. A report by (Adugna *et al.,* 2012) indicated that crop residues contribute to about 50% of the total feed supplied in Ethiopia. Stems and leaves were the most preferable parts of crop residue

and they were obtained after harvesting of grains. In order to know the net quantities of crop residues, the collection, transport, storage and processing, seasonal availability the most important factor affecting available for livestock feeding. Straws from teff, barley and wheat form the largest component of livestock diet in the medium and highland areas, while maize, sorghum and millet Stover's constitute larger proportion of livestock feed in lower to medium altitudes. Much has been said about the importance of crop residues as livestock feed by many authors. However, adequate information on the availability of crop residues in relation to their potential for feeding livestock in Ethiopia are limited.

2.1.3 Agro-industry by-products

The major agro-industrial by products commonly used are obtained from flour milling industries (wheat bran, wheat short, wheat middling and rice bran), edible oil extracting plants (noug cake, cottonseed cake, peanut cake, linseed cake, sesame cake, sunflower cake etc.), breweries and sugar factories (Molasses). The current trends of increasing urban population has a significant effect on the establishment of agro-industries due to the corresponding increasing demand for the edible main products (Yayneshet, 2010). Agro-industrial by-products have special value in feeding livestock mainly in urban and peri- urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply (Firew and Getnet, 2010). They are in general rich in energy or protein or both and have low fibre content and high digestibility compared with the other classes of feeds. Agro industrial by products are mostly used for supplementation of ruminants kept on low quality feeding to assist them perform well due to its high nutrient density to correct nutrient deficiencies set by the basal diet.

2.1.4 Cultivated Pasture and Forage

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

Forage crops are commonly grown for feeding cattle oats and vetch mixtures, fodder beet, elephant grass mixed with siratro and desmodium species, Rhodes/ lucerne mixture, Guatemala, hedgerows of Sesbania, leucaena and tree-lucerne being common ones Improved forage crops especially legumes are needed to improve the nutritional values of crop residues. Improved forages also provide benefits such as soil fertility through their nitrogen fixing ability and reducing soil erosion (Yeshitila, 2008). Due to unprecedented population increase, land scarcity and crop dominated farming, there has been limited introduction of improved pasture and forages to smallholder farming communities and the adoption of this technology by smallholder mixed farmers has been generally slow (Abebe *et al*., 2008). However, for the majority of small scale farmers who have small land holdings or communal lands, par ticularly as positive results may not be achieved in the short term (Mekonnen and Ali, 2013; Mergia *et al*., 2014). One option, which had some measure of success at the smallholder level, is the cultivation of improved fodder plants. The contribution of cultivated forages and pasture crops to the diet of farm animals in Ethiopia is relatively very small in terms of energy value. This was due to the low adoption of improved forages, low level of awareness, lack of adequate extension service, lack of suitable forage seeds and planting materials by smallholder (Mekonnen and Ali, 2013) and due to land scarcity and a crop-dominated farming system to introduce improved cultivated species into traditional grazing areas (Zewdie, 2010).

2.1.4 Fodder Trees

One of important animal feeds in Ethiopia in different climate zone like arid, semi-arid, and mountain zones were fodder tree and shrubs. During dry season when the grass dry up and deteriorate in quality and quantity, most browse species have benefit of maintaining their greenness and nutritive value from those fodder trees. Tree fodders are generally rich in protein, vitamins and mineral elements and can be used as dry season feed sources and supplements to poor quality grasses and crop residues. However, their utilization is reducing by the presence of tannins and other phenolic, compounds in their leaves. Compared to grasses, fodder trees and shrubs have relatively high concentrations of crude protein and minerals. These nutrients are subject to less variation than in grasses and this particularly enhances their value as dry season feeds for livestock. However, nutritive value of fodder trees decreases with aging, since they become woody as they mature. Nevertheless, such situation can easily overcome by regular lopping of the plants (Mekonnen and Ali, 2013).

2.1.5 Non-conventional feed resources

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

2.1.6 Seasonal Availability of Feed Resources in Ethiopia

The performance of any livestock depends on feed availability, nutrient content, feed intake, digestibility and metabolism of the feed digested (Onyeonagu, 2013). Feeding of livestock in different places differs depending on forage availability, climatic variability of a given location or region to mitigate feed shortage problems during worse conditions, season of the year and type of animal the owner prioritize to feed (Endale, 2015). Feed resource availability is influenced by seasonal fluctuation of rainfall. In some areas feed is available relatively in higher quantity and better quality during the rainy season and early dry season compared to the long dry season (Kassahun, 2016). According to Dereje, *et al.* (2014) feed shortage is commonly experienced among most farmers particularly from every December onwards. High temperature in drier seasons leads to feed shortage as grasses dry out and the residues are consumed by termites. Fodder conservation for the dry season is not a common practice. Thus the excess forage available during the rainy season is often wasted by being trampled upon by animals and burning during the dry season. Natural pasture supports animal productivity in the rainy season, while in the dry season these pastures can hardly maintain the animals as most of the feed resources are less available and of poor nutritional quality. This could be due to the poor practices of feed conservation and flash burning of the feed resources during the dry season. In the wet season natural pasture is the sole sources of livestock feed, while in

the dry season, natural pasture, crop residues, stubble grazing and grass hay are the major feed resources. Next to natural pastures, crop residues are other main sources of livestock feed during the dry season (Tesfaye *et al.*, 2010). According to Dereje *et al.*, (2014), there is plenty of natural pasture during the wet season, while farmers do not have a tradition of conserving and keeping the excess forage for the dry season, when there is a relative shortage of feed.

2.2 Dairy cattle feeding practices in Ethiopia

Feeding of livestock in different places differs depending on forage availability, climatic variability of a given location or region to mitigate feed shortage problems during worse conditions, season of the year and type of animal the owner prioritize to feed (Beyene *et al*., 2011). The feeding systems in the country include communal or private natural grazing and browsing, cut and carry feeding, hay and crop residues. The major feeding systems of dairy cattle in the study area were stall feeding/ zero grazing, herded grazing and tethered grazing systems applied (Mengistu *et al.,* 2016). Even though the major feeding systems practices for dairy cattle production in Humbo Woreda, Wolaita Zone Southern Ethiopia were free grazing, rotational grazing and zero-grazing (Asrat *et al.,* 2015). Dairy cattle feeding systems practices in and around Wolaita Sodo town, Southern Ethiopia includes free grazing, tethering and cut and carrying systems (Asrat *et al.*, 2016). Three types of dairy cattle feeding systems are practiced: zero-grazing/stall feeding, zero- and partial-grazing and fulltime-grazing in Jimma town, Ethiopia (Belay and Geert, 2016). Animals are grazing around homestead and are supplemented with weed, by-products of enset and crop residues. Herding depends on size of land per household and season. Those households with large number of livestock allow their animals to graze around the homestead or nearby communal grazing land (Funte *et al.*, 2010) variation in livestock management according to wealth category; wealthier households possess more livestock and require greater access to additional labor and grazing land. Reduction of communal and private grazing lands was caused by using the grazing lands for crop production; enclosures of vast areas as a result of severe overgrazing, land degradation and deforestation (Funte *et al.,* 2010). Tethering is also the common way of managing animals in highland of mixed farming areas. Tolera (1990) earlier reported that there is increasing practice of cut-and-carry system (feeding of grasses and weed from crop field and roadsides) in southern Ethiopia. Tethering or herding depends on size of herd and land per household and season. Those with small herd size tether their animals in front of their houses. Stall-feeding is practical during the rainy season in the watershed when enset leaf attains its

maximum rate of growth and also to protect the crop land from damage due to livestock (Funte *et al.,* 2010).

2.3. Constraints of Dairy Cattle Feeding

According to Zewdie (2010) in Debre Birhan and Jimma, 65% and 80% of the respondents encountered feed shortage in wet and dry seasons, respectively. Among the farmers with small herd sizes, 90% in Debre Birhan and 40% in Sebeta reported to not have enough feed in wet seasons. In general, feed shortage problem is common for cattle production due to different factors (Zewdie 2010). Among these shortage of grazing land ranked first in most area of the country particularly in highland and midland agro ecologies. The work of Zewdie (2010) which illustrated shortage of grazing land as the major contributes to critical feed shortages in the Highland areas. Moreover, in Debre birhan, 60% of the dairy farmers described that grazing lands are converted into croplands (Zewdie, 2010). In addition, availability and accessibility of concentrate feeds is another problem of dairy producers. In Debre Birhan, 40% of the dairy farmers described that expensive market price of concentrate feeds as the main problems of feed supply. Seventy five percent of both farms with small and medium herd size at Jimma and Sebeta had feed problems in relation with the current escalating cost of feeds. Moreover 80 and 55% of the dairy farmers at Jimma and Sebeta, respectively, indicated that commercial feeds are not available sufficiently in the market. Moreover, 70% of the dairy farmers in Jimma and 85% in Sebeta did not have any land to grow forage (Zewdie, 2010). According to Birhanu *et al.* (2011) and Bedasa (2012) issues of land degradation is another problem that related to feed shortage. Land degradation and low biomass yield were ranked as second in Diga and third in Jeldu (Bedasa, 2012). In Fogera, livestock population pressure ranked as second constraint of feed sourcing and feeding strategies (Bedasa, 2012). Probably what is peculiar in those relatively high rain fall areas is the fact that poor rain fall distribution stood the second important problem for systems in Jeldu. Water logging on grazing land was a constraint in farming systems of Fogera mainly in rice-pulses system (Bedasa, 2012).

2.4 Watering sources and frequency

Temporary surface water, ponds, rivers, streams traditional well hand dug wells like hand and bore holes are the main source of water for cattle in Ethiopia. In highland areas water sources of cattle is rivers, streams and temporary surface water both in dry and wet seasons. In all pastoral areas, temporary surface water and ponds are used in the wet seasons. Livestock watering frequency varies from season to season, species to species and accessibility of water sources. During the wet seasons most of the livestock are watered every 1-2 days. Belay *et al.* (2012) reported that in Ginchi area there are three water sources and these include rivers, streams and springs and majority of the households (98%) water their animals at river. On the same report, during the dry season, when animals are herded, watering takes place almost all at rivers and streams and 80.3% of the respondents water their animals once in a day whereas19.7% twice a day.

3. MATERIAL AND METHODS

3.1 Map of the study area

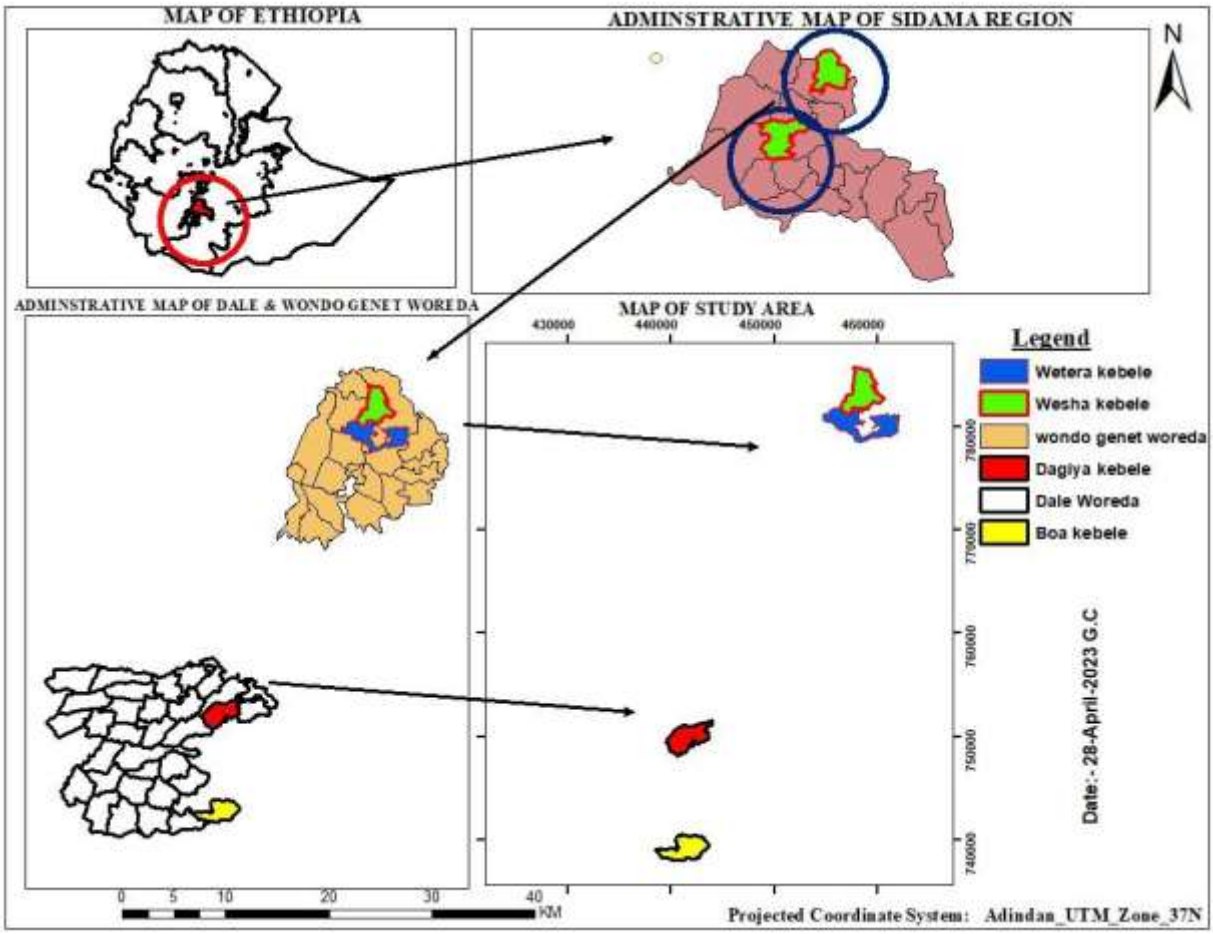

Figure 1. Map of the study area

3.2 Description of study area

The assessment of feed resource and feeding practices of dairy cattle was conducted in Dale and Wondo Genet districts of Sidama National Regional state. Dale district is located 45km from Hawassa and 320km from Addis Ababa. The district is stratified into highland, midland and lowland agro-ecological zones. Its elevation ranges from 1200-3200 m.a.s.l. The main livestock species in the district are cattle, goats and sheep (Abebe., 2016). Wondo Genet district is located 24km to North East of Hawassa and 265 km to South of Addis Ababa. The altitude ranges from 1,800 to 2,580 m a.s.l. The average yearly rainfall is 1,210 mm, with a rainy season during March to September, and a relatively dry period from December to February. The average annual temperature is 20°C.

3.3. Sample size and Sampling technique

Preliminary visit was made in the study area to get general picture of the study sites and to identify the target population. Two kebeles were purposively selected from each district and thus, dairy farmers in Dale and Wondogenet districts were purposively identified based on their potential to produce milk. Out of 316 dairy farmers keeping crossbred cattle in the study area, totally 140 farmers were selected from the study area (80 farmers from Dale and 60 from Wondogent districts). Following identification of dairy farmers, structured questionnaires was developed and pre tested before commencement of the actual survey. Information was gathered by interviewing the households and group discussions. The sample size was determined using the formula recommended by Yamane (1967) for survey studies:

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

Where: N=total population of districts who rear dairy cattle, n= sample size, and
e= standard error of the proportion (5%) and the confidence interval of 95%.

3. 4 Data Collection procedure

Data collected during the survey include household characteristics, land holding and land use pattern, livestock and dairy cattle holding, milk production performance of the cattle, types of feed available, feeding practice of dairy cattle, forage availability, current production, utilization and feeding plan of animal feeds at household levels, feed quality improvement techniques, the potential of feed availability in the area, the trends of feed production in the area, and constraints related with dairy cattle feed. The questionnaire was translated in to local language, pre–tested and re-formed in such a way that interviewing households would respond without difficulty. The designs involve cross-sectional study by applying formal survey, field observation, focus group discussion and key informants interview. For the focus group discussion (FGD), members of the community including elders, male and females who engaged in livestock production were included to get general overview of the feed resources and livestock production in the community. One FGD at each kebeles was conducted. A total of 4 FGD discussion s involving 6-9 members in each group were heled in selected sites of the districts to collect appropriate data for the study. Key informant interview was employed in each kebele by using different check lists for cross checking the data collected by household survey and FGD. Those key informants are from districts sector of agriculture and livestock office, concerning with the study issue was participated in availing required information or

data. Thus was guiding me to get data about the overall activities of the community as well as the feed resource available in the area.

3.5 Feed Sample Preparation Procedures

The selection of feeds sample for laboratory analysis was done based on information provided during group discussions. Their relative abundance in the area and their consumption by dairy cattle were found to be the major factor in this regard. Representative samples of the feeds, which were dominantly grown and used for feeding dairy cattle in the districts, were collected from selected kebeles. The collected feed samples were bulked per feed type for the districts separately in different kebeles. Then samples were dried under shade, and the amount sufficient for lab analysis was subsampled and transported to Hawassa University Animal Nutrition Laboratory.

3.6 Determination of Chemical Composition and In vitro Dry Matter Digestibility

The samples were oven dried at 60 C for 72 hours and feed samples are ground to 1 mm particle size with a Wiley mill. Feed samples were analyzed for DM, nitrogen (N) and ash contents according to AOAC (2005). Nitrogen was determined using the micro-Kjeldahl method (AOAC, 2005). The CP content was calculated by multiplying nitrogen content by a factor 6.25 (N x 6.25). The determination of neutral detergent fiber (NDF) and acid detergent fiber (ADF) were followed using Van Soest *et al.,* (1991) and Vansoest and Robertson (1985), respectively, using the Ankom 200 Fiber Analyzer. The acid detergent lignin (ADL) was determined using Ankom Daisy II incubator according to AOAC (1990). The Ankom Daisy II incubator was used to determine in vitro DM digestibility (IVDMD) (Tilley and Terry, 1963).

3.7 Data Analysis

The data were managed and organized with Microsoft-Excel spread sheet (2007) and analyzed using SPSS version 26 statistical software. Descriptive statistics were the methods of analysing data. Means were separated using Tukey test. The analyzed data were presented using tables, frequencies, percentages, means and standard error.The means of quantitative data between districts were compared. Level of significance was considered at $P<0.05$. The statistical differences between quantitative variables that were analyzed followed cross tabulation (chi- square procedure) was also proclaimed significant at $P<0.05$.

4. RESULTS

4.1 Household characteristics

The household characteristics of the respondents in the survey area are shown in Table 1. Overall, 75.4% and 24.5% of the households were male and female headed households, respectively. The overall mean age of respondents in the study area was 45 years. The observed level of illiteracy was 48.2%. The proportion of respondents who are capable of reading and writing only was 25% whereas 14.1%, 8.9% and 3.7% of the respondents attended formal education (Elementary school), Secondary school and above secondary, respectively.

Table 1: Household characteristics of the respondents'%

Variables	Districts		Over all	X^2
	Dale N=(80)	Wondogenet N=(60)	N=(140)	
Sex of respondents %				
Male	72.5	78.3	75.4	0.62^{ns}
Female	27.5	21.7	24.6	
Literacy status %				
Illiterate	51.3	45	48.2	
Read and write	25	25	25	
Elementary	15	13.3	14.1	2.11^{ns}
Secondary	6.2	11.6	8.9	
Above secondary	2.5	5	3.7	
Age of the household head(Mean ±SE)	45.9±1.06	43.8±1.09	45.0±0.77	

The chi-square (x^2) value denoted significance difference between districts ^{ns} (P>0.05), N=Number of respondents and SE=Standard error

4.2 Farming system characteristics

4.2.1 Land holding and land use pattern per household

Table 2 indicates average land holding per household and the use pattern in the study area. The overall mean of land holding in the study area was 1.76 hectare per household. The overall mean of crop land, grazing land, fallow land and forage production land per household of the study areas were 1.14 ha, 0.23 ha, 0.05 ha and 0.06 ha respectively.

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

	Districts		
	Dale N=(80)	Wondogenet N=(60)	Over all N=(140)
Variables	Mean ±SE	Mean ±SE	Mean ±SE
Land holding size	1.86±0.09	1.63±0.09	1.76±0.06
Land using pattern			
Crop land	1.51±0.08	1.35±0.13	1.14±0.07
Grazing land	0.25±0.01	0.21±0.01	0.23±0.01
Fallow land	0.06±0.01	0.04±0.007	0.05±0.006
Forage production land	0.07±0.01	0.05±0.006	0.06±0.007

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

4.2.2 Livestock holding and composition

Livestock herd size and composition per household (TLU) are presented in Table 3. The overall livestock herd size per household in the study area was 5.94. The average livestock holding per household in Dale and Wondogent districts was 6.48 and 5.26 respectively. Cattle were the most important species in both districts which can be seen 5.55 in Dale and 4.53 in Wondogent districts of total cattle holding per household.

Table 3: Composition of livestock specious per household TLU

	Districts		
Livestock	Dale	Wondogent	Over all
	N =(80)	N=(60)	N=(140)
	Mean ±SE	Mean ±SE	mean ±SE
Cattle	5.55±0.21	4.53±0.16	5.11±0.14
Sheep	0.27±0.01	0.24±0.01	0.25±0.01
Goat	0.17±0.01	0.21±0.01	0.18±0.01
Poultry	0.04±0.03	0.04±0.03	0.04±0.02
Donkey	0.23±0.02	0.15±0.03	0.20±0.02
Horse	0.12±0.03	0.05±0.02	0.11±0.02
Mule	0.10±0.03	0.04±0.01	0.05±0.01
Total livestock(TLU)	6.48±0.28	5.26±0.27	5.94±0.27

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

4.2.3 Cattle herd size and its composition

Table 4 indicates cattle herd size and its composition in the study area. The overall average cattle herd size was 5.1 heads/household in the study area. The cattle herds are dominated by cows, of which, the majority were indigenous. Oxen also comprised a significant proportion of the cattle herd size. The numbers of bull kept by the respondents in both study districts were very smaller than other types of dairy cattle's heads/household. The size of heifers in Dale and Wondogent districts was 1.08 and 0.85 heads/household, respectively, with the overall size of 0.94 heads/household. Local cattle herd size in Dale and Wondogent were 3.67 and 2.63 heads/household, respectively. The overall cattle herd size of the study area is 3.22 head/household. The crossbred cattle herd size in Dale and Wondogent were 1.97 and 1.41 head/household, respectively, with overall 1.73 head/household in the study area.

Table 4: Cattle herd size and its composition heads/household

Dairy cattle	Districts		
	Dale	Wondogenet	Over all
	Mean ±SE	Mean ±SE	mean ±SE
Cattle herd size	5.55±0.21	4.53±0.16	5.11±0.14
Local breed cattle	3.67±0.17	2.63±0.11	3.22±0.11
Crossbred cattle	1.97±0.12	1.41±0.10	1.73±0.08
Cow	1.62±0.06	1.16±0.05	1.42±0.04
Oxen	1.31±0.07	1.05±0.09	1.20±0.6
Heifer	1.01±0.07	0.85±0.06	0.94±0.05
Calves	1.08±0.07	0.68±0.06	0.91±0.05
Bull	0.47±0.05	0.28±0.05	0.39±0.04

N=Number of respondents and SE=Standard error

4.2.4 Main farming activity, reason of keeping dairy cattle and major source of income

Table 5 shows main farming activity, reasons of keeping dairy cattle and sources of income in the study areas. All respondents in the study area responded that both crop and livestock farming are the main farming activity and used as main sources of income in both Dale and Wondogent districts. Respondents in the study area kept dairy cattle for multiple purposes (milk, meat, draught power and income).

Table 5. Main farming activities, reason of keeping livestock and source of income of the respondent's %

Variables	Districts			X^2
	Dale N=(80)	Wondogent N=(60)	Overall N=(140)	
Main farming activity				
Both crop and livestock farming	100	100	100	ns
Reasons of keeping Dairy cattle				
Multipurpose(sources of milk, draught power, income from sale and meat)	100	100	100	ns
Sources of income				ns
Both crop and livestock farming	100	100	100	

The chi-square (x2) value denoted significance difference between districts ns (P>0.05) and N=Number of respondents

4.2.5 Dairy cattle production constraints

Shortage of feed was mentioned as the most important constraint by most of cattle owners (32.2%) followed by shortage of land (30.7%), disease outbreak by (15.7%), shortage of extension services (12.1%) and veterinary services shortage (9.3%). The highest number of respondents indicated that shortage of land was the main challenges for dairy cattle production in Wondogent district and shortage of feed was also the main challenges for Dale district respondants.

Table: 6 Livestock production constraints in the study area %

Dairy cattle production constraints	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Overall N=(140)	
Shortage of feed	32.4	31.7	32.2	
Disease out break	18.8	11.7	15.7	0.46^{ns}
Shortage of land	25.0	38.3	30.7	
Shortage of extension services	13.8	10.0	12.1	
Shortage of veterinary services	10.0	8.3	9.3	

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

4.2.6 Lactation yield and lactation length of dairy cows

The daily milk yield and lactation length of local and cross breed cows in the study area are shown in Table 7. The average estimated daily milk yield of local and cross breed dairy cows was found to be 1.34 and 5.75 liters, respectively. The daily milk yields of local cows in Dale and Wondogenet districts were 1.42 and 1.25 liters/day respectively. Whereas the lactation yields of cross cattle breed in Dale and Wondogenet districts were 6.02 and 5.30 liters of milk yields/day. The overall average lactation length of local and crossbred cows was 9.4 and 10.0 months, respectively. The lactation length of local dairy cow breed in Dale and Wondogenet districts were 9.74 and 9.11 months and cross breed cows lactation length was 10.1 months in Dale district and 10.01 months in Wondogenet districts.

Table: 7 Daily milk yield and lactation length of cows in the study area.

Dairy cow milk production performances	Districts		
	Dale N=(80) Mean ±SE	Wondogent N=(60) Mean ±SE	Overall N=(140) Mean ±SE
Daily milk yield liter/day			
Local cow	1.42±0.06	1.25±0.05	1.34±0.04
Crossbred cow	6.02±0.21	5.30±0.21	5.75±0.15
Lactation length (months)			
Local cow	9.74±0.70	9.11±0.11	9.47±0.70
Crossbred cow	10.1±0.10	10.0±0.1	10.0±0.8

N=Number of respondents and SE=Standard error

4.3 Dairy cattle feed resources

4.3.1 Available feed resources in dry season

Table 8 indicate the major feed resources available in the dry season. The major feed resources available in dry season were crop residues 37.1%, hay 25.7%, natural pasture 19.3%, non-conventional fee 10.7% and forage and pasture 7.1%. The main feed resources available in both Dale and Wondogenet districts were crop residues, hay, natural pasture, non-conventional feeds and forage and pasture in in a decreasing order.

Table 8. Feed resources availability in the dry season in the study area (%).

Feed resources availability in dry season	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Overall N=(140)	
Natural Pasture	17.5	21.7	19.3	
Crop residue	40.0	33.3	37.1	0.87ns
Hay	25.0	26.7	25.7	
Forage and pasture	7.5	6.7	7.1	
Non-conventional feed	10.0	11.7	10.7	

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

4.3.2 Available feed resources in wet season

Table: 9 indicate major feed resources available in the wet season. The feed resources available in the study areas in wet season were natural pasture 33.6%, forage and pasture 22.9%, non-conventional feed 20.7%, crop residues 13.6%, and hay 9.3%.

Table 9. Feed resources availability in the wet season in the study area (%)

Feed resources availability in wet season	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Overall N=(140)	
Natural Pasture	30.0	38.3	33.6	
Crop residue	16.3	10.0	13.6	0.64ns
Hay	11.3	6.7	9.3	
Forage and pasture	22.5	23.3	22.9	
Non-conventional feed	20.0	21.7	20.7	

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

4.3.3 Seasonal variability of feed resources and feed calendar

Feeding calendars for different feed resources are indicated in Table 10. Natural pasture, improved forage and fodder trees were available from January to December. A limited amount of natural

pasture was available in the months of January, February, March, April and May. Crop residues were available from November to March in the study area. Enset leaves and pseudo-stem are available from December to March

Table 10: Feed resources availability across the different months of the year in study area

Feed resources	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Natural pasture	✓	✓	✓	✓	*	*	*	*	*	✓	✓	✓
Maize Stover	-	-	✓	✓	✓	✓	✓	*	-	-	-	-
Haircoat bean straw	-	-	*	✓	✓	✓	✓	-	-	-	-	-
Sugar cane tops	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Improved forage	✓	✓	✓	✓	*	-	-	-	*	✓	✓	✓
Enset leaves and stem	*	*	*	✓	✓	✓	✓	*	*	*	*	*
Fodder tree	✓	✓	✓	✓	*	*	*	*	*	✓	✓	✓

✓ = The feed resource mentioned is available in the specified month/months

- = Unavailable,

* = Limited availability;

4.3.4 Types of Grazing land and feeding system

4.3.4.1 Grazing land availability and constraints

Table 11 shows availability, types of grazing land and constraints of grazing land in the study area. In Dale and Wondogenet districts 67.5% and 56.7% of the respondents, respectively replied that there was communal grazing land in their areas. The respondents indicated that the majority of communal grazing lands are open grass lands (44.3%), but 37.9.3% is tree covered grass land and

17.9% was bush covered grass land. Constraints related to grazing lands were weed (18.6%), over grazing (31.4%), and decreased size of land (50%), in both districts.

Table 11: Types of grazing system practices and feeding system in the study area %

Variables	Districts			X^2
	Dale N= (80)	Wondogene t N= (60)	Overall N= (140)	
Do you have communal grazing land				
Yes	67.5	56.7	62.9	0.18^{ns}
No	32.5	43.3	37.1	
Types of grazing land available				
Open grass land	56.3	28.3	44.3	0.01^{***}
Tree covered grass land	25.0	55.0	37.9	
Bush covered grass land	18.8	16.7	17.9	
Constraints of grazing land				
Decreased size of land	37.5	66.7	50.0	
Over stocking	37.5	23.3	31.4	0.002^{***}
Weed	25.0	10.0	18.6	

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

4.3.4.2 Adequacy, status of communal grazing land and types of grazing system

Table: 12 shows that adequacy, status of common grazing land and grazing system. Communal grazing land was not adequate to their dairy cattle and its status was decreased in the study area. High numbers of respondents (43.6%) adopted rotational grazing system followed by zero grazing system (37.1%). and only 19.3% respondents were uses dairy cattle's continuously grazing on communal grazing land.

Table 12: Adequacy, status and grazing system of communal grazing land in the study area %.

Variables	Districts			X^2
	Dale N= (80)	Wondogenet N= (60)	Over all N=(140)	
Is there grazing land adequate to your animal				
Yes	0.00	0.00	0.00	1.45^{ns}
No	100	100	100	
Status of common grazing land %				1.45^{ns}
Decrease	100	100	70.9	
Types of grazing system practices				
Continuous grazing	21.3	16.7	19.3	
Rotational grazing	40.0	48.3	43.6	0.59^{ns}
Zero grazing(cut and carry)	38.8	35.0	37.1	

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

4.4 Crop residue and hay production

4.4.1 Major crop residue

Table 13: shows the major crop residue in the study area. The Major crop residues in the study area were maize Stover (30.7%), Haricot bean straw (21.4%), sugarcane tops were accounts (18.6%) enset pseudo-stem and leaf (17.1%) and Very fewer respondents were uses plus crop residue bean straw (12.1%) in the study area.

Table 13: Major crop residues in the study area (%)

Variables	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Over all N=(110)	
Major crop residue				
Maize stover	31.3	30.0	30.7	
Enset pseudo-stem and leaf	18.8	15.0	17.1	
Hair coat bean straw	22.5	20.0	21.4	0.79^{ns}
Sugar cane tops	15.0	23.3	18.6	
Bean straw	12.5	11.7	12.1	

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

4.4.2 Crop residue and utilization and utilization challenges

Table 14 shows crop residue utilization and challenges of utilization in the study area. Most of respondents as responded that, (85.7%) they utilize the crop residue for feeding of the dairy cattle and (7.9%) were use crop residues for selling purpose. Less number of respondents (6.4%) was utilizing crop residues for fuel. (86.5%) most of the respondents of Dale district were uses crop residues for feeding of dairy cattle, 7.5% and 6.30% were uses crop residues for sealing and fuel purposes. Whereas in Wondogenet district most of respondents use crop residues for feeding dairy cattle followed by selling and fuel. According to the responses of the sampled households, the major constraints associated with crop residue utilizations for dairy cattle feeding were collection and transportation, storage, and feeding problems. About 52.5 % in Dale and 45.0% in Wondogenet districts residences responded about the presence of problems in collecting and transporting the crop residues from the farm to homes.

Table 14: Crop residue utilization and challenges of utilization in the study area %

Variables	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Over all N=(110)	
Utilization of crop residues				
For feeding	86.3	85.0	85.7	
For fuel	6.30	6.70	6.40	0.97^{ns}
For sale	7.50	8.30	7.90	
Challenges of crop residues utilization				
Collection and transportation	52.5	45.0	49.3	
Feeding	12.5	18.3	15.0	0.5^{ns}
Storage	35.0	36.7	35.7	

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

4.4.3 Hay production and its sources

Table: 15 shows hay production and sources in the study area. Majority of respondents 74.3% practices hay production whereas 25.7% do not practice hay production in the study area. 46.4% of respondents produce hay from private grazing land, 32.1% from cultivated land boundaries and only 21.4% of respondents produce hay from communal grazing land.

Table 15: Hay production and it sources in the study area%

Variables	Districts		Over all	X^2
	Dale	Wondogenet		
	N=(80)	N=(60)	N=(140)	
Do you produce hay?				0.1^{ns}
Yes	78.8%	68.3%	74.3%	
No	21.3%	31.7%	25.7%	
From where do you produce hay				
Private grazing land	42.5%	51.7%	46.4%	
Communal grazing land	22.5%	20.0%	21.4%	0.5^{ns}
Cultivated land boundaries	35.0%	28.3%	32.1%	

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

4.5 Improved forage production

4.5.1 Improved forage production and seed sources

Table: 16 shows improved forage production and seed sources in the study area. About 65.7% of the sampled households in the study area have improved forages on their farm land as dairy cattle feed source whereas 34.3.2 % do not have produce improved forage for animals in the study area. The majority of respondents (52.1%) got forage seeds from governments and 32.1% respondents took improved forage seed from NGOs. Only 15.7% of the respondents purchase improved forage seed from market.

Table 16: Improved forage production and sources of seed in the study area (%)

Variables	Districts		Over all N=(140)	X^2
	Dale N=(80)	Wondogenet N=(60)		
Do you produce improved forage?				
Yes	67.5	63.3	65.7	0.26^{ns}
No	32.5	36.7	34.3	
Sources of improved forage seeds				
Government	51.2	53.3	52.1	
NGO	33.8	30.0	32.1	0.23ns
Market	15.0	16.7	15.7	

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

4.5.2 Common types of improved forage

Table 17 shows common improved forage type in the study area. Desho grass (20.7%) was the most dominant types of forage species in the study area followed by elephant grasses (19.3%). Most of respondents cultivate in their forage production land elephant grasses (20.0%), desho grass (18.8%) and Guatemala grasses(17.5%) in Dale district whereas respondents in Wondogenet districts mostly cultivate desho grass (23.3%), elephant grass (18.3%) and phalaris (15.0%).

Table 17:- Common improved forage available in the study area (%).

Variables	Districts		Over all N=(140)	X^2
	Dale N=(80)	Wondogenet N=(60)		
Common types of improved forage				
Elephant grass	20.0	18.3	19.3	
Rhodes grass	10.0	13.3	11.4	
Desho grass	18.8	23.3	20.7	
Phalaris	11.3	15.0	12.9	0.9^{ns}
Guatamala grass	17.5	10.0	14.3	
Cow pea	8.80	8.30	8.60	
Pigeon pea	7.50	6.70	7.10	
Vetch	6.30	5.00	5.70	

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

4.5. 3 Feeding of improved forage and challenges of production

Priority given to feed improved forage to different class of dairy cattle and major challenges that hampered improved forage production is presented in Table 18. A high proportion of the respondents (36.4%) give priority to feeding improved forage for lactating dairy cows followed by calves (24.3%) and for draught oxen (15.7%). Only small number of respondents provide improved forage feeds for heifers (15%) and pregnant cows (8.6%) in both districts of study area.

Land shortage (43.6%) and improved forage seed shortages (30.7%) were the major challenges of improved forage production in the study area followed by poor productivity (17.9%) of improved forages and rain fall shortage (7.9%). In both Dale and Wondogenet districts the land shortage and improved forage seeds were the most challenges for respondents followed by poor productivity of improved forage production. Rain fall shortages were not that much affects improved forage production in both Dale and Wondogenet districts.

Table 18: Provision of improved forage to different class of dairy cattle and major Challenges %

Variables	Districts			X^2
	Dale N=(80)	Wondogent N=(60)	Over all N=(140)	
For which dairy cattle priority is given				
Draught oxen	17.5	13.3	15.7	
Lactating cow	35.0	38.3	36.4	0.87^{ns}
Pregnant cow	7.5	10.0	8.6	
Heifers	13.8	16.7	15.0	
Calves	26.3	21.7	24.3	
Major Challenges of production improved forage				
Land shortage	40.0	48.3	43.6	
Seed shortage	31.3	30.0	30.7	
Rainfall shortage	11.3	3.3	7.9	0.3^{ns}
Poor productivity	17.5	18.3	17.9	

The chi-square (x^2) value denoted significance difference between districts) ns ($P<0.05$) and N=Number of respondents

4.6 Non-conventional feed

Majority (83.6%) respondents reported the availability of non-convectional feeds, like residues of local drinks tella (16.4%), coffee residues (25.7%), enset byproduct (28.6%) and banana leaf and pseudo-stem (29.3%). Respondents of Dale districts feed their dairy cattle residues of coffee, enset by products like enset leaf, pseudo-stem and others part, followed by bananas leaf and pseudo-stem. Only 11.3% of respondents were using the residues of areqe and tella atela. Whereas in Wondogenet district banana leaf and pseudo-stem, enset by products and the residues of areqe and tella atela were highly used types of non-conventional feeds. Very few respondents use residues of coffee in the district. 65.7% of respondents provide non-conventional feed to their dairy cattle mixing with other feeds whereas 34.3% feed the non-conventional feeds alone.

Table 19: Availability, types and methods of feeding of non-conventional feeds in the study area%.

Variables	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Over all N=(140)	
Availability of non-conventional feed				
Yes	88.8	76.7	83.6	0.05^{*}
No	11.3	23.3	16.4	
Types of non-conventional feed				
Atela	11.3	23.3	16.4	
Residues of coffee	32.5	16.7	25.7	
Enset by products	31.3	25.0	28.6	0.04^{*}
Banana leaf and pseudo-stem	25.0	35.0	29.3	
Methods of feeding conventional feed				
Mixing with other feed	66.3	65.0	65.7	0.8^{ns}
Feeding alone	33.8	35.0	34.3	

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

4.7 Dairy cattle feeding practices and feeding system

4.7.1 Dairy cattle feeding plan and feeding system

Table 20 shows dairy cattle feeding plan, feeding frequency and feeding system. 77.5% of respondents in Dale and 66.7% of respondents in Wondogenet districts have a good plan to feed their dairy cattle. Most of the respondents provide feeds three times per day (48.6%) followed by twice per day (32.9%) and 10.0% respondents were provides feeds only once per day. Majority of respondents in Dale districts were feeding their cattle three times per day whereas in Wondogenet districts majority of respondents (43.3%) provides feeds twice per day. The commonly used feeding systems in the study area were free grazing (40.78%), group feeding (35.7%) and indoor feeding (23.6%). Most of the respondents in Dale and Wondogenets were practices free grazing system and group feeding system followed by individual feeding their dairy cattle.

Table 20: dairy cattle feeding plan, feeding frequency and feeding system in the study area %.

Variables	Districts			X^2
	Dale N=(80)	Wondogenet N=(60)	Over all N=(140)	
Do you have a feeding plan for your dairy cattle				0.15^{ns}
Yes	77.5	66.7	72.9	
No	22.5	33.3	27.1	
How often feed for a dairy cattle				
Once per day	5.0	16.7	10.0	
Twice per day	25.0	43.3	32.9	0.001^{***}
Three times per day	62.5	30.0	48.6	
Four time per day	7.5	10.0	8.6	
Types of feeding system				
Indoor feeding	20.0	28.3	23.6	0.51^{ns}
Group feeding	37.5	33.3	35.7	
Free grazing	42.5	38.3	40.7	

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

4.7.2 Feed shortage, reasons of feed shortage and coping mechanism

Feed shortage problems, reason of feed shortage and coping strategy are presented in Table 21. All of the respondents in the study area faced with feed shortages. The main reasons of shortage of feed in the study area were land shortage (82.1%) followed by difficulty to get improved forage seed (15.0%) and only 2.9% of respondents responded that shortage of rain fall or irrigable water. Coping mechanisms with feed shortage in the study area include increasing use of crop residues (42.1%), purchasing concentrate feeds (23.0%), purchasing forage feeds/ green feeds (20.0% and reducing herd size (13.6%). The Dale district respondents indicated that they cope with feed shortage through using different crop residues like maize stover and hair coat bean haulms, purchasing concentrate feeds from around markets, purchasing forage feed/ green feed in their importance's orders and very few farmers were reducing numbers of animals.

Table 21: Feed shortage, reasons of feed shortage and coping mechanism in the study area %.

Variables	Districts		Over all	X^2
	Dale N=(80)	Wondogenet N=(60)	N=(140)	
Is their feed shortage for dairy cattle				
Yes	100	100	100	14.0^{ns}
No	0	0	0	
Reason of feed shortage				
Shortage of rain or irrigable water	2.5	3.30	2.90	
Shortage of land	78.8	86.7	82.1	0.35^{ns}
Shortage of improved forage	18.8	10.0	15.0	
Coping mechanisms feed shortage				
Purchase concentrate	24.0	22.0	23.0	
Purchase forage/green feeds	18.5	23.3	20.9	0.68^{ns}
Use crop residues	42.5	41.0	42.1	
Reduction of number of animals	15.0	11.7	13.6	

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

4.7.3 Form of feeding crop residues and quality improvement practices

The respondents feed crop residues to their animals in different ways (Table 22). All of the respondents were faced by challenges of feed shortage in both Dale and Wondogenet districts in which, 53.7% of the respondent practiced chopping, 30.7% of the respondents mix crop residues with other feeds and the only 13.6% practiced whole feeding. Chopping was the most dominant practices for feed quality improvement (55.7%) followed by soaking with water (32.1%) and only (12.1 %) of respondent used grinding in the study area.

Table 22:- Form of feeding crop residues and quality improvements practices of feed in the study area %.

Variables	Districts			
	Dale N=(80)	Wondogenet N=(60)	Over all N=(140)	X2
Form of feeding crop residues				
Whole provided	17.5	8.30	13.6	0.03*
Provided after chopping	60.0	50.0	55.7	
Chopped and mixed with other feeds	22.5	41.7	30.7	
Feed quality improvement practices				
Soaking in water	25.0	41.7	32.1	0.08^{ns}
Chopping	60.0	50.0	55.7	
Grinding	15.0	8.30	12.1	

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

4.8. Water sources and watering frequency in the study area

Table 23 indicates water sources, types of water and watering frequency for dairy cattle in the study areas. River water was the major sources of water in both Dale (57.5%) and Wondogenet (56.7%) districts. Individual watering system (53.6%) was used by majority of respondents and households who were providing water mainly once a day (62.9%).

Table 23: sources of water, types and frequency of watering of respondents' %

Variables	Districts			X^2
	Dale N=8(0)	wondogenet N=(60)	Over all N=(140)	
Sources of water				
River	57.5	56.7	57.1	
Spring	27.5	35.0	30.7	0.38^{ns}
Pond	15.0	8.3	12.1	
Types of watering system				
Group watering	16.3	11.7	14.3	
Individual watering	50.0	58.3	53.6	0.57^{ns}
Group and Individual watering	33.8	30.0	32.1	
Frequency of watering				
Once a day	62.5	63.3	62.9	0.10^{ns}
Twice a day	37.5	36.7	37.1	

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

4.9. Quality of Available Feed Resources

The chemical composition of major feeds in the study area is presented in Table 24. The overall DM content of Guatmala grass, Desho grass, Elephant grass, natural pasture, sugarcane tops, enset leaf, enset pseudo-stem and enset corm were 24.2%, 29.6%, 16.2%, 30.3%, 32.8%, 17.9%, 16.4% and 25.0%, respectively in the study area. The highest crude protein contents were found in enset leaf (12.2%). Guatemala grass (11.8%), elephant grass (11.0%), and desho grass (9.67%) natural pasture (9.25%) and enset psudostem (7.8%) the study area. The over all NDF, ADF and ADL contents of all available feed resources in the study area were in the range 44.7% to 64.8%, 31.5% to 36.6%, and 3.02% to 7.00% respectively. The NDF content of sugar cane tops was also among the highest. The over all in vitro dry mater digestibility of Guatemala grass, desho grass, elephant grass, natural pasture, sugarcane tops, enset leaf, enset pseudo-stem and enset corm were 60.8%, 61.8%, 61.5%, 59.2%, 59.5%, 59.2%, 59.5 and 60.5%, respectively.

Table 24: Chemical composition and IVDMD of major feed resource (%) in the study area

Districts	Feeds types	DM	ASH	CP	NDF	ADF	ADL	IVDMD
	Guatemala grass	22.3	10.9	11.3	60.5	35.9	5.68	60.5
	Desho grass	29.6	9.98	9.13	61.0	34.7	5.38	62.1
	Elephant grass	17.9	8.99	11.8	59.7	33.9	5.99	61.5
Dale	Sugarcane	31.4	9.89	5.38	64.2	35.7	6.07	59.4
	Natural grass	32.7	10.8	8.01	64.7	36.0	6.97	59.6
	Inset leaf	17.5	13.0	12.2	56.5	31.8	3.20	59.0
	Enset pseudo-stem	15.7	11.8	7.9	60.8	32.7	3.50	59.6
	Enset root	24.6	9.02	10.8	44.8	31.8	3.04	60.3
	Guatemala grass	26.1	11.9	12.3	61.5	35.7	5.10	61.1
	Desho grass	29.7	10.4	10.2	61.4	35.2	5.79	61.5
Wondogenet	Elephant grass	14.6	9.4	10.3	60.4	34.7	5.93	61.5
	Sugarcane	30.3	10.9	6.40	65.4	37.4	6.39	59.1
	Natural grass	32.8	10.5	10.5	64.4	36.0	7.03	59.2
	Inset leaf	17.9	13.4	12.5	58.0	32.2	3.30	59.5
	Enset pseudo-stem	17.1	12.3	7.7	60.0	33.8	3.63	59.4
	Enset root	25.4	9.28	11.0	44.7	31.7	3.01	60.9
	Guatemala grass	24.2	11.4	11.8	61.0	35.6	5.39	60.8
Over all	Desho grass	29.6	10.2	9.67	61.2	34.9	5.58	61.8
	Elephant grass	16.2	9.20	11.0	60.0	34.2	5.96	61.5
	Sugarcane tops	30.8	10.4	5.89	64.8	36.6	6.23	59.2
	Natural grass	32.7	10.7	9.25	64.0	36.0	7.00	59.5
	Inset leaf	17.5	11.4	12.2	57.3	32.0	3.25	59.2
	Enset pseudo-stem	16.4	12.9	8.9	60.4	33.3	3.56	59.5
	Enset root	25.0	9.28	7.8	44.7	31.5	3.02	60.5

DM= dry matter; NDF=neutral detergent fiber; CP= crude protein; ADF=acid detergent fiber; IVDMD = in vitro dry mater digestibility

5. DISCUSSION

5.1 Household Characteristics

The average age of the sampled households in this study was 45 years. This result is higher than the report of Solomon (2004) (42.18 years). Education plays great role in transferring technology and in initiating farmers' willingness to adopt different technologies. The high percentage of illiterate compared to the other categories can hinder in the adoption of agricultural technologies in the study area. Similar finding was reported by Yisehak Kechero *et al.,* (2013), in three districts of Jimma zone Southwest Ethiopia.

5.2 Farming characteristics

5.2.1 Land holding and use pattern of household

Land is the most important limiting factor for dairy cattle production in the study area.The overall average land holding in the study area was 1.76 ha per household which is comparable with the result of 2.18 ha reported by Selamawit *et al.* (2017) from north Achefer district in Amhara region but much lower than the value of 3.3 ha reported by Yitaye *et al*. (2007) in the highland areas of Amhara region. On the other hand, the land holdings recorded per household in the present study was larger than values reported by Mengistu *et al.* (2016) which was 0.69 ± 0.02 per household. The farmers in the Dale districts had larger land holding per household than those in Wondogenet district. The land allocation differences in the distrcts might be due to differences in the size of the land and farming system. The land allocated for crop production, animal grazing and forage production in Wondogenet districts was smaller as compared to Dale districts and this could be due to the availability of smaller size of land per household in the Wondogenet district. The amount of crop land and grazing land in current study was 1.14 ha and 0.23 ha per household respectively. This finding was lower than finding of Bedasa (2012) who reported the amount of land size allocated for crop production as 1.7 ha and grazing land as 0.4 ha in Jeldu district West Shewa zone of Oromia Regional State. The average grazing landholding size in the current study was lower than the values (0.52 ha) reported by Mekete (2018) and 0.46 ha reported by Ahmed *et al*. (2010) in the central highlands of Ethiopia. The overall mean value of 0.06 ha per household was allocated for improved forage production and there was no significant difference among the districts. This result was larger than that the value reported by Mergia *et al.* (2014), which was 0.004 ha per household in Baresa

watershed. Furthermore, forages could be grown as hedges around field edges and on soil bund, particularly on the sloping land, intercropped with cereals and alley cropping is also a possibility.

5.2.2 Livestock holding

The overall livestock herd size per household in the study area was 5.94 TLU per household. Current study finding were in line with the finding of Bedasa (2012), who reported TLU values of 5.35 for cattle, 0.49 sheep, 0.03 goats, 0.22donkeys and 0.02 poultry but higher than 3.9 TLU for cattle reported by Asrat *et al*. (2013) in Delbo area. This higher value may be due to higher pasture landholding in the study area. The number of the different livestock species owned per household was comparatively highest in Dale district than Wondogenet district, which could be due to the difference in household land holding and existence of grazing land. The livestock species raised in the study areas include cattle, goats, sheep, chicken, donkey, horse and mule. Cattle followed by sheep, goat, donkey and chicken are the dominant species raised by majority of the surveyed households in in the study area.

5.2.3 Cattle herd size and its composition

Cattle ownership varies depending on the districts, wealth status and the overall farm production objectives. The greater number of cattle holding in Dale district could be due to higher pasture landholding in the district. The average number of cattle per household for current study (5.11) is a bit higher than the average cattle number of 4 at Akaki and Lemu, central Ethiopia reported by Bayush *et al.* (2008); however, it is tremendously lesser than 8.27 at Adami Tullu Jiddo Kombolcha district in Oromiya Region, reported by Dawit *et al*. (2013). The local cattle holding per household in Dale are significantly larger ($P<0.05$) than Wondogenet. The overall mean of local cattle breed (3.22) reared in the study area were higher than cross breed cattle (1.73) reared. This might be due to farmers holds more a number of local cattle for plowing and threshing purpose than crossbred cattle by considering feed consumption as crossbred cattle need more feed. Out of the total cattle, cows are dominant in both districts followed by oxen and heifer. Mean cow holding per household was not significantly different ($P>0.05$) between the two districts.

5.2. 4 Main farming activity, Purpose of keeping dairy cattle and major source of income

Both crop and livestock productions are the main farming activity and sources of income in the study area and both are complementary. Livestock generate income for the farmers directly by selling or

through the production of milk and milk products and also provides power for land preparation and crop transportation after harvest and manure as fertilizer, while crop by-products represent an important source of animal feed. The current finding is in agreement with Teshager (2013), who reported (72.8%) HHs incomes were from both crop and livestock in Ilu Aba Bora zone of Southwest Ethiopia and Kechero *et al.* (2013) in Jimma zone of Southwest Ethiopia. All the respondents in both Dale and Wondogenet districts practices crop production and livestock production as main farming activity. There is no significances difference (P>0.05) in reasons of keeping dairy cattle among the districts. The objective of cattle keeping in the study area was for multi purposes objectives, mainly for sources of milk, draught power, and income.

5.2.5 Dairy cattle production constraints

About 32.2% of HHs in the study areas indicated feed shortage as the first major constraint in affecting dairy cattle production and productivity followed by land shortage, disease outbreak, shortage of veterinary services and shortage of extension services. This is in agreement with other studies (Zewdie, 2010; Dawit *et al.,* 2013 and Teshager *et al.,* 2013). This is mainly due to shortage of land for grazing and fodder production as the result of expansion of crop agriculture at the expense of grazing land. It was also indicated during group discussion that the quantity and quality of natural grass is very low to meet the nutrient requirement of animals. Majority of respondents in Dale districts reported that feed shortage is the main challenges of dairy cattle production, whereas land shortages is the main challenges in Wondogenet district. The interaction of these constraints affects the overall livestock productivity in the area. This is in agreement with work of (Zemenu *et al.,* 2014).

5.2.6 Lactation yield and lactation length of dairy cows

The reported average daily milk yield of local cows in the present study is higher than the value reported by (ILDP, 2004) which was 4 liters and that reported by (CSA, 2005) which was 1.23 liters elsewhere in the country. In addition to improved nutrition and management, selection for milk yield traits within the indigenous breeds should be planned as a long-term objective in order to increase milk yield from indigenous cattle. However, in order to meet the immediate demand for milk, crossbreeding indigenous cattle with exotic cattle breeds can be planned and implemented. The overall average lactation length of local and crossbred cows was 9.47 and 10.0 months, respectively in the study area. The lactation length of the indigenous cows observed in this study is longer than

the national average of 7 months (CSA, 2005). The lactation length of crossbred cows observed in this study is slightly shorter than the lactation length of 11.7 months reported for crossbred cows in the central highlands of Ethiopia (Zelalem *et al.,* 2001). In general, the lower average daily milk yield per cow and the variation in lactation length observed in the present study may be attributed to feed shortage and poor genetic potential of the local cows.

5.3 Dairy cattle Feed resources

5.3.1 Available feed resources in dry and wet seasons

The importance of natural pasture and crop residue in this study is in agreement with report of Adugna *et al.* (2012), Ahmed *et al*. (2010) and Belay *et al. (*2012) who worked on natural pasture assessment in the central zones of Ethiopia, in the central highlands of Ethiopia and in Dandi district, respectively. It was generally accepted by all respondents that there is seasonal shortage of feed resources in the study areas. The crop residues, hay, natural pasture and non-conventional feeds in the current study were the major feed resources for dry season, in their descending order of study area. The result in this study is agreement work of Tolera *et al.* (2012) and Seyoum *et al.* (2001) who reported that the major basal feed resources for cattle in the highlands of Ethiopia are crop residues and natural pasture stubble grazing. Contrary to the current study, Tesfaye (2008) reported that the major dry season feed resources for cattle in Metema district were natural pasture (55.7 %), crop residues (20.7%), stubble (14.3 %) and hay (9.3 %) and this is mostly due to agro- ecological differences between the study areas. Natural pasture was the major feed resources in wet season of both Dale and Wondogenet districts in study area. The finding was in line with Tesfaye (2008) reported that in wet seasons, all the respondents in the both districts use natural pasture and to some extent hay and crop residues to feed their animals. In current finding forage and pasture and non-conventional feeds was the second widely used in both Dale and Wondogenet districts.

5.3.2 Seasonal of feed resources availability

The type, quality and quantity of available feed resource are influenced by season. Natural pastures, fodder tree, sugar cane tops, enset leaf and pseudo-stem are used during most part of the year in current study area. According to the respondent households, natural pasture is fed 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 was consists

the main source of animal feed throughout the year with maximum availability Jun-December. According to current study in overall study area, excess animal feed was available in the months of September, October, November and December. This excess availability of feeds during these months was associated with the availability of natural pasture grazing, hay production, crop residues and sugar cane tops and enset leaf and pseudo-stem, improved forage and fodder tree.

Likewise, for cultivated forage grass June- December was good in availability and January and May were fair in availability. Also, months November-March were good in availability while as April were fair in availability for crop residues (maize stover and hair coat bean) feeding. Months September-March were good while as April-August was fair for enset leaf and pseudo-stem. On the other hand, June-December were good while as January-April were fair for fodder trees/shrubs in the study districts.

5.3.3 Types of Grazing and feeding system

5.3.3.1 Grazing land availability and Constraints

Majority (56.3%) of respondents in Dale districts responded that there communal grazing land is open grass land they have, whereas in Wondogenet districts (55.0%) the respondents uses tree covered grass land majorly. Open grass communal grazing land was the dominant types of grazing land followed by tree covered grassland in the study area. Constraints related to grazing lands in Dale district were over stocking but in Wondogenet district decreased size of land were the major constraints for grazing land. Decreased size of land was the main challenges or constraints of communal grazing land in the study area. Similarly, shortage of land, low technical know-how on improved forage production and high cost of feeds and poor access to markets were indicated as livestock productivity problem in Diga Woreda, Ethiopia (Adugna *et al*., 2014).

5.3.4 Adequacy, status of communal grazing land and types of grazing system

Majority of the respondents in current study area have common grazing land but in terms of adequacy, the grazing land is not adequate and the area of grazing land is decreasing from time to time. 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 declining from time to time due to expansion of cropland. This study is also in accordance with the report of Altaye *et al.*,(2014) who pointed out in Metekel zone, northwest Ethiopia where majority of farmer described that there

was a decreasing trend of grazing area because of converting grazing land to crop fields. The sizes of communal grazing lands in the study areas were decreasing from time to time and this indicates that the quantity of feed obtained from these sources was also decreasing. According to group discussion respondents the reduction of communal grazing lands was caused by using the grazing lands for crop production; enclosures of vast areas as a result of severe overgrazing, land degradation, deforestation and higher number of livestock population compared with grazing land. There is no significances difference (P>0.05) in types of grazing system in the study area. Rotational grazing system was highly practices in both of the districts followed by zero grazing (cut and carry system). Current findings was different in Jeldu district where 94.5, 4.4 and 1.1% of the respondents practiced let to graze, cut and carry and tethering, respectively (Bedasa, 2012). The difference might be due to livestock owners followed different feeding systems for efficient utilization of the available feeds and the accessibility of the grazing land.

5.4 Crop residue and Hay production

5.4.1 Major crop residue

According to Tsegaye *et al.* (2008), shortage of grazing lands and the absence of alternative feed resources emphasize the increased dependence on crop residues in the central highlands of Ethiopia. Crop residues which are serving as the main source of roughage during dry season (Mekasha *et al.*, 2014; Salo *et al.*, 2017) are low in their nutrient content (Deribe, 2015). Present study result indicated those maize stover, hair coat bean straw, sugar cane top, enset leaf and pseudo-stem and bean straw were majorly used for dairy cattle in the study area. There is no significance difference between the study area (P>0.05) in major crop residue. Moreover, farmers reported that crop residues are mainly fed during feed shortage.

5.4.2 Crop residue and utilization challenges

Farmers reported that crop residues are mainly fed during the dry season. However, small amounts of crop residues are sold as an income source in current finding. This finding is in agreement with Yeshitila *et al.* (2008) who reported that of all feed resources produced, crop residues alone accounted 68.7% of livestock feed supply. According to the responses of the sampled households, the major constraints associated with crop residue utilizations for dairy cattle feeding were collection and transportation, storage, and feeding problems. About 49.3 % in the study area responded about

the presence of problems in collecting and transporting the crop residues from the farm to homes. Problems associated with storage of crop residues result mainly from improper storage practices as a consequence many residues can be wasted. In focal group discussion the respondents discussed about the contribution of crop residues as livestock feed which depends on proper collection, handling, processing, and storage. Baling of crop residues was totally unknown and stacking loose straws into heaps was the sole traditionally adopted handling and storage of the crop residues to extend their use as feed. Such a practice may lead to losses in both biomass and nutritional quality during collection, transportation, storage and feeding. Baling crop residues is not only convenient and reduces cost of transportation, but also helps to reduce the space required for storage and facilitates feed budgeting as compared to the traditional handling of crop residues in loose form (Massawe and Mruttu, 2001).

5.4.3 Hay production and its sources

Hay making for more difficult times is essential. One of the things a smallholder livestock farmer can do is to prepare enough animal feed for the dry or cold season. The current study indicated that majority of respondents (74.3%) in the study area participate in hay production. Greater number of respondents in Dale district reported producing hay compared with Wondogenet district. Private grazing land was the first sources hay production in the study area followed by cultivated land boundaries.

5.5 Improved forage production

5.5.1 Improved forage production, seed sources and common types of forages

There was relatively good adoption and availability of improved forage crops grown in the study area, the adoption rate of the forage technologies in the study area were found to be relatively better due to strong extension support and currently with rapid improved forage development. Forage development strategies such as hedges around field edges and on soil bunds, particularly on the sloping land, intercropped with the cereals and alley cropping have a chance of better acceptance by the community. According to the respondents majority of households about 65.7% planted improved forage crops, and the major sources of improved forage seeds were from government agricultural office and NGO who are working with collaboration of agricultural sectors in current study. Current finding was in line with, 58 and 67 % of dairy farmers in Nekemte and Bako towns of the western Oromia were practicing improved forage production (Diriba *et al.,* 2012) and current

finding were different Belay *et al.* (2012) reported that all households (100%) interviewed in Dandi Woreda, west shoa zone, did not cultivate improved forage species for their livestock production.

The most common available improved forages in the study area were Desho grass (20.7%), Elephant grass (19.3%), Guatemala grasses (14.3%) and Phalaris grasses (12.9%). Elephant grass, desho grass and Guatemala grass species were the most dominant forage in Dale districts whereas Desho grass, elephant grass and phalaris were the most dominant forage grass in Wondogenet district.

5.5. 2 Feeding of improved forage and challenges of production

Feeding strategy depends on the nature of the farming system, objective of rearing animals and the availability of feed resources in specific area which is to be affordable by the farmers. About 36.4% of the respondents in current study provide improved forage for lactating cows followed by calves (24.3%). There is no significance ($P>0.05$) differences between the study area on feeding of improved forage. The manner of feeding priority in the current study area has given more attention to the lactating cows, calves, oxen, heifers and pregnant cow, which is in line with the report made by Mekuanint and Girma (2017) in Gasera and Ginnir districts in Bale zone of Oromiya region. Improved forage production is believed to overcome feed shortage but is constrained by many challenges including small land holding, lack of forage seeds, and poor productivity forage species and their rain fall shortage has been encountered in current study. This findings were in line with the report (Salo *et al*., 2017) for Anelemo district and (Yadessa, 2015) Robi district, in which land was primary constraint, forage seed/planting material shortage was the secondary constraint followed by land shortage and lack of awareness. Land shortage was the major challenge of improved forage production in current study, which is supported by previous studies (Belay et al., 2011; Azage *et al.*, 2013), who reported that shortage of land was the main limiting factor to urban dairy production.

5.6 Non-conventional feed

Out of interviewed households, 83.6% practiced feeding of non-conventional feed resources. The most commonly used non-conventional feed are banana leaf and pseudo-stem, enset by products, residues of coffee and atela in their order of importance in current study area. There was a significances difference ($P<0.05$) among the districts on common types of non-conventional feeds utilization. Majority of the respondents in Dale districts used residues of coffee whereas the use of banana leaf and pseudo-stem was highly practiced in Wondogenet district. In both districts enset by

products were the second most important non-conventional feeds that have been utilized by respondents. Enset (Ensete venticosum) (pseudo-stem leaf and corm), cabbage wastes, kitchen wastes and edible leaves of other plants are also fed to animals in the study area and this is in agreement with Azage *et al.*, (2013) in Boditti.

5.7 Dairy cattle feeding practices and feeding system

5.7.1 Dairy cattle feeding plan and feeding system

Majority (72.9%) of the respondents has their own plan to feeds their dairy cattle in the study area and the can gives feeds of cattle three times per day. There was a significances difference ($P<0.05$) among the districts with the frequency of feeding their cattle. Respondents in Dale district provide three times per day whereas in Wondogenet districts they provide twice per day. This differences were due to better availability of feeds in Dale than in Wondogenet districts. The major feeding systems of dairy cattle in the study area were free grazing. This finding was in line with the reports of Asrat *et al.* (2015). Even though the major feeding systems practices for dairy cattle production in Humbo Woreda, Wolaita Zone Southern Ethiopia were free grazing, rotational grazing and zero-grazing and opposable stall feeding/ zero grazing, herded grazing and tethered grazing systems was reported by (Mengistu *et al.*, 2016). Those households with large number of livestock allow their animals to graze around the homestead or nearby communal grazing land (Fumet *et al.*, 2010). The highest percentage of farmers allowing their dairy cattle let to grazing land. In this feeding system, the farmers could not know either the daily dry matter requirement of the animals is fulfilled. Followed by free grazing large percentage of farmers practiced group feeding system and in that feeding system all age categories of animals fed together so that it is difficult for younger animals to satisfy their daily dry matter requirement as some of the animals can consume more than others.

5.7.2 Feed shortage, reasons of feed shortage and coping mechanism

All of the respondents in current study responded that there are shortages of feed for dairy cattle. The main reason for shortage of feeds was shortage of land both the study districts. Only few respondents indicated that the reasons of feed shortage were shortage of improved forage seed availability and shortages of irrigable water sources. To overcome feed shortage during critical season of the year, livestock producers in both study districts use different strategies. The coping strategies adopted by the farmers to overcome dry season feed scarcity include increasing use of crop residue followed by

purchasing concentrate feed, purchasing forage feeds/green feed while few respondents indicated reduction of livestock numbers. The main season with livestock feed deficiency in the current study area started from the end of January to the beginning of May which is in line with reports for highland of Ethiopia (Yami *et al.,* 2015). The feed shortage problem during dry seasons in the study area is related with moisture stress that resulted in low herbage growth on existing grazing land (Ashenfi *et al.,* 2013). Crop residues which are serving as the main source of roughage during dry season (Mekasha *et al*., 2014; Salo *et al*., 2017) are low in their nutrient content (Deribe, 2015). Jayasuriya (2002) reported that when smallholder farmers in developing countries faced with limited feed availability for feeding livestock they use what is locally available to them, at either no or low costs. There is a significance differences (P>0.05) in current study area in coping mechanism in dairy cattle feed shortage. Current finding was agree with the finding of Zewdie (2010), during the dry periods, 85% of the farmers around Ziway use farm produced crop residues to feed animals while in the wet season (July to August), 43% of them use rented grazing pasturelands in other areas. On the other hand, the current findings are contrary to the finding of Duguma and Janssens (2016) who reported coping strategies used by farmers in JImma zone to overcome dry season feed scarcity were increasing use of concentrate mix (87%), increasing use of conserved hay (74.13 %), increasing use of non-conventional feeds (50%), and purchasing green feeds when available (14.8 %).

5.7.3 Form of feeding crop residues and quality improvement practices

The current finding was different from Zewdie (2010), who studied at Central Rift Valley and reported, that feeding crop residues in whole (55%) and treated straw (10%). Number of practices are suggested and to some extent experimented in Ethiopia to treat crop residues to improve its palatability and digestibility. Amara *et al*. (2011) and Descheemaeker *et al*. (2011) already demonstrated that crop residues management like chopping and urea treatment improves the feed quality. Smith (1993) also listed chopping, grinding, and treatment with urea as the most appropriate methods of improving the feed value of crop residues at the smallholder level. Hence, untreated crop residues may reduce the quality of available feed for livestock. Chopping of large cereals maize, sugar cane tops, enset and banana leafs and pseudo-stems and others feeds was observed in most number of farmers (55.7%)and also soaking with water and grinding some concentrate feeds in current study area in order to improve feed quality and increasing palatability.

5.8 Water sources and watering frequency in the study area

The main sources of water in the study area were river. This results was agree in the finding of Belay *et al.*(2012) reported that in Ginchi area there are three water sources and these include rivers, streams and springs and majority of the households (98%) water their animals at river.There was no significances difference (P>0.05) water sources in the study area. Most of the respondents in the study area were practiced individual watering system followed by group watering system. There is significance difference (p<0.001) in types of watering system in the studded area.

Watering frequency of dairy cattle's was not varied from one district to the others. Most of the respondents were practices providing water to their dairy cattle once in a day. Small numbers of farmers were providing water twice per day in the study area. current finding results were disagree with findings of Belay *et al.*(2012) 52.2% of the respondents were watering their animals twice a day, 38.9% once a day and 7.8% *ad libitum*.

5.9. Quality of Available Feed Resources

5.9.1 Dry matter and ash contents of available feed resources

The DM content of the feeds available for dairy cattle feeding in both Dale and Wondo Genet districts was below 50%. Ash content of Guatemala grass, desho grass and elephant grass in current study ranged from 11.4 %, 10.2% and 9.20 % respectively. Enset leaf had the highest ash content of 13.4 % in Wondogenet districts, followed by 12.3 % in enset pseudo-stem on Wondogenet district. The ash content of leaf, pseudo-stem and root of enset (E. ventricosum) reported in this study area, respectively, were 13.2 %, 12.9% and 9.28 % which is lower than the reported value of 16.8% by Mohammed *et al.,* (2013). The ash content of natural grass pastures was 10.8% for Dale and 10.5% for Wondo Genet districts. The variation observed on ash content of native pastures could possibly be due to variation in agro ecology, difference in climate and soil types of study areas that corresponds with the report of Little (1982), who stated that the ash content of natural pastures increase as elevation in altitude decreases and such variations could possibly arise from difference in climate and soil types. However, Mekuanint and Girma (2017) reported 10.99% ash content of native grasses from dega and 9.89% from weinadega which disagreed with the statement made by Little (1982) and the results reported in the current study. The variations observed on ash contents of

different dairy cattle feeds could be associated with environmental factors of rain fall, soil character, temperature and contamination of residues by other external factors.

5.9.2 Crude protein contents of available feed resources

The highest crude protein contents were found in enset leaf (12.8%), Guatemala grass (11.8%), and elephant grass (11.0%).The lowest crud protein contents was found in sugar cane tops (5.89%) in current study area. This indicates that enset leaf had higher CP content compare to natural pasture, forage plant, and sugarcane tops. The high CP content of enset species might allow chance to protein supplements for feeds of poor quality roughages and forages. The relatively high CP content of enset leaf is in line with the values (17%) reported by Adugna *et al.,* (2012) at southern Ethiopia, which makes it a favorable feed resource in ruminant feeding. The CP content of desho grass in the study area was between (9.67%) which was lower than the earlier report of Bezabih *et al.,* (2016). The lower content of CP dairy feeds may be compensated with strategic supplementation of proteinaceous feeds to improve cattle performance. The CP content of grass obtained from natural pasture from the study area was in line with reported (9.6%) by Solomon (2004) for highlands of Bale and (12%) by Bezabih *et al*., (2016) for southern Ethiopia of Angacha district. The high fiber and low crud protein contents of the different feed resources could be related to varietal differences, location or climate, fertility of the land, stage of maturity at harvest, morphological fraction fed, method of harvesting and transporting, length and condition of storage (Archimade *et al.,* 2002).

5.9.3 NDF, ADF and ADL contents of available feed resources and IVDMD

Roughage feeds with NDF content of less than 45% are categorized as high quality, 45 to 65% as medium quality and those with more than 65% as low quality roughages (Singh and Oosting, 1992). The NDF content of grass obtained from natural pasture from the study area was 64% and can be categorized as medium quality feeds (Singh and Oosting, 1992). The NDF value of natural pasture that observed in the current study was comparable to the finding of Mengistu *et al.,* (2016) for the same study area. The NDF content of enset leaf, pseudo-stem and root was 57.3%, 60.4% and 44.7%, respectively. The NDF content of enset leaf obtained from the current study is comparable to the report of Bezabih *et al.,* (2016). The NDF content of Guatemala, desho grass and elephant grass were 61.0%, 61.2% and 60.0%, respectively. Relatively higher NDF contents were observed on sugar cane tops 64.8%. So, these results might be considered medium-quality feeds according to the statements of (Singh and Oosting, 1992; Usman *et al*. 2018).

ADF is widely used for measuring the fiber in feeds, often substituting for crude fiber, which is used in the proximate analysis of feeds. The acid soluble fraction included primarily hemicelluloses and cell wall proteins, while the residue recovers cellulose and the list digestible non carbohydrate fractions. Acid detergent has the advantage of removing substances that interfere with the estimation of refractory components so that ADF residue is useful for the sequential estimation of lignin, cut in, cellulose, indigestible Nitrogen and Silica (Van Soest, 1982). Kellems and Church (1998) categorized roughages with less than 40% ADF as high quality and above 40% as low quality. The ADF content of natural pastures in the current study was 37.0 % for Dale district and 35.0% for the Wondogenet districts areas. The overall ADF contents of current study area were 36.0%. This value was comparable to that of Yihalem (2004) and Ahmed (2006). The ADF content of enset leaf, pseudo-stem and roots was 32.0%, 33.3 and 31.5% respectively in current finding is comparable to the report of Bezabih *et al.,* (2016). The ADF content of Guatemala grass, desho grass and elephant grass was between in the range of 35.6%, 34.9% and 34.2 respectively.

ADL is completely indigestible and forms lignin-cellulose/hemicelluloses complexes (Kellems and Church, 1998) due to physical encrustation of the plant fiber and making it unavailable to microbial enzymes (McDonald *et al.,* 1995). The lignin content was high for all except for maize leaf and desho grass which is beyond the maximum level of lignin 7%, (Reed *et al.* 1988). The lignin content of natural pasture varied from 7 % in current study. The ADL value of natural pasture in the present study was comparable to earlier reported values (8.3 and 8.6%) by Zewdie (2010) and Bezabih *et al.*, (2016) respectively; while, it was higher than the previous finding of Mengistu *et al.,* (2016) for the same study area. The ADL content of enset pseudo-stem and roots in the current study was 3.20% for Dale and 3.30 % for Wondogenet districts with overall average lignin content of 3.25% and for enset root the ADL contents were 3.50% in Dale and 3.63% in Wondogenet districts with overall 3.56%. The ADL content of enset leaf (E. ventricosum) in the current study area was 3.25% and it was in line with the average ADL content of 3.26% reported by Mohammed *et al.,* (2013), however it was lower than 7% maximum lignin content to affects rumen activities and feed intake reported by (Reed et al., 1986) and average ADL content of 8.54% reported by Dereje (2009) from three enset growing regions of southern Ethiopia. Variations observed in ADL composition of enset leaf could be associated with differences in stage of growth of the enset plant, landraces (varieties) of enset plant used, method of sample taking, edaphic and agro climatic differences encountered.

The IVDMD value of natural pasture was 59.2 % in the current study area. The observed IVDMD value of natural pasture in the current study was higher than earlier reported value (57.7%) by Mengistu *et al.*, (2016) and lower than earlier reported value (66%) by Bezabih *et al.*, (2016). The IVDMD value of enset leaf, pseudo-stem and roots was 59.2%, 59.5% and 60.5% respectively. The highest digestibility coefficient was observed in desho followed by elephant grass and enset root at current study. Lower IVDMD values were observed in sugar cane tops and in natural pasture grass which is likely associated with their higher lignin content compared to the other feed resources. IVDMD of enset leaf at both districts was lower than earlier report (69.2%) of Adugna *et al.*, (2012).

6. CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

Natural pasture and crop residues and non conventional feed resources were the most important feed resources available in wet and dry seasons respectively. Shortage of feed and shortage of forage production lands were the main constraint of dairy cattle production in both districts due to intensification of crop land and over grazing. Farmers uses crop residue and purchasing concentrates feed in order to alleviate feed shortage problem for the dairy cattle. There is an availability of common grazing land in the area but it is not adequate for their animals and currently in case intensive crop production the grazing land were decreasing. Maize stover, haricot bean straw, sugarcane tops, enset pseudo-stem and leaf and plus crop residue bean straw were the major crop residues used in the study area Most of respondents practices cultivation of improved forage like Desho grass, elephant grass, Guatemala grass, phalaris grass, Rhodes grass, cow pea and pigeon pea. Agricultural government offices and NGO play a great role in the provision of improved forage seed. The commonly practiced feeding systems in the study areas were free grazing on private grazing land, natural pasture and roadsides around the village and group feeding around homestead on natural pasture stall feeding (zero grazing). Farmers adopted coping strategies with dry season feed scarcity are increased use of crop residues, purchasing of concentrates, purchasing forage/ green feed and reducing herd sized. River water, spring water and pond water were the main water sources in the study area. The highest crude protein contents were found in enset leaf (12.2%) than others feed types. The NDF content of most feed resources across districts was less than 65% and can be categorized as medium quality feeds. Except the enset corm the NDF values of feeds were above 50% across districts in the study area.

6.2. RECOMMENDATION

Based on the finding of the current study, the following recommendations are forwarded:

- In order to solve, the shortage of feed availability, farmers should practice feed conservation methods, particularly hay and silage making during excess of feed resources availability.
- Moreover, farmers should practice improved legume forage production widely on their own farm land and collect crop residues during crop harvesting times and store it under shed.
- Training should be given on effective utilization strategies of available feed resources such as use of urea treatment, nutrient block and silage making, in order to improve the quality of feed in the study area.
- Need due attention to design strategies to maximize the use of crop residues as feed than other alternative uses, such as by introduction of multipurpose trees as a source of fuel and construction wood and animal feed.
- Dairy cattle feeding practices were poor in the study area. To improve this management practices for the future, development agents and office experts of the woreda should provide intensive extension services and continuous follow-up of the management practices.
- Crop residue management and utilization options, improved forage cultivation strategies needs a special focus.

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BIOGRAPHICAL SKETCH

The author, Misahme Alemayehu was born in 1989 in Adilo zuria district Kemebata tembaro zone of SNNPR. She attends her elementary school education in Ailo town elementary, junior school and high education school.

After successfully passing EGSSLE (Ethiopian General Secondary school Leaving Examination) She joined the Haramaya University College of agriculture in October 2008 and graduate in July 2010 with Bsc in the field of Dairy and meat Technology. After her graduation She employed in Kemebata tembaro zone Adilo zuria district Livestock development office from 2011 to 2012 and there for She joined the schools of graduate studies of Hawassa University in September 2013 to 2015 purse her MSc. Study in specialization of Animal Production.

APPENDEXES

Appendex 1

Questioners

Part one: Household background

1. Name of respondent: _____Date _____

2. Sex: a) Male b) female

3. Age of the respondent _____

4. Address of the respondents

Region	1) Sidama
Zone	
District	1) Dale 2) Wondo-Genet
Kebele	1) 2) 3)

5. Land holding and land use system of the HH.

Land use type	**Area coverage in ha/(local unit)**
Area used for food crop production	
Grazing land	
Rent grazing land	
Fallow land	
Forage crop production	
Forest and wood land	
Others (specify)	
Total area of land owned by HH	

Part Two

A, Livestock production and Constraints

2. What species of livestock you are rearing and for what purpose?

No	Species of livestock	✓	Number	Purpose of keeping
1	Dairy Cattle			
	Local breed			
	Cross breed			
2	Calf			
3	Heifers			
4	Bull			

5	Sheep			
6	Goat			
7	Donkey			
8	Horse			
9	Mule			
10	Poultry			

2. Major livestock production constraints? And which season?_____

3. What are major dairy cattle feeding constraints? And which season?_____
_____

4. What do you suggest about the solution of livestock production constraints? And dairy cattle feeding constraint?_____ _

B) Feed resources and Feeding Practices

1. What are feed resources available for your animals?

Types of feeds	Wet season	Dry season	Both season
Natural pasture			
Browse trees			
Crop residue			
Hay			
Improved forage			
AIBPs			
Non-conventional feed resources :(Enset, sugarcane tops, tree leaves Etc.)			
Others(specify)			

2.Do You have any grazing area for your animals? 1) Yes 2) No

If yes, what is the status? a) Increasing Why?_____ b) Decreasing why?_____ c) No change why?_____

3. How is grazing land ownership? a) Communal b) private c) both d) others (specify) _____

4. How do you use feed resources on the pasture in your area?_____

a) Grazing b) cut and carry c) other (specify)

Natural pasture

1. What are the grass species available for animals in your area? List the names of grass spices in order of importance for livestock feed in the table below.

No	Type of species	For which animal type
1		
2		
3		

Crop residues

1. Do you have crop residue for your animals? A, Yes B, No

   If yes, list their name and land utilized for major types of food crop and amount of crop residue production?

Major types of crop

Number	Major types of crop
1	
2	
3	
4	
5	
6	

2, what are the other uses of crop residue other than animal feed?_____

3, For which animal do you feed crop residue? 1) Cattle 2) Sheep 3)Goats 4)Equines 5) Other (specify)_____

4, During which season do you fed crop residues to your animals?

1) Dry season 2)Wet season 3) Both seasons

5. What are the major challenges and suggested solutions in crop residue utilization?_____

Improved forage

1, Do you have improved forage for your animals? 1)Yes 2)No

If yes what types of improved forage? List their name _

Improved forage availability

Number	Forage type
1	
2	
3	
4	

2, who introduced these improved forage in to your area? a, government b, NGO c, other (specify)_____

3, When was it introduced into your area? Year_____ for which animal priority is given?_____

4, When improved forages are feed to animals? a, Dry season b, wet season c, Both season

5. Where do you produce improved forage? a, on farm b, backyard c, road side d, other (specify)_____

6. What are the major problems concerning with production of improved forage in your area and what are the suggested solutions?_____

Ago- industrial by products

AIBPs

Number	AIBPs		Available		Source
			Yes	No	
1	Flour mill	Wheat bran			
		Wheat short			
		Maize bran			
		Rice bran			
2	Oilseed cake	Noug seed cake			
		Linseed cake			
		Peanut seed cake			
		Sesame seed cake			
		Rape seed cake			
		Sunflower seed cake			
3	Brewer by products	Yeast			
		Brewer spent grain			
4	Traditionally distilled by products	Tell atella			
		Arake atella			
5	Sugar factory by products	Molasses			
		Bagasse			
		Sugar cane top			
6	Concentrates	Compound feed			

1, Do you have the access to any of AIBPs for your livestock? A. yes B. No if yes, which AIBPs?

2. When do you feed agro industrial by products to your animals? a. dry season b. wet season c. both season

3. What are the problems concerning with the use of AIBPs? _____

Non-conventional feed resources

1.Do you use any Non-conventional feed resources as feed for your livestock?
A) Yes b. No if yes which of them? Fill the following table

Non-conventional feed resources availability

Number	Name of non-conventional feed resources	Source	For which animal it use
1			
2			
3			
4			
5			
6			

2. What are problems concerning with non-conventional feed resources in your area? And what solution do you suggest?

_____

_____

Feed availability

1. Is enough feed available through the year? a. yes b. no

   If no in which season is the feed shortage serious?

   A)Long rainy season b. shortage rainy season c. long dry season d. short dry season

2. How do you see the amount and quality of feed available throughout the year? Circle one

   A)Same ,why?_____ b. now is better why?_____ c, decline

3. What measure do you take to tackle this situation? Rank 1st 2nd 3rd

   _____

   A)Sale of animal

   b)Migration to other place

   C) Use of fodder trees

   D). Use of crop residue and conserved feed

   E).Use of AIBPs

   F).Other(specify)

4. What do you suggest about how to tackle to or minimize the problem of animal feed shortage in your District?

_____

_____

Feeding practices of dairy cattle

1. Do you use a feeding plan for your dairy cattle? 1. Yes 2. No

2. If yes, fill the table;

Feed type	Feeding time		
	Morning and kg	After noon and kg	Evening and kg

3. If No, for Q1 why?

_____

4. Do you feed hay for your cow? 1. Yes 2. No

5. If yes, what are the predominant sources of hay and how much do you give per day?

6. What are the sources of water for your cow? _____

Water sources and watering practices of dairy cattle

1. What sources of water are available for your dairy cattle? a) River b)Spring c).Pond d).Pipe water e) Others (specify)

2. Watering frequency for dairy cattle A. Adlibutum B. Once in a day C. Twice in a day D. Three times per day

3. What type of watering system you are following while watering your dairy cattle? a) Group watering b) individual watering c) both

Appendex 2

Cheek list

Cheek list for key informant for data collection

Part one: location of the KI

Region _____ Date _____

Zone _____ district_____

Name of respondent (expert) _____ telephone_____

Administrative kebele _____

A, Livestock production constraints

1. Major livestock production constraints?_____

2. What do you suggest about the solution of livestock production constraints?_____

B, Livestock feed resources and constraints

1. What are the major livestock feed resources?_____

2. What are non conventional feed resources for dairy cattle?_____

2. Major Livestock feed resources constraints?

_____

3. What do you suggest about the solution of livestock feed resource constraints?_____

4.How do you see amount and quality of feed available throughout the year, when compared the current to that of 5 years back?_____

5. What measures will the communities are taking to tackle this situation?

_____

Cheek list for focused group discussion for data collection

Part one: composition and location of the group

Composition of the group: elders_____, youth _____women _____ model farmers_____

Location of group

Region _____

Zone _____

District _____

Administrative kebele _____

A, Livestock production

1. What are the main constraints of livestock production related with feeding practices in your area?
_____

2. How these constraints can be solved?
_____

3. What are the opportunities you have for livestock production in your area in relation to feed?_____

Feed resource

1, what are the major feed resources available for the animals in the area?
_____

2. Is enough feed available through the year?
_____

3,Do you feed non conventional feed resources to your animals? if yes list their name,_____

3. How is the seasonal availability of these feed resources during different seasons?_____

4. Which feed available at which season?

A) Long rainy season_____

b) Short rainy season_____

c) Long dry season _____

d) Short dry season_____

4,What are the grass species available for animals in your area? List the names of grass spices in order of importance for livestock
feed._____

5. Which crop residues do you use as animal feed in your area and to which animal do you give priority? Name and
rank_____

6. Do you feed your animals any improved forage? A) Yes b) No If yes, which types of improved forage? Name and rank .if no why? Is it available for all HHs? Which animal gets priority?_____

7. Are there any agro industrial by products which you use for animal feed in your area? A) Yes b) no if yes, which type of agro industrial by products? Name and rank .if no why?
_____

8. What are the other feed resources available in your area other than those mentioned above? List their name?
_____

9. Is there a period of critical feed shortage in the area? If yes mention the
months._____

10. What is the role of government and other stake holders to tackle this
situation?_____