



**ASSESSMENTS OF DAIRY CATTLE PRODUCTIVE AND REPRODUCTIVE
PERFORMANCES, AND THE MAJOR FEED RESOURCES AVAILABLE AT
DIFFRENT AGRO- ECOLOGIES OF MESKAN DISTRICT, EAST GURAGE
ZONE, CENTERAL ETHIOPIA**

MSc. THESIS

BY

ADEM REDI SIRMOLO

**February, 2025
Wolkite, Ethiopia**



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By

ADEM REDI SIRMOLO

**ATHESIS SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCE
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Wolkite, Ethiopia

WOLKITE UNIVERSITY
SCHOOL OF GRADUATE STUDIES
ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled **“ASSESSMENTS OF DAIRY CATTLE PRODUCTIVE AND REPRODUCTIVE PERFORMANCES, AND THE MAJOR FEED RESOURCES AVAILABLE AT DIFFERENT AGRO ECOLOGIES OF MESKAN DISTRICT, EAST GURAGE ZONE, CENTRAL ETHIOPIA”** submitted in partial fulfillment of the requirements for the degree of Master's with specialization in Animal Production, the Graduate Program of the Department of Animal Science and has been carried out by Adem Redi, ID.AGPGR/004/14, under my/our supervision. Therefore I/we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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Final approval and acceptance of the Thesis are contingent upon the submission of the final copy to the Council of Graduate Studies through the school/department graduate committee of the candidate’s major school/department.

DEDICATION

I dedicate this thesis manuscript to my beloved father Ato Redi Sirmolo for his proper guidance, nursing me with love and sacrifice he paid in the success of my life.

STATEMENT OF THE AUTHOR /DECLARATION

I declare that this thesis is my bonafide work and that all sources of materials used for the thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirement for MSc degree at Wolkite University and is deposited at the University Library to be made available to borrowers under rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHICAL SKETCH

The author Adem Redi was born in 1987 at Butajira town of Gurage Zone, Southern Ethiopia. He attended his elementary and secondary school at Butajira Junior Secondary and High Schools. He joined Haramaya university in 2007 and graduated with Bachelor of Science Degree in animal production in 2009.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Acid Detergent Fiber
ADL	Acid Detergent Lignin
AFC	Age at First Calving
AFS	Age at First Service
AI	Artificial Insemination
AOAC	Association of Official Agricultural Chemists
CCI	Calving-to-Conception interval
CI	Calving Interval
CP	Crude Protein
CSA	Central Statistics Agency
DA	Development Agent
DCP	Digestible Crude Protein
DM	Dry Matter
DO	Days Open.
EE	Ether Extract
FAO	Food and Agricultural Organization of the United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GL	Grazing land
HH	House hold
IBP	Industrial By- Products
IVDMD	In Vitro Dry Matter Digestibility
IVOMD	In vitro Organic Matter Digestible
LSD	Lump Skin Disease
MDADO	Meskan District Agricultural Development Office
ME	Metabolizable Energy
MAFF	Ministry of Agriculture, Fisheries and Food
NRC	National Research Council
NDF	Neutral Detergent Fiber

NM	Natural Mating
N	Nitrogen
PA	Peasant Association
SNNPRS	Southern Nations Nationalities and Peoples Regions
SPSS	Statistical Package for Social Sciences
TDM	Total Dry Matter
TLU	Tropical Livestock Unit

Table of Contents

.....	i
DEDICATION	iv
BIOGRAPHICAL SKETCH	vi
ACKNOWLEDGEMENTS	vii
LIST OF ABBREVIATIONS AND ACRONYMS	Error! Bookmark not defined.
LIST OF TABLE	xiii
LIST OF FIGURES	xiv
LIST OF APPENDIX TABLE	xv
LIST OF APPENDIX FIGURE.....	xvi
ABSTRACT.....	xvii
1 INTRODUCTION	1
1.1. Background.....	1
1.2. Statements of the Problem	3
1.3 General Objective was	3
2. LITRATURE REVIEW	4
2.1. Dairy Production Systems in Ethiopia.....	4
2.1.1. Rural Smallholder Dairy Farming.....	4
2.1.2. Peri-Urban Dairy Production System.....	6
2.1.3. Urban Dairy Production System	6
2.2. Landholding and Land Use System	7
2.3. Cattle Holding.....	8
2.4. Productive and Reproductive Performance of Cow.....	9
2.4.1. Age at first calving.....	10
2.4.2. Calving interval.....	10
2.4.3. Lactation length and milk yield.....	11
2.4.4. Days open.....	11
2.4. Milk Processing in Ethiopia.....	12
2.5. Dairy Cattle Production Constraints in Ethiopia.....	13
2.5.1 Inadequate animal feed resources	14
2.5.2. Cattle breeds.....	15
2.5.3. Animal health problems	15

2.5.4. Reproductive problems	16
2.6. Feed Resources	16
2.7. Nutrient Requirement of Cattle	17
3. MATERIALS AND METHODS	18
3.1 Description of Study Area.....	18
3.2. Sampling Techniques and Sample Size Determination	19
3.3. Sources of Data and Methods of Data Collection	20
3.4. Estimated Annual Feed Supply	21
3.5. Estimated Annual Feed Requirement	22
3.6. Chemical Analysis of Feed Samples.....	22
3.7. Data-Analysis for Survey Study	23
4. RESULTS	25
4.1. Household Characteristics.....	25
4.2. Landholding and Land Use System	27
4.3. Crop Yield and Crop Residue Estimation	28
4.4. Livestock Population and Herd Structure	29
4.5. Cattle Population and Structure	45
4.6. Trends of Cattle Population in the Past One Decade in the District	46
4.7. Purpose of Dairy Cattle Keeping	47
4.8. Labor Division per Household for Dairy Cattle Related Activities	48
4.9. Productive and Reproductive Performance of dairy Cow.....	49
4.9.1. Daily Milk Yield	49
4.9.2. Lactation Length	49
4.9.3. Age at First Service.....	50
4.9.4. Age at First Calving	50
4.9.5. Calving Interval.....	50
4.10. Constraints of Dairy Cattle Production	51
4.10.1. Shortage of Animal Feed	46
4.10.2. High Cost of Animal Feed	46
4.10.3. Poor Genetic Potential of Indigenous Breeds	46
4.10.4. Animal Disease	48
4.11. Dairy Cattle Management	48
4.11.1. Types of Livestock Feeds and Feeding System	48

4.11.2. Feed Conservation Practice.....	49
4.11.3. Chemical composition and nutritive value of feeds	50
4.11.4. Estimated Annual Feed Supply, Demand and Balance.....	52
5. DISCUSSIONS	54
5.1. Demographic Characteristics of Households	54
5.2. Landholding and Land Use System	55
5.3. Livestock Population and Herd Structure	55
5.4. Purpose of Dairy Cattle Keeping	56
5.5. Labor Division towards Cattle Production.....	56
5.6. Reproductive and Productive Performance.....	57
5.7. Constraints of Dairy Cattle Production	58
5.8. Dairy Cattle Management	59
5.8.1. Types of livestock feed resources and feeding systems.....	59
5.9. Chemical Composition and Nutritive Value of Feeds	60
5.10. Estimated Annual Feed Balance	63
6.CONCLUSION AND RECOMMENDATION.....	65
6.1. Conclusion	65
6.2. Recommendation	66
8. REFERENCES.....	67
9. APPEDICES	82

LIST OF TABLE

Table 1 Major Production System of HHs in the study area of Meskan district East Gurage zone	Error! Bookmark not defined.
Table 2 Demographic characteristics of HHs in the study area of Meskan district East Gurage zone.....	26
Table 3 Average landholding/HH and land use pattern in the study area of Meskan district	27
Table 4. Annual field crops yield and crop residues in tons per HHs in the study area of Meskan district in East Gurage zone.	28
Table 5. Number of livestock population in the study area of Meskan district in East Gurage zone	29
Table 6. Livestock size in number and TLU in the study area of Meskan district in East Gurage zone.....	30
Table 7. Cattle size and structure (Mean \pm SE)/HH in the study area of Meskan district East Gurage zone	45
Table 8. Purpose of dairy cattle rearing in the study area of Meskan district East Gurage zone .	47
Table 9 Labor division the house hold in the study area of Meskan district East Gurage zone ...	48
Table 10 Productive and reproductive performances of cattle in study areas of Meskan district East Gurage zone.	51
Table 11 Constraints of dairy cattle production in the Meskan district of East Gurage zone	47
Table 12 Animal disease and veterinary service in the Meskan district of East Gurage zone	48
Table 13; Major livestock feed resource and feeding system in the Meskan district of East Gurage zone	49
Table 14 Chemical composition and nutritive value of feed stuffs in study area of Meskan district East Gurage zone	52
Table 15. Estimated annual nutrient supply of feed stuffs in highland and midaltitude agro ecology in the study area of Meskan district in East Gurage zone.	53
Table 16 Estimated annual nutrient supply, requirement and balance of animals in the study area of Meskan district East Gurage zone	54

LIST OF FIGURES

Figure 1 Location map of selected study area-----19

Figure 2 Trends of high land and midland Cattle population in Meskan district East Gurage zone the past one decad-----

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LIST OF APPENDIX TABLE

Appendix Table 1: Conversion factors of livestock number to tropical livestock unit (TLU).....	82
Appendix Table 2: Total daily nutrient requirement of livestock per livestock species	82

LIST OF APPENDIX FIGURE

Appendix Figure 1 Feed conservation methods in midland area of Meskan district-----	83
Appendix Figure 2, conservation methods in midland area of Meskan district-----	84
Appendix Figure 3 Hausing and feeding of dairy cattle in Meskan district East Gurage zone---	84

ABSTRACT

The objective of this study was to assess the productive and reproductive performance dairy cattle, and availability of major feed resources at different agro ecologies of Meskan district, east gurgage zone, central Ethiopia. The kebeles of the district were stratified into two agro-ecological zones and representative kebeles were selected from the two agro-ecologies. A total of 376 sampled respondents were selected purposively and data were collected by using semi-structure questionnaire interview, focus group discussion, and personal observation. The result of the study showed that the dairy production system in the district was a mixed crop-livestock production system. The overall family size per household was 6.72 ± 0.20 , the average cattle population per household was 7.17 ± 0.3 heads (6.84 TLU), and the overall land holding was 1.29 ± 0.325 ha per household in this study. About 64.1% and 35.9% of households in the study areas indicated that the producing milk and milk products were used for consumption and sale, respectively. In the highland agroecology of the study areas, the major feed resources of cattle were crop residue, natural pasture, IBP, enset leaf, and leaf midribs, while it was natural pasture, crop residue, IBP, and maize Stover in midland agroecology. Annual feed supply in the district satisfies 68.9%, 79.7% TDM, 44.83%, 39.36% TDCP, and 69.46%, 83.25% TME of the maintenance requirement of livestock in TLU per year in highland and midland agroecologies, respectively. Major dairy cattle constraints are shortage of feed, poor genetic potential of indigenous breed, high-cost feed, inadequate extension and training service, limitation of AI technicians, Nitrogen and Bull semen, animal disease, reproduction problem and shortage of manpower. The major cattle diseases observed in the district were parasites, mastitis, black leg, lumpy skin disease, and anthrax. It could be concluded that, due to poor husbandry practices, the productive and reproductive performance of local cows was low. Therefore, different intervention strategies are needed to improve the husbandry practices, mainly to improve the feed resource available and the indigenous breed through crossbreeding to increase the milk production and productivity. Cattle feed deficit was a serious problem and needs strong intervention and attention by the concerned bodies.

Key words: Chemical composition, Constraints, Feed resources, Tropical livestock unit

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1 INTRODUCTION

1.1. Background

Ethiopia has the largest livestock population in Africa that possesses 70.3 million cattle, 42.9 million sheep, 52.5 million goats and 8.1 million camels (CSA, 2021). The livestock sector in the country contributes about 45% of the agricultural GDP, 18.7% of the total national GDP, 30% of agricultural employment and 16–19% of the total foreign exchange earnings of the country (Behnke and Metaferia 2011). In Ethiopia, dairy production depends mainly on indigenous livestock genetic resources of cattle, camels and goats. Cattle are the largest contributors to the total national annual milk output, followed by camels (CSA, 2021). Livestock products and by-products like meat, milk, honey, eggs, cheese, and butter etc. are desirable animal protein that contributes to the improvement of nutritional status of people. Livestock also plays an important role in providing export commodities, such as live animals, hides, and skins to earn foreign exchanges to the country (CSA, 2020).

The livelihoods of about 80% of rural population have depended on livestock production (Metaferia *et al.*, 2011). From the total cattle population reported by CSA (2021), female cattle constitute about 56% and the remaining 44% were male cattle. From those female cattle population, about 15.04 million were milking cows yielding about 4.96 billion liters milk/year and accordingly, an average production of milk/day/cow was about 1.482 liters through seven months of lactation period. About 97.4% of the total cattle populations in the country were local breeds and the remaining 2.3% hybrid and 0.31% exotic breeds (CSA, 2020).

Cattle production plays an important role in the economies and livelihoods of smallholder farmers and pastoralists. It provides significant nutritional supplement to rural society of vulnerable groups, increase flexibility of smallholder households in the face of food crisis, and help to maintain traditional social safety nets. Dairy production is an important and potential component of livestock farming in Ethiopia due to having large population of dairy cattle, conducive and diversified agro-ecology for dairying, particularly the mixed crop-livestock production systems in the highlands, a huge potential for production of high-quality feeds, increasing demand for dairy products in urban and peri-urban areas, long-standing culture of

dairy product consumption (Bernabas *et al.*, 2018). However, there are a number of bottle neck problems including shortage of grazing land and feed, diseases prevalence, inadequate veterinary service, shortage of land for cultivation of improved forage, low genetic performance of indigenous cattle, inadequacy of artificial insemination (AI) and bull services for genetic improvement, weak extension services and climate change are major constraints affecting milk production potential of dairy cattle in most parts of Ethiopia (Andualem, 2015; Ayeneshet *et al.*, 2017). Consequently, the per capita milk consumption has declined from 26 liters/annum in 1980, to 22 liters in 1993, 19 liters in 2000 and 16 liters in 2009. This was likely to be attributed to the unbalanced growth rate of milk production and human population (Zelalem *et al.*, 2011). This was much lower than African and World per capita averages of 27 kg/year and 100 kg/year, respectively, (Sale *et al.*, 2018). Dairy cows offer an important source of cash income, calories and key nutrients, and mitigate the effects of often large seasonal fluctuations in availability of cereals through milk production (Aynalem *et al.*, 2011; Kebede *et al.*, 2017 and Kasa *et al.*, 2018). Milk is a good source of dietary fat, energy, protein and other nutrients in general and provides substantial amounts of nutrients such as calcium, magnesium, selenium, zinc, riboflavin B3 vitamin B12 and pantothenic acid particularly (Azage *et al.*, 2013; Ayalew, 2017 and Kiros *et al.*, 2018).

In order to maximize the production of milk and milk products, assessing the production and reproduction practices of households is crucial to intervene and bringing improvement (Yetera *et al.*, 2018). Understanding of dairy cattle husbandry practices helps to design appropriate technologies, which are compatible with the existing system, to plan development and research activities and bring improvements in productivity (Hirpha and Amanuel 2018). Productive and reproductive traits are essential factors in determining the profitability of dairy production. The way incorporated calving interval, daily milk yield, lactation length and age at first calving are some of the major numerous measures of production and reproductive performance parameters for dairy cattle production. However, there is limited information regarding to reproductive and productive performance of local cattle in Ethiopia (Habtamu, *et al.*, 2018).

1.2. Statements of the Problem

The milk production obtained from dairy cows is still under expectation throughout the country (Hailu *et al.*, 2012, Ayeneshet *et al.*, 2018 and Alemu, 2019). In order to identify the major factors that affecting the efficiency of dairy cows, investigation of all aspects of management practices under small holders production systems is very crucial task (Azage *et al.*, 2013; Belay and Janssens, 2016; Mebratu *et al.* , 2018). Therefore, need arise to assess and explore the reproductive performance of dairy cows under smallholders within the rural, peri-urban and urban dairy production systems (Dejene, 2014; Ayeneshet *et al.*, 2018, Ayalew, 2017 and Alemu, 2019). Meskan District of Gurage Zone, where the study was conducted, is endowed with large number dairy cattle population and diversified agro-ecological zones as elsewhere in the country. However, smallholder farmers who have been engaged in dairy production are not benefitted from the sector. It is impossible to design improvement strategies on dairy production systems and management practices without understanding the nature of dairy production and reproductive performance of dairy cows, and the feed resource quality and availability of the study area, which is one of the critical challenge to boost the dairy cow productivity. However, there was no detailed and well-organized information related to dairy production and reproductive performace of dairy cows, and the feed resource quality and availability in the study area.

Thus, this study aimed to generate baseline information on dairy production and reproductive potential of dairy cows, and the feed resource quality and availability that could be helpful to design appropriate strategy by stakeholder and intervene accordingly.

1.3 General Objective was

To investigate the productive and reproductive performances of dairy cattle, and major feed resources availablility in the study area

1.3.1 Specific objectives were:

1. To assess the production and reproductive performance of dairy cattle production in the study area.
2. To assess available feed resources and determine feed balance on dry matter basis.

2. LITRATURE REVIEW

2.1.Dairy Production Systems in Ethiopia

In Ethiopia, dairy production is one of the subsectors of livestock production that contributes to the live of the owners through important sources of food and income; even though dairying has not been fully exploited and promoted in the country (Beyene *et al.*, 2015). Like most dairy production systems found in the tropics, the Ethiopia dairy production system includes large number from small to large sized and subsistence to market oriented farms (Bereda *et al.*, 2014)

Dairy production is practiced almost all over Ethiopia. Most classifications of dairy cattle production systems in Ethiopia are based on the degree of integration of livestock production with crop production, level of inputs and intensity of production, agro ecology and market orientation. Dairy production systems in Ethiopia have been classified in to five pastoral, agro-pastoral, mixed crop-livestock farming, peri-urban and urban dairying (Mengistu, 2021). The three system of (pastoral, agro-pastoral and highland mixed smallholder production system) are contributing about 98%, while the urban and peri-urban dairy farms produce only 2% of the total milk production of the country (Mebrate *et al.*, 2019).

Based on climate, land holding size, management practices (feed sources and feeding system, watering, breeding and health care), breed types and size, land use type, objective of rearing animal, location, and the scale of market situation, production intensity, and overall inputs supply as classification criteria. On the other hand, the dairy production system is categorized into three major production systems in Ethiopia including (Sintayehu *et al.*, 2008; Tadesse and Mengistie, 2016), rural dairy production systems, urban and peri-urban dairy production systems.

2.1.1. Rural Smallholder Dairy Farming

Most dairy farmers in Ethiopia are widely dispersed in rural areas while majority of dairy markets are in urban areas. Due to highly perishable nature of dairy products and its potential to transmit zoonotic disease and other pathogens and toxins, it is difficult for dairy farmers to exchange in urban markets (Bekuma *et al.*, 2018). Thus, a whole chain approach is basically needed, which includes education of consumers. Unless milk and milk products find a market

outlet, they are retained for household consumption and the level of production is kept low (Seifu and Tassew, 2014). Over 85% of the milk produced by rural households is consumed within the producer households with the proportion marketed being less than 7% (Bereda *et al.*, 2014). From the total national milk production, 97 % from rural milk production system which is produced by smallholders. The rural milk production system is highly reliant on the low productivity of the indigenous zebu cattle breeds that can produce 400–680 liters of milk per cow per lactation period. Pastoralists, agro-pastoralists and mixed crop-livestock producers are grouped under the rural dairy cattle production system (Gebresellasie, 2019).

According to Merema (2020), breeding system undertaken in the rural production dairy production system is mainly focused on natural mating practice. About 6% fresh milk is sold to neighbor hoods and the remaining 94% is either home consumed or processed into butter, local cheese (*ayib*) and whey of which 20% is sold. This indicates that fresh milk and butter sales contribution under rural dairy is not a priority; however, their nutritional contribution to households could be of considerable importance (Ayalew, 2017).

Pastoral milk production system is one of the major systems of milk production, practiced in the lowland region of Ethiopia where the livelihood of the semi-nomadic transhumance population is dependent on their stock. Pastoralism is a system mainly practiced in the rangelands where the peoples involved follow animal-based lifestyles, which requires them to move from place to place seasonally based on feed and water availability. It is a mechanism found in the rangeland areas with relatively large size of animals characterized by the use of livestock grazing and the main aim of management of livestock in a pastoral system is to minimize risk (Mengistu, 2021). Pastoralist's main income-generating mechanism and food depend on livestock and livestock products and their accumulated wealth is saving in the form of live animals (Abdulkadir, 2019).

In the mixed crop-livestock systems of the Ethiopian highlands and mid-altitudes, livestock production is subordinate, but economically complementary to crop production. In this agro-ecological zone, livestock, especially cattle, provide traction, which is a vital contribution to the overall farm labor requirement. Within the integrated crop-livestock production systems, animals play a particular vital role, the extent of which is dependent on the type of production system, animal species and scale of the operation (Belete *et al.*, 2010). Particularly highland mixed crop-

livestock farming system of Ethiopia support 2/3 of the livestock population and hold about 95% of the cropped area. It is estimated that the highlands contain nearly 75 to 80% of the national cattle and sheep, and 30% of the national goat flock (Zinash *et al.*, 2001).

2.1.2. Peri-Urban Dairy Production System

Peri-urban system is largely found in the highlands where mixed-crop livestock-farming is practiced as well as within urban centers. This system is located around major cities and towns. It comprises of small sized to medium dairy farms which are also capable of keeping improved and local dairy stock, and the cattle are housed in improved shelters made of locally available materials (Ayalew, 2017). The main feed resources are agro-industrial by-products, purchased roughage and crop residue and pasture land. Dairy processors and most milk collecting cooperatives are located in this system. Milk producers are commercially oriented and respond to improved best practices, technology, input supply, and marketing services, if available, especially when a milk market is secured (Makoni *et al.*, 2013).

The peri-urban dairy cattle production systems are mainly located at the edge of the town areas which have comparatively better access to urban centers in which dairy cattle products are extremely wanted (Tegegne *et al.*, 2013). This production system is categorized as semi-intensive crop-livestock farming system. Because of steadily increasing demand in milk consumption, peri-urban dairy farms are growing around cities and towns (Galmessa *et al.*, 2013). Most of the dairy cattle producers depend on hybrid cows and they practiced supplementary concentrate feeding (Gebresellasie, 2019). It possesses animal types ranging from 50% crosses to high grade Friesian in small to large sized farms, and contributed only 2% of the total milk production of in Ethiopia. This sector owns most of the country's improved dairy stock (Gobena, 2016). As related to the rural dairy cattle production system, peri-urban dairy cattle production systems is typically located along roads within reasonable distance to urban centers and keepers are involved in fluid milk market (Nigatu *et al.*, 2012).

2.1.3. Urban Dairy Production System

In most towns of Ethiopia, the urban dairy cattle production systems are practiced with little or no land resources for the production and sale of milk. It is the most market oriented dairy cattle production system compared to other production systems (Bekele *et al.*, 2015). Urban areas

producers use crossbred, as well as high grade, dairy animals. However, only 1% of the dairy cattle from the total population of dairy cattle of the country are kept under urban dairy cattle production system (Gezu and Zelalem, 2018). Cattle are housed in improved shelters made of locally available materials. Concentrates, roughages and non-conventional feeds are the main feed resources which are used in urban dairy cattle production system. Moreover, road side grazing, fruits of plants and wastes also used in urban dairy cattle production system (Gurmessa *et al.*, 2015).

Under the use of intensive management system urban dairy cattle production systems has better access to inputs and services providing by the public and private sectors as compared to other dairy cattle production systems (Gebresellasi, 2019, Gobena, 2016). They have also access to animal health services, use more intensive systems. Milk is sold to consumers and processing plants through informal market. But milk supply is low due small number of dairy cattle population kept under this system (Gurmessa *et al.*, 2015). Generally, the urban and peri-urban dairy cattle production systems use improved dairy cattle or hybrid cows with relatively better management, purchased and conserved feed and stall-feeding. As a result cows shows the better performance and highly profitable as compared to other systems (Gebresellasi, 2019)

The urban dairy production system is located in and around the major cities in the different agro-ecology of Ethiopia mainly in areas with high demand for milk and milk product (Mengistu, 2021). The types of feed commonly used in this production system include purchased concentrates, agro-industrial by-products and roughages of conventional and non-conventional sources such as atela (by product of local beverages). In addition to these, different fruits, wastes and road side grazing was also used (Asrat *et al.*, 2016). The urban dairy production system is developed in towns located mostly in the highlands of Ethiopia. It comprises medium to large sized dairy farms which are capable of keeping improved dairy herds (Azage *et al.*, 2013).

2.2.Landholding and Land Use System

The land is a key resource for dairy farming activity in the mixed crop-livestock system of the central highlands of Ethiopia. While land size per household and communal grazing land have been decreasing due to population growth and expansion of urbanization further indicated that

land scarcity as one of the main constraints for dairy farmers in the central highlands of Ethiopia (Admasu, 2020).

Most farms in Ethiopia are fragmented and smallholder mixed crop–livestock systems are interdependent. Increasing human population coupled with diminishing land resources have aggravated the increment of urbanization as well as a number of landless people to produce their subsistence mostly in the highland areas of Ethiopia where mixed crop-livestock farming is practiced (Kebreab *et al.*, 2005). In the high land, the number of populations is more densely; as a result, the ratio of farm size to household is small. Across the production system, land holding higher in rural low land dairy production system, moderate in rural high land system, but limited to small back yard in Urban Dairy system as Reported by Azage *et al.* (2013).

The land is a key resource for dairy farming activity in the mixed crop-livestock system of the central highlands of Ethiopia. While land size per household and communal grazing land have been decreasing due to population growth and expansion of urbanization. The average landholding per household 0.9 hectares(ha) reported by Abebe (2014) in *Ezha* Districts of the *Gurage Zone*, Southern Ethiopia was lower than the national average value 1.6 ha and 1.4ha reported by Tahir *et al.* (2018) in North Shoa Zone of central highlands of Ethiopia.

2.3.Cattle Holding

Cattle ownership varies depending on the type of production system, wealth status and the overall farm production objectives (Kiros, 2019). The average cattle herd size per household for smallholder farmers were 4.7 cattle in Central highlands of Ethiopia (Abebe *et al.*, 2017), 5.74 cattle around Wolaita Zone, Southern Ethiopia (Zereu and Lijalem, 2016), 4 cattle at Akaki and Lemu, Central Ethiopia (Bayush, 2008), 4.87 cattle in Gurage Zone Southern Ethiopia (Dirsha, 2019) and 8 cattle in Mekelle City (Nigussie, 2006). Cattle holding differ markedly due to differences in resource endowments, climate, human population, disease incidences, level of economic development, research support and government economic policies (Seid and Berhan, 2014).

Cattle are an important component of nearly all farming systems in Ethiopia and provide draught power, milk, meat, manure, hides and serve as a capital asset against risk. In addition, cattle are

important source of cash income and play an important role in ensuring food security and alleviating poverty (Ehui *et al.*, 2002). In both crop-livestock and agro-pastoral systems traction ranked highest, followed by milk and reproduction/breeding. Manure production is also considered important by most crop/livestock and agro-pastoralist farmers, but as secondary rather than a primary purpose. On the other hand, cattle manure in *enset* production system of Gurage area plays a critical role in maintaining soil fertility and agricultural sustainability.

In this low input farming systems, the primary purpose of cattle production was based on the production of and in this area from a total of manure produced almost all (100%) was used for fertilizing farm lands including *enset*, vegetable crops, chat, coffee and fruits. There is a prudent interaction between *enset* and cattle in *enset* farming areas particularly in Gurage zone southern Ethiopia where *enset* serves as a source of fodder for cattle and cattle provide manure to fertilize *enset* fields. Limiting the number of cattle per household also limits the availability of manure to fertilize the *enset* plant and decreases in cattle manure causes reductions in the long-term sustainability of *enset* systems (Dirsha, 2019).

2.4. Productive and Reproductive Performance of Cow

Productive and reproductive performance is a biologically crucial phenomenon associated with traits of outstanding importance in dairy cattle enterprises which determine the efficiency of animal products and productivities (Haileyesus, 2008). The traits such as milk yield and lactation length, age at first service, age at first calving, calving interval, number of services per conception, and survival of dairy cows can be combined to provide a selection for longevity with maintaining acceptable levels of milk production (Kassu, 2016). Economic losses because of poor fertility can be attributed to the cost of prolonged calving interval, increased insemination costs, reduced returns from calves born and forced replacements in the event of culling. A delay in conception because of poor fertility increases calving interval mostly due to the increase in the number of days from calving to conception (Nishida *et al.*, 2006).

2.3. 1. Age at First Service

Age at first service (AFS) is the age at which heifers attain body condition and sexual maturity for accepting service for the first time. It influences both the productive and reproductive life of

the female through its effect on her lifetime calf crop. The average age at first service of local cattle was 42.61 ± 2.82 months reported in selected districts of the Sidama zone, Southern Ethiopia (Nibret, 2012) and 33.51 ± 0.70 months as reported by Ayalew and Feyisa (2017) in Gurage zone, south west Ethiopia.

2.4.1. Age at first calving

Age at first calving (AFC) marks the beginning of the cow's reproductive life and is closely related to generation interval. Age at first calving is affected by factors such as breed, nutritional status and management differences of dairy cows (Ayalew *et al.* 2018). However, in traditional production systems, breeding is often uncontrolled and heifers are bred at the first opportunity and this frequently results in longer subsequent calving intervals. Early age at first calving is an important economic character of dairy cows as it increases the margin of profit by increasing life time production (Levi Mgeni, 2010). Age at first calving has been reported to be 35.1 to 53 months in different Ethiopian breeds and 29.8 months in cross breed cows in central high lands of Ethiopia (Kassa, 2019).

2.4.2. Calving interval

Calving interval (CI) is the period of time between successive calving. In order to maintain optimum economic benefits under modern intensive dairy systems, it is generally accepted that the calving interval should be around one year. However, in many traditional production systems it is common to see cow calving only once every 2 years (Kassa, 2019). Longer calving interval affects overall lifetime production and reproduction performance through reduced milk production and fewer numbers of calves being born. It is a function of calving to conception interval or days open, which is considered to be the most important component determining the length of calving interval, and gestation length (Dayani, *et al.*, 2013).

Calving interval of local breeds (611.92 ± 2.0 days) of cows was greater than the calving interval of crossbreed cows (525.08 ± 1.7 days). The overall mean of calving interval for local dairy cows in *Ezha* Districts of the *Gurage* Zone, Southern Ethiopia found to be 24 months (Abebe *et al.* 2014). The length of calving interval decreased by better feeding, heat detection or time of insemination and management of cows is essential (Amare and Zeleke, 2018). Calving interval has two components: 1) calving-to-conception interval (CCI) or days open, which is considered

to be the most important component in determining the length of the calving interval, and 2) gestation length, which is more or less constant, varying slightly due to breed, calf sex, litter size, dam age, year and month of calving, and little can be done to significantly manipulate the gestation length (Ayalew *et al.* 2018).

2.4.3. Lactation length and milk yield

Milk production is affected by genetic and environmental factors. Among the environmental factors, the quantity and quality of available feed resources are the major ones. Inadequate level of nutrition has been found to be the most important factor influencing length of postpartum an estrus in cows grazing tropical pasture lands (Zewdie, 2010). The indigenous breeds of cows are considered as low milk producers. According to the report of Beriso *et al.*, (2015) 2.04, 1.78, and 0.54 liters in first, second and third lactation, respectively with overall mean of 1.45 liters of milk, for lactation length (LL) of 9.93 ± 0.2 months in Aleta Chukko district were recorded. On the other hand, the estimated daily milk yield and lactation length for local zebu cows, respectively, reported include: 1.0 kg/day/cow and 285 days for Arsi zebu breed (Lemma *et al.*, 2005), 2.1 kg/day/cow and 264 days for Sheko breed in Bench Maji zone (Stein *et al.*, 2006) and 1.7 liters /day/cow and 7.90 ± 0.08 months lactation length for Guraghe highland cows (Ayalew and Feyisa, 2017).

The estimated daily milk yield and lactation length for crossbred cows, respectively, reported include: 7.3 kg/day/cow and 342 days for Holstein Friesian- Boran crosses in the Highlands of Ethiopia (Demeke *et al.*, 2000), 8.9 kg/day/cow and 296 days for crossbred cows in urban and peri-urban areas of Addis Ababa (Yoseph *et al.*, 2003) and 7.8 kg/day/cow and 336 days for crossbred cows in urban and peri-urban areas of North Western Highlands (Yitaye, 2008). In most dairy units, a lactation length of 305 days (10 months) is commonly accepted as a standard. Various factors contributed to variations in the milk yield of cows which include feeding systems, breed, calving season, parity number, and effects of the location (Mengistu, 2021).

2.4.4. Days open

Days open, the number of days between calving to conception, influences profitability of the dairy industry. The average length of days open reported for crossbred dairy cows in Ethiopia was 85.6 to 197 days (Belay *et al.*, 2012b). Days open, influences profitability of the dairy

industry. This influence is partly attributed to factors such as increased breeding cost, increased risk of culling and replacement costs, and reduced milk production (DeVries and Risco, 2005). Days open should not exceed 80 to 85 days, if a calving interval of 12 months is to be achieved. This requires re-establishment of ovarian activity soon after calving and high conception rates (Kefena, 2004). Nutritional deficiencies coupled with heavy internal and external parasite load under extensive management systems, and allowing calves to suckle their dams may all interfere with ovarian function, thereby prolonging the days open. Cows that are over conditioned at calving or those that lose excess body weight are more likely to have a prolonged interval to first estrus, which could result in longer days open (James, 2006).

2.4. Milk Processing in Ethiopia

Traditional milk processing in Ethiopia based on ergo (fermented milk), without any additional culture, and this practices in the country is basically limited to smallholder level and hygienic qualities of products are generally poor. Small holder dairy producers follow traditional milk processing systems. Different studies from Bahir Dar Zuria and Mecha areas showed that they prefer processed milk products to raw milk because processed products diversify their diets and generate income, while in Jimma study areas result revealed that, majority (72%) of the milk is processed during fasting periods aiming on extending the shelf-life of milk by converting to milk products (Eyassu and Asaminew, 2014 and Kefyalew *et al.*, 2016).

According to Sintayehu *et al.*, (2008) in the urban dairy production system about 54.5% of household practiced the churning of surplus milk but not the rest household. In mixed production system 66% of household churn all the milk and 37.3% did it intermittently, some others did not churn at all. The procedure for making butter for the traditional Ethiopian practice is, to accumulate the milk for two to three days until it is sour. A clay pot is then used to churn the sour milk. The churning operation started after stirring the content and transferring to another smoked clay pot. The clay pot is agitated until butter grains are formed. The developed gas is released every 2-3 minutes by opening the top of the churn during the first 10-15 minutes of the churning operation. The churning operation, a back-and-forth movement, is manually performed in a traditional way. The buttermilk remaining after the butter has been separated from the whole milk is used to produce a cottage type cheese (ayib) by heating the buttermilk (Belete, 2006).

According to Dirsha (2019), small holder farmers in Gurage zone southern Ethiopia used different utensils for milking, storage and processing (plastic jar for milking, while clay pot was used for churning and storage of milk until the desired volume is collected). He also reported that all the producers in the study areas practiced the cleaning of milking and milk storage utensils mostly using hot water; the utensils were smoked with woody plants having good aroma such as Weyira (*Olea africana*). The major milk products produced in Gurage zone southern Ethiopia were Ergo (Ethiopian naturally fermented milk), traditional butter (Kibe), traditional ghee (Neter Kibe), cottage cheese (Ayib), sour defatted milk (Arrera), and whey (Aguat).

Milk is fermented for the main reason that the daily production is small and to get the volume that justifies processing (primarily churning for butter-making), the daily milk yield should be accumulated over a few days. In this process, milk ferments naturally at the prevailing tropical ambient temperatures. Products obtained from the fermented milk include butter and cottage cheese is used for generation of income to purchase agricultural commodities and to fulfill other day to day necessities. Traditional butter is produced from naturally fermented whole milk and during churning, the traditional churners are covered with materials such as dry Enset pseudo stem sheath and/or a piece of plastic material, which is stretched over the opening of the churn and securely tied (Abebe *et al.*, 2013). The traditional milk processing materials and methods used are time consuming, laborious and inefficient in terms of fat recovery (Belay and Janssens, 2014). Small holder producers however, lack the required technological, organizational as well as institutional capacities. They are less organized and distant from market outlet, lack economies of scale and institutions for risk management and face higher transaction costs.

2.5. Dairy Cattle Production Constraints in Ethiopia

The constraints of dairy cattle production differ with in the three production systems and among different locations (Kassa, 2019). As indicated by Gebresellasie (2019) high feed cost, land shortage and space limitation, feed quality, availability and cost problems as well as inadequate extension and veterinary services were the major dairy production system constraints in the Urban and Peri-Urban areas of central Highlands of Ethiopia. Bereda *et al.* (2014) also reported that land shortage, feed shortage, water shortage and poor artificial insemination efficiency (AI) service as the most important dairy production constraints. Similarly, feed shortage and land

scarcity, diseases, poor access to market place, restricted market information, lack of improved breed, inadequate artificial insemination (AI) and infrastructure were reported as the primary constraints of dairy cattle production by Gemechu and Amene (2017).

The major production problems listed by Misganaw *et al.* (2017) includes absence of milk processing plants and equipment's, lack of skills, inadequate manufacture space, changeable marketing scheme, shortage of water, poor genetic potential of dairy cows for milk production. Assessment of cattle husbandry practices is a pre-requisite to bring improvement in cattle productivity in the country in general and in the study area in particular. "Shortage of grazing land, diseases prevalence, absence of proper housing and breeding management, lack of trained manpower and poor marketing practice, Shortage of land for cultivation of improved forage, low milk production potential of zebu cattle, inadequacy of Artificial Insemination (AI) and bull services for genetic improvement is major constraints in affecting milk production potential of dairy cattle in most parts of Ethiopia (Ayeneshet *et al.*, 2017).

2.5.1 Inadequate animal feed resources

In the main reasons of feed shortage indicated by the respondents were cultivation of grazing lands, declining yields of grazing land and increase of livestock population. Shrinking sizes of the grazing lands driven by the expansion of land cultivation was reported to be the leading reasons for feed shortage across all the review. Declining yield and carrying capacity of the grazing lands was rated as the second important impediment in adequate supply of feeds across all the sites. Increases of human and livestock population and drought are also mentioned to cause feed shortage (Minale G. and Yilkal T., 2015).

Understanding type of feed resources and its nutritional quality are important for improving production and productivity for enhancing food security. Dairy productivity is the function of nutrition, health status and genetic potential of the animal. Among these factors, nutrition plays the most important role as it represents the major cost dairy production. Seasonal inadequacy of the quantity and quality of available feeds are the major problems facing dairy cattle production. Additionally the efficiency with which the available feed is utilized is constrained by failure to use recommended management practices that could improve dairy output (Gobena, 2016).

Dietary nutrition plays a substantial role in any dairy development and the best appearance of genetic potential for milk production depends on satisfactory supply of nutrients. Dietary nutrients favor the metabolic pathways that empower the animal to catch up its genetic potential. The, nutrients (minerals, vitamins, carbohydrate, proteins and fat) are equally important as imbalances or deficiencies of one or more of these nutrients barricade the production, productivity and health status (Gezu and Zelalem, 2018). In Ethiopia, dairy cattle are chiefly fed on crop residues, natural pasture (grazing and/or hay), different agro-industrial, and locally available by-products as supplementary feeds. Such feeds are often lacking adequate macro and micro mineral concentrations (Bekele *et al.*, 2019). According to the study conducted by Beyene *et al.* (2015); feed shortage, livestock disease and market are the common problems in dairy production in the study area. Feed usually based on fodder and grass are either not available in sufficient quantities, or when available, are of poor nutritional quality. These constraints result in low milk and meat yields, high mortality of young stocks, longer parturition intervals and low animal weights (Galmessa *et al.*, 2013). Feed shortage in terms of quality and quantity is the major constraint regardless of the dairy Production system and agro-ecology (Gobena, 2016).

2.5.2. Cattle breeds

According to CSA (2020), about 97.4% of the total cattle in the country are local breeds. The remaining are hybrid and exotic breeds that accounted for about 2.3 percent and 0.31 percent, respectively that are adapted to feed and water shortages, disease challenges and harsh climates. The productivity of indigenous livestock is, however, believed to be poor even if no practical recording scheme at national level has been used to judge their merit. Most of the time breed improvement programs is not successful because of lack of infrastructure and the costs involved, such as transportation and liquid nitrogen for storage of semen, well skilled manpower and because the breeding program has not been designed to be sustainable (Philipsson *et al.*, 2011).

2.5.3. Animal health problems

The prevalence of various animal disease, tick born disease internal and external parasite and infectious diseases affect dairy development programs in various scale, depends on ecological zones and management levels. A number of parasite, bacterial, fungal and viral diseases and nutritional deficiency which are prevalent in the country affect the productivity and reproductive

efficiency of dairy cattle and make Individuals insecure to be involved in and invest on dairy production especially cows used with exotic blood (Horst, 1996). External parasite infestation as one of vectors of diseases causing agents and ranked them in 4th place (Minale G. and Yilkal T., 2015). Livestock disease is one of the challenging issues for dairy development in the country. The problem is further exacerbated with either absence or insufficient veterinary services (Galmessa *et al.*, 2013). Among fourteen identified common animal diseases trypanosomiasis ranked first (82.65%), blackleg second(60.75%) and internal and external parasites (54.9%) the third and cause major production losses (Mersha *et al.*, 2019).

2.5.4. Reproductive problems

Reproductive efficiency is critical component of successful dairy operation and act as an important factor of a profitable dairy farm however it is one of most determining problems facing the dairy industry today. Reproductive problems occur frequently in lactating dairy cows and dramatically affect reproductive efficiency in dairy herd. Some of the most common problems include twinning, dystocia, abortion; stillbirth, retained placenta, pyometra and repeat breeder (Hafez, 2000). These are diverse disorders that are similar in that they all can result in impaired reproductive function.

Low fertility reduces the profit by decreasing the average milk production and the number of calves per cow per year. Poor reproductive performance is a major cause of involuntary culling and therefore reduces the opportunity for voluntary culling and has a negative effect on the productivity of a dairy herd. Reproductive performance is influenced by the interactive effect of environment management, health and genetic factors (Gröhn, *et al*, 2000).

2.6. Feed Resources

Livestock feed resources in Ethiopia are mainly natural grazing lands, crop residues, browses, forage crop, agro-industrial by products and non-conventional feed resources (e.g. leaf and stem of *enset*, banana and sugarcane, crop thinning) and crop aftermath. In mixed cereal livestock farming systems of the Ethiopian highlands, crop residues provide on average about 50% of the total feed source for ruminant livestock. The contributions of crop residues reach up to 80% during the dry seasons of the year. In some cases, during the dry season, these feedstuffs can be

the only feeds available to the animals. Moreover, the improvement of the utilization of these feedstuffs through physical and/or chemical processing methods to increase the availability of nutrients is only practiced on a limited number of farms (Minale and Yilkal, 2015). In some parts of southern Ethiopia, the leaf, midribs and the whole parts of Enset (*Ensete ventricosum*) is used as a major source of feed mainly during the dry season of the year where the availability of feed is limited due to the absence of rain fall (Abebe *et al.*, 2014; Dirsha, 2019).

2.7. Nutrient Requirement of Cattle

Cattle need nutrients for maintenance, growth, production and reproduction. Nutrients required for these functions are expressed in terms of energy, protein, minerals (particularly calcium and phosphorous) and vitamins. Energy, protein, and digestibility of feeds are central in determining nutritional adequacy and feeding levels for different classes of stock (Streeter, 2006).

Demand for energy depends on breed, live weight, sex and physiological state (pregnancy, lactation) of the animal. The amount of feed needed to meet maintenance requirements will vary with the type and quality of feed available (McDonald, 1988). Proteins are the main constituents of an animal body and are continuously needed in the feedstuff. The protein content of herbage falls with the phosphorous so that protein deficiency and frequently also a deficiency of available energy, are worsening factors in the malnutrition of dairy animal in phosphorous deficient areas (Eric, 1981). With increasing crude protein concentrations, milk yield increased by 4.0 kg/day at the same concentrate intake but tended to fall at reduced concentrate intake (Sutton *et al.*, 1996).

3. MATERIALS AND METHODS

3.1 Description of Study Area

The study was conducted in Meskan district, East Guraghe Zone, Central Ethiopia Region. The district is located at about 135 km on south of Addis along Hosanna asphalt road and 110 km from Wolkite the capital town of Gurage zone on the east direction. The district is found at 8° 13' North and 38°42' East and covering an area of about 50,177 hectares of land. The district borders with Silty district in the South, Muhir and Aklil district in the West, Kookier Gedebano Gutazer Welene District in the West, South Sodo in the North and North East as well as East Meskan district in the south east. According to Meskan District Agricultural Development Office (MDADO, 2022 annual report), the district has a total human population of 148,355 of which 71,210 are men and 77,145 are women. The total number of household (HH) is about 27,655, of this 26,098 are men households and 1,557 are women households (MDADO, 2022).

Based on the data obtained from MDADO (2020), a total livestock population was estimated to be about 520,040, of which 130,712 were cattle, 88,223 sheep, 51,807 goats, 228,073 chickens, 5,488 horse, 255, mule and 15,482 donkeys. The altitudinal range of the district varies from 1800-3500 meters above sea level. Agroecologically, Meskan district is classified as 80% Weina Dega (midland) and 20% Dega (highland) (Admassu, 2020). The annual rainfall ranges between 1001-1200 mm and the district has a bimodal rainfall of short rainy season from March to April and the main rainy season from June to October. The mean daily maximum and minimum temperature is estimated to be 27.7°C and 6.5°C respectively. Enset and cereal grain production are the two basic crops grown in in the district. Among the cereal crops grown maize, teff, wheat and barley are the major ones.

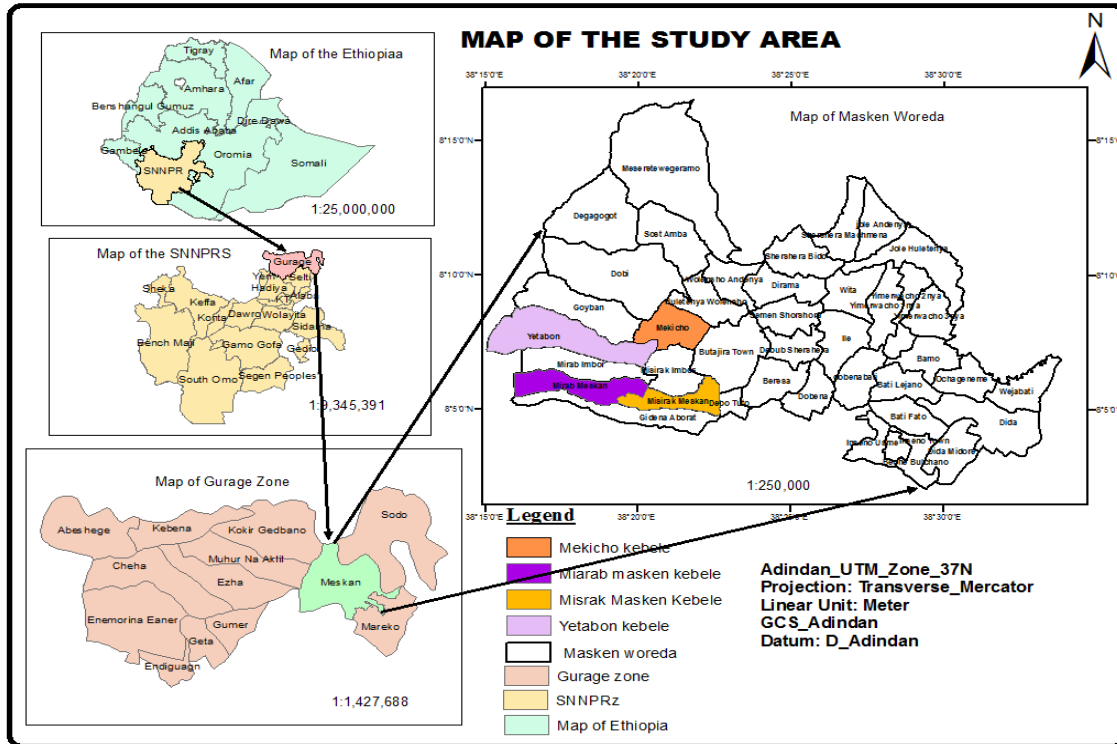


Figure 1 Location map of selected study area

3.2. Sampling Techniques and Sample Size Determination

The study was conducted in six kebeles of Meskan district. The kebeles were selected purposively based on the dairy cattle potential and accessibility. Stratified sampling procedure was used to select representative kebeles and household heads. The kebeles of the district were stratified in to highland and midland agro-ecological zones based on the altitudinal difference. Thus, kebeles which are found at an altitude of >2400 m.a.s.l were grouped in to highland while kebeles found at an attitude range of 1500-2400 m.a.s.l were grouped in to midland. Two representative kebeles(Yetabon and Mrab Meskan) from Highland and four kebeles (Dobo Tuto, Debub Shershera, Beresa and Misrak Meskan) from Midland agro-ecological zone were selected based on dairy cattle production potential and accessibility purposively with the consultation of district livestock production experts and development agents. Representative household heads were selected randomly for the interview using Probability Proportional to Size (PPS) based on the population of each kebele. The sample size was determined by using Yamane, 1967 formula. The total target population of the study area was estimated to be 5923.

$$n = N/1+N (e)^2$$

Where;

N = Population size (5923)

n= sample size (376)

e = expected error (5%)

Table 1. Total sample size selected from the two agro-ecological zones in the study area

Agro-ecologies	Kebeles	Household heads	Sampled proportion (%)	Sample size
Highland	Yetebon	1851	31	117
	Mrab Meskan	1111	19	71
Midland	Dobo Tuto	497	9	62
	Debub Shershera	621	10	32
	Beresa	869	15	39
	Misrak Meskan	974	16	55
Total		5923	100	376

3.3. Sources of Data and Methods of Data Collection

Primary and secondary data were collected. The primary data was collected by using semi-structured questionnaire interview and field observations. The semi-structured questionnaire was pretested to check the appropriateness and clarity of the questions before the commencement of the actual data collection. Secondary data was collected from different documents of the district, articles, books, internet, etc. Focus group discussion consisting of 6-8 members per group in each kebele was organized with purposively selected farmers who had long experience on livestock rising; livestock experts and development agents (DAs) in order to substantiate the primary data collected using questionnaire.

The questionnaire used in the study was designed focused on the following information: household demography, farm size, land use pattern, herd size, herd composition, breed type,

purpose of livestock raising and dairying practices, age at first service, age at first calving, calving interval, lactation length, days open, mating systems, daily milk yield, major crops grown, crop grain yield, types of livestock feed, feeding and housing system of livestock, types of milking and milk processing, market places for milk, milk products, live animal and feed markets, milk and butter price, types of butter making, types and quantity of total feed available for livestock, major livestock diseases, available livestock health services and associated problems, water access and types of livestock health service organizations.

3.4. Estimated Annual Feed Supply

The quantity of dry matter (feed) from natural pastures was determined by multiplying the hectareage of land under each land use category by their respective estimated annual DM yield per hectare i.e. 2.0 t/ha (FAO, 1987). The amount of purchased dry forages such as hay and straw, if any, was determined by estimating the amount based on given information from the respondent households and for baled hay by asking how many bales of hay would be purchased for a year. The quantity of available crop residues produced by farmers was estimated by applying grain to straw ratio as suggested by FAO (1987). Accordingly, for a ton of wheat, barley, oat and teff straw, a multiplier of 1.5; for faba bean, field pea, and haricot bean straw a multiplier of 1.2; for maize a multiplier of 2.0, and for sorghum a multiplier of 2.5 was used. The quantity of potentially available crop residues for animal consumption was estimated by assuming 10% wastage (Adugna and Said, 1994). The amount of grain yield obtained from the respective crops was quantified by interviewing the farmers and by cross checking the data recorded by development workers and the respective offices for any deviation. The assessment of dry feed quantity and potentially available crop residues was taken from 2023 September to March 2024.

The quantity of concentrates and non-conventional feed resources was estimated by interviewing the households with regard to frequency and quantity purchased per month. The grazing potential of crop stubbles was estimated using a mean of 0.5 ton per hectare of land as reported by FAO (1987). Utilization factor of 75% as suggested by Woody Biomass Inventory and Strategic Planning Project (WBISPP, 2002) for extensive grassland was used to quantify the DM that would be utilized by livestock. The feed DM from enset leaf and leaf midribs used for animal

consumption was estimated by assuming a mean of 8 ton per hectare of enset garden (FAO, 1987) as cited by (Dirsha, 2019).

3.5. Estimated Annual Feed Requirement

The annual availability of feed was compared with the annual requirements of the livestock population. Livestock populations were converted in to Tropical Livestock Unit (TLU) as suggested by Gryseels (1988) for indigenous zebu cattle and Bekele (1991) for crossbreds. The dry matter (DM) requirements for maintenance was calculated based on daily DM requirements of a 250 kg dual-purpose tropical cattle (an equivalent of one TLU). Nutrients supplied by each feed types was estimated from the total DM output and nutrient contents of that feed on DM basis (Abdinasir, 2000). The total nutrient requirements (DM, crude protein (CP) and Metabolizable energy (ME)) per day per TLU was estimated based on recommendations of Kears (1982) and McCarthy (1986) for tropical livestock unit.

3.6. Chemical Analysis of Feed Samples

DM and Ash contents of feed samples including enset leaf parts (cut into slices using cultural enset leaf slicing knife) used as livestock feed resources was determined by oven drying at 105°C over-night,(AOAC, 1990) at Wolkite University Animal Nutrition laboratory. Ash contents of feed samples including enset leaf parts (cut into slices using cultural enset leaf slicing knife) used as livestock feed resources was determined by igniting the sample in a muffle furnace at 550-600°C for 6 hours, (AOAC, 1990) at Wolkite University feed process engineering laboratory. Chemical analysis of feedstuffs for CP and EE was performed at Wolkite University feed process engineering laboratory and ADF, ADL, NDF and IVDOMD at Holetta Agricultural Research Center laboratories. Nitrogen (N) content was determined by Kjeldahl method and Crude Protein (CP) will be calculated as $N \times 6.25$ (AOAC, 1995). Chemical analysis of feedstuffs for IVDOMD at Jima University Animal Nutrition laboratory.

Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL), Neutral Detergent Fiber (NDF), and *In vitro* Organic Matter Digestible (IVOMD) was determined by the modified Tilley and Terry method (Van Soest and Robertson, 1985). Metabolizable Energy (ME) and Digestible Crude

Protein (DCP) content of a particular feed was estimated from IVDOMD and CP contents, respectively, as per the following equations:-

$$\text{ME (MJ/kg DM)} = 0.015 * \text{IVOMD (g/kg)} \text{ (MAFF, 1984).}$$

$$\text{DCP (g)} = 0.929 * \text{CP (g)} - 3.48 \text{ (Church and Pond, 1982).}$$

3.7. Data-Analysis for Survey Study

The collected data was analyzed to achieve research objective and to answer the research question. Statistical analysis of collected data was done using statistical Package for Social Sciences (SPSS) software, version 20 (SPSS, 2011). Descriptive statistics of means, frequency distribution, figures and percentages was used by where to disclose the results. General linear model was also used to analyze the relation between dependent and independent variables. Tukey was applied to examine existence of differences between levels of significance of milk yield between agro ecology and milking season. Chi-square and general linear model was used to test different variables in highland and midland agro ecologies. Statistical significance between variable was determined by using P-value at critical point of ($P < 0.05$) and index calculation was used for ranking constraints

Formula for ranking:

$$\text{Index} = \frac{R_n * C_n + R_{n-1} * C_2 + \dots + R_n * C_n}{\sum R_n + C_1 + R_{n-1} * C_2 + \dots + R_n * C_n}$$

Where;

R_n = value given for the least ranked level (example, if the least rank is 5th, then $R_{n-1} = 4$, and --- $R_1 = 1$);

C_n = count of the least ranked level (in the count of the 1st rank = C_1).

Model for survey

$$Y_{ij} = \mu + P_i + e_{ij}$$

Where;

Y_{ij} = the response of dependent variable

μ = overall mean

P_i = the effect of agro-ecologies (i = milk yield, lactation length, calving interval, days open and, dry matter yield)

e_{ij} = random error.

Model for feed chemical analysis

$$Y_{ij} = \mu + A_i + e_{ij}$$

Where;

Y_{ij} = observed variable

μ = Overall mean

A_i = agro ecology effect (i = DM, CP, ASH, OM, EE, NDF, ADF, ADL, DCP, IVDMD, ME (MJ/kg DM))

e_{ij} = Random error

4. RESULTS

4.1. Household Characteristics

The household characteristics of the study area is presented in table 2. The proportion of male household heads(96.8%) was higher than female household heads(3.2%). This might indicate that males are more involved in the livestock production. Regarding to the age grouping, majority of respondents(47.9%),(44.1%), (8%) were at the age of 41-60 years and followed by 21-40 and 61-80 years, respectively. This result showed that about 92% of the respondents were at the age of 21-60 years which is good opportunity towards obtaining of workable labour power in the areas of agriculture in general and in animal husbandry in particular. However, there was significant difference ($P < 0.05$) between the two agro-ecological zones in terms of age categories. Majority of the sample households (85.1%) in both agro ecologies of the study areas had opportunities of getting different level of education. Conversely, households of about 18.02% in the highland agro ecology and 11.7% in the midland areas were not in a position to get educational opportunities as the result they remain illiterate. About 81.91% of the farmers in highland and 88.29% of households in mid altitude areas have got the opportunity of education (Table 2). The educational level showed significantly difference ($P < 0.05$) between the two agro-ecologies. This variation might be associated with accessibility to schools. The overall marital status of the respondents in the current study showed that majority of them (96.8%) were married while the rest (3.2%) were unmarried. Martial status didn't show significant ($P > 0.05$) variation between the two agro-ecological zones. The cattle production system in the study area was identified as mixed crop-livestock production system which was characterized by production of livestock and cereal grains including Wheat, Barley, Bean, Pea and Enset (*Ensete ventricosum*) in high land and mid land areas of the study.

Family size of respondents in the study area is indicated Table 3. The overall family size of the study area was 6.72 ± 0.20 . The average family size in the highland was 5.82 ± 0.19 , while it was 7.63 ± 0.21 in mid land. Out of the total population in the study area about 47.47% and 52.53% were male and female, respectively.

Table 2. Household characteristics of the study area in highland and mid agro-ecological zones

Characteristics		Agro-ecology				Overall		χ^2 - value	p-value
		Highland		Midland					
		(n =188)	%	(n =188)	%	(N= 376)	%		
Sex	Male	180	95.8	184	97.9	364	96.8	1.38	0.19
	Female	8	4.2	4	2.1	12	3.2		
Age/year	21-40	70	37.2	96	51.0	166	44.1	7.50	0.02
	41-60	100	53.2	80	42.6	180	47.9		
	61-80	18	9.6	12	6.4	30	8.0		
Educational level	Illiterate	34	18.1	22	11.7	56	14.9	27.68	0.00
	Read & write	78	41.5	40	21.3	118	31.4		
	Primary	52	27.7	80	42.6	132	35.1		
	Junior school	16	8.5	30	16.0	46	12.2		
	High school	6	3.2	12	6.4	18	4.8		
	> high school	2	1.1	4	2.1	6	1.6		
Marital status	Married	180	95.8	184	97.9	364	96.8	1.37	0.19
	Unmarried	8	4.2	4	2.1	12	3.2		
Farming system	Livestock production	3	1.6	7	3.7	10	2.7	1.64	0.17
	Crop production	-		-		-	-		
	Mixed production	185	98.4	181	96.3	367	97.3		

N= number of households; n = number of households in each agro-ecological zones

Table 3 Demographic characteristics of HHs in the study area

Variables		Agro ecology					
		Highland(n=188)		Midland(n=188)		Overall(N=376)	
		N	%	N	%	N	%
<5year	Male	93	8.6	104	7.25	197	7.79
	Female	120	11	97	6.76	217	8.58
	Total	213	9.8	201	14.02	414	16.37
5-15 years	Male	88	8.9	130	9.06	218	8.6
	Female	129	12.7	159	11.08	288	11.39
	Total	217	10.7	289	20.15	506	20
16-40 years	Male	157	14.5	291	20.29	448	17.72

	Female	162	15.6	373	26.01	535	21.16
	Total	319	15.0	564	39.33	983	38.88
41-60 years	Male	163	12.4	125	8.7	288	11.39
	Female	162	13.4	124	8.6	286	11.35
	Total	325	12.8	249	17.36	576	22.78
>60years	Male	23	3.0	21	1.46	44	1.74
	Female	10	1.7	10	0.69	20	0.79
	Total	33	2.5	31	2.16	64	2.53
Total	Male	529	48.01	671	46.8	1200	47.47
	Female	565	51.99	763	53.2	1328	52.53
	Total	1094	43.27	1434	56.73	2528	100
	Mean	5.82±0.19	--	7.63±0.21	--	6.72±0.20	
	SE	0.190	--	0.215	--	0.202	

^{a,b} = means in the same row with different letter of superscripts are significantly different ($P<0.05$), N= number of respondents, HH= household, %= percentage.

4.2. Landholding and Land Use System

The average landholding (ha) per HH and land use pattern in the study area is indicated in Table 4. The overall landholding of the study area was 1.29 ± 0.375 ha. However, the landholding in highland agro-ecological zone was $1.32\pm 0.5a$ ha, out of which 0.9, 0.25, 0.1, 0.003, 0.002, 0.05ha of land were allocated for cropland, enset production, grazing land, forestland, fallow land and homestead, respectively. In the midland agro ecology the average land per house hold was 1.26 ± 0.25 ha, of which 1.15, 0.065, 0.004, 0.004, 0.02, and 0.02ha were allotted for cropland, enset, grazingland, forest, fallow land an home stead land , respectively. The total landholding per household in highland agro ecology was significantly($P< 0.05$) higher than that of the mid land and the largest part of the land was allocated for annual crop production followed by grazing land in both agro-ecologies.

Table 4. Average landholding/HH and land use pattern in the study area of Meskan district(Mean±SD)

Variables	Agro ecology			P-value
	Highland(n=188)	Midland(n=188)	Overall(N=376)	
Total land(ha)	1.32 ± 0.05^a	1.26 ± 0.25^b	1.29 ± 0.38	0.04
Crop land	0.9 ± 0.50	1.15 ± 0.25	1.03 ± 0.38	0.02
Enset	0.25 ± 0.01	0.065 ± 0.01	0.17 ± 0.01	0.01
Grazing land	0.10 ± 0.03^b	0.004 ± 0.02^a	0.052 ± 0.02	0.000

Forest land	0.003±0.14 ^b	0.004±0.02 ^a	0.003±0.08	0.002
Fallow land	0.02±0.0	0.02±0.01	0.02±0.01	0.003
Home stead land	0.05±0.02	0.02±0.17	0.035±0.06	0.001
Land allocated for annual crops(ha)				
Wheat	0.25±0.13	0.15±0.05	0.20±0.04	0.000
Barley	0.125±0.05	**	0.065±0.02	
Teff	0.25±0.05 ^a	0.25±0.04 ^b	0.25±0.04	0.000
Maize	0.25±0.00 ^a	0.625±0.03 ^b	0.44±0.02	0.000
Bean	0.01±0.01 ^b	0.025±0.00 ^a	0.02±0.00	0.000
Pea	0.02±0.01 ^b	0.01±0.00 ^a	0.01±0.00	0.000
Sorghum	**	0.01±0.00 ^b	0.005±0.00	0.000

^{b-a} = means in the same row with different letter of superscripts are significantly different ($P<0.05$), **= not grown in the area, HH = household, ha = hectare.

4.3. Crop Yield and Crop Residue Estimation

Crop yield and crop residues production in study area is indicated in Table 5. From the result of current study, it is clear that the types of annual crops grown were limited in number. This could limit the amount of produced crop residues for livestock feeding in both agro ecologies of the study areas. Bearing the difficulties of provision of cultivable land in mind, the use of appropriate agricultural technologies and environmental challenges were other bottlenecks in bringing improvement in the production and productivity of lands available in the area. The major annual crops grown in highland agro-ecology of the study areas of Meskan district in East Gurage zone were wheat, barley, bean, pea and partially teff. Whereas wheat, teff and maize took the highest rank of production in midland agro ecology of the study area. Consequently, the biomass of wheat and barley straw were the largest among other crop residues produced in highland. The crop residues of wheat, teff and maize encompass the largest portion of crop residues produced in midland agro ecology.

Table 5. Annual field crops yield and crop residues in tons per HHs in the study area of Meskan district in East Gurage zone(Mean±SD).

Type of crops	Agro ecology						P-value
	High land(n=188)		Mid land(n=188)		Over all(N=376)		
	Grain yield	Straw	Grain yield	Straw	Grain yield	Straw	

Wheat	2.42±0.25 ^b	3.63±0.38	3.85±0.23 ^a	5.77±0.38	3.14±0.24	4.71±0.3	0.01
Barley	1.54±0.24	2.31±0.36	**	**	0.77±0.12	1.16±0.1	
Teff	0.26±0.25 ^b	0.39±0.38	1.74±0.11 ^a	2.61±0.17	1.00±0.18	1.5±0.27	0.00
Maize	3.8±0.16 ^b	5.7±0.24	5.7±0.14 ^a	8.55±0.21	4.75±0.15	7.13±0.2	0.01
Bean	0.37±0.19 ^a	0.44±0.28	0.05±0.8 ^b	0.06±0.12	0.21±0.11	0.30±0.1	0.00
Pea	0.2±0.26 ^a	0.25±0.39	0.01±0.7 ^b	0.02±0.11	0.11±0.13	0.16±0.1	0.00
						9	3

^{b-a} = means in the same row with different letter of superscripts are significantly different ($P<0.05$), ** = not grown in the area, HHs = households.

4.4. Livestock Population and Herd Structure

The livestock population and herd structure data are indicated in Table 6 and 7. The percentage of indigenous cattle population in highland areas of the study were about 82.04% with the remaining 17.96% were crosses. On the other hand, the cattle population of about 64.60% and 35.40% in midland areas of the study, respectively, was indigenous and cross breed cattle. The overall average of livestock population in the study areas of Meskan district of East Gurage zone was found to be 73.40%, 12.37%, 9%, 1.25%, 4.03%, Cattle, Sheep, Goat, Horse, and Donkey respectively.

Table 6. Number of livestock population in the study area of Meskan district in East Gurage zone

Livestock species		Agro ecology					
		Highland		Midland		Overall	
		(n=188)	%	(n=188)	%	(N=188)	%
Cattle		1292	72.38	1401	74.32	1347	73.40
	Indigenous	1060	82.04	905	64.60	947	70.3
	Crosses	232	17.96	496	35.40	400	29.7
Sheep		276	15.46	179	9.49	227	12.37
Goat		117	6.55	212	11.25	165	9
Horse		46	2.57	**	**	23	1.25
Donkey		54	3.02	93	5.21	74	4.03
Total		1785	48.63	1885	51.37	1835	100

n = number of livestock per agro ecology, N = total number of livestock in the study

Table 7. Livestock size in Number and TLU in the study area of Meskan district in East Gurage zone

Livestock Species	Agro ecology							
	High land				Mid land			
	Indigenous		Cross		Indigenous		Cross	
	N	TLU	N	TLU	N	TLU	N	TLU
Cow	454	363.2	116	208.8	428	342.4	274	493.2
Heifer	198	99	36	25.2	66	33	53	37.1
Oxen	234	257.4	28	53.2	257	282.7	67	127.3
Bull	48	52.8	6	11.4	59	64.9	13	14.3
Calves	142	28.4	46	18.4	126	25.2	89	35.6
Sheep	276	27.6	**	**	179	17.9	**	**
Goat	117	11.7	**	**	212	21.2	**	**
Donkey	54	27	**	**	93	74.4	**	**
Horse	46	36.8	**	**	**	**	**	**
Total	1569	903.9	232	317	1420	861.7	496	707.5

N= number of cattle, TLU= tropical livestock unit

4.5. Cattle Population and Structure

The Cattle population and herd structure of the study areas of Meskan district is indicated in Table 8. The average cattle holding per household in number was 6.87 ± 0.27 in highland agro ecology and 7.45 ± 0.33 in midland agro ecology with overall mean of 7.17 ± 0.30 . The average crossbred cattle population per house hold was higher in mid land area and significantly different ($P < 0.05$).

Table 8. Cattle size and structure (Mean \pm SE)/HH in the study area of Meskan district East Gurage zone

Cattle type		In number			In TLU			P-value
		High land	Mid land	Overall	High land	Mid land	Overall	
Cow		3.02 ± 0.08	3.72 ± 0.09	3.37 ± 0.06				0.000
	Indigenous	2.41 ± 0.08	2.27 ± 0.12	2.34 ± 0.07	1.93 ± 0.06	1.82 ± 0.09	1.87 ± 0.06	0.000
	Cross	0.61 ± 0.01	1.45 ± 0.04	1.03 ± 0.02	1.11 ± 0.02	2.62 ± 0.07	1.86 ± 0.04	0.000
Heifer		1.24 ± 0.07	0.63 ± 0.06	0.93 ± 0.04				0.000
	Indigenous	1.05 ± 0.07	0.35 ± 0.05	0.7 ± 0.04	0.53 ± 0.04	0.17 ± 0.03	0.35 ± 0.02	0.000
	Cross	0.19 ± 0.00	0.28 ± 0.02	0.13 ± 0.01	0.13 ± 0.00	0.2 ± 0.01	0.16 ± 0.01	0.000
Oxen		1.39 ± 0.11	1.72 ± 0.13	1.55 ± 0.08	1.53			0.000
	Indigenous	1.24 ± 0.10	1.36 ± 0.13	1.3 ± 0.08	1.36 ± 0.11	1.49 ± 0.14	1.42 ± 0.09	0.000
	Exotic	0.15 ± 0	$0.350.090.1$	0.2 ± 0.01	0.28 ± 0	0.39 ± 0.02	0.33 ± 0.02	0.000
Bull		0.28 ± 0.05	0.38 ± 0.05	0.33 ± 0.04				0.000
	Indigenous	0.25 ± 0.06	0.31 ± 0.05	0.28 ± 0.0	0.28 ± 0.07	0.34 ± 0.06	0.31 ± 0.00	0.000
	Cross	0.03 ± 0.01	0.07 ± 0.01	0.05 ± 0.01	0.06 ± 0.01	0.07 ± 0.02	0.06 ± 0.02	0.000
Calves		1 ± 0.05	1.24 ± 0.04	1.12 ± 0.03				0.000
	Indigenous	0.75 ± 0.05	0.67 ± 0.06	0.72 ± 0.04	0.15 ± 0.01	0.13 ± 0.01	0.14 ± 0.01	0.000
	Exotic	0.25 ± 0.01	0.47 ± 0.03	0.4 ± 0.02	0.1 ± 0.00	0.18 ± 0.0	0.14 ± 0.01	0.000
Total		6.87 ± 0.27	7.45 ± 0.33	6.98 ± 0.2				0.040
	Indigenous	6.63 ± 0.27	4.77 ± 0.3	5.7 ± 0.2	5.02 ± 0.29	5.02 ± 0.33	5 ± 0.18	0.031
	Cross	0.24 ± 0.24^a	2.63 ± 0.10^b	1.28 ± 0.06	0.18 ± 0.02	1.16 ± 0.13	0.63 ± 0.10	0.002
Sheep		$1.46 \pm 0.2b$	0.96 ± 0.2^a	1.21 ± 0.17	0.36 ± 0.02	0.23 ± 0.03	0.3 ± 0.02	0.000
Goat		0.62 ± 0.24^a	1.12 ± 0.27^b	0.87 ± 0.18	0.11 ± 0.02	0.27 ± 0.29	0.19 ± 0.02	0.000

Horse		0.24±0.03	**	0.12±0.02	0.28±0.02	**	0.14±0.02	0.000
Donkey		0.28±0.05	0.49±0.09	0.38±0.05	0.4±0.03	0.52±0.05	0.46±0.03	0.000

b-a = means in the same row with different letter of superscripts are significantly different ($P<0.05$), HH = household, SE= Standard Error, TLU= Tropical livestock unit, **= not found in the area.

4.6. Trends of Cattle Population in the Past One Decade in the District

Respondent's perception about the trends of cattle population in the past one decade was indicated in figure 2 . Accordingly, about 31%, 44% and 25% of the respondents in the highland and about 16.5%, 66% and 17.5% in the midland areas of the study indicated that the cattle population in the last one decade (10 years) was in decreasing, increasing and no changing order, respectively. Trends of cattle population declining were higher in high altitude areas than midland agro ecology. The Major reasons reported by the respondent households for decreasing cattle population in the district were shortage of feed, manpower to manage cattle and reduction in production and reproductive performance of cattle owned by the households.

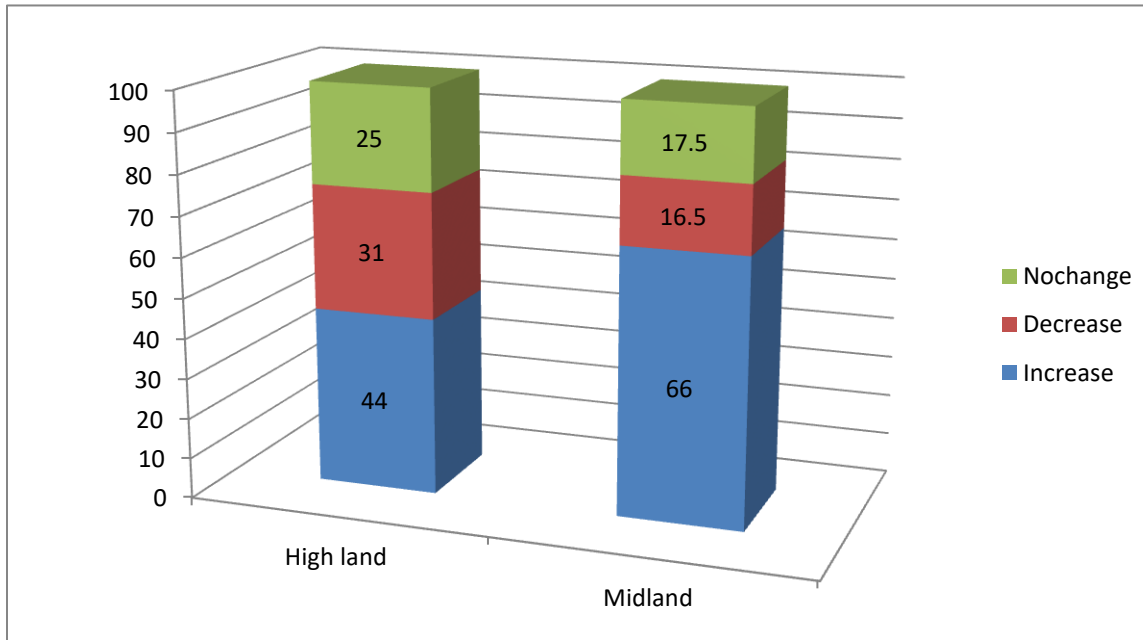


Figure 2 Trends of Cattle population in the past one decade in the study area of Meskan district East Gurage zone %

4.7. Purpose of Dairy Cattle Keeping

According to the responses of households of the study areas, cattle were mainly held to satisfy both milk and traction needs. Cattle also were reared in the district for different purposes including milk and milk product consumption (64.1%), whole milk sale (35.9%). In addition to these cattle provide manure for organic fertilizer particularly in highland agro ecology to fertilize enset crop and rarely used for energy source at home.

Table 9. Purpose of dairy cattle rearing in the study area of Meskan district East Gurage zone

Variables	Agro ecology					
	Highland(n=188)		Mid land(n=188)		Overall(N=376)	
	N	%	N	%	N	%
Milk sale	46	24.58	89	47.26	135	35.9
Milk & milk Product consumption	47	25.00	25	13.26	72	19.15
Milk processing	95	50.42	74	39.09	169	44.95

n = number of households per agro ecology, N = total number of households in the study area.

4.8. Labor Division per Household for Dairy Cattle Related Activities

Labor division involved in livestock herding, feed collection, feeding, milking and milk processing were indicated in Table 10. In both agro ecologies herding was commonly practiced by household head (41.75%) and spouse (34.84%) and feeding was also practiced by the household (38.3%) and spouses (43.9%). The activities of feed collection, on the other hand, were major responsibility of the house head (43.35%) and children (42.55%). Milking, milk processing, transport and selling of milk and milk product were carried out by spouse (88.29%).

Table 2. Labor division the house hold in the study area of Meskan district East Gurage zone

Variables		Agro ecology					
		Highland		Midland		Overall	
		N	%	N	%	N	%
Herding	1. HH head	95	50.5	62	32.97	157	41.75
	2, spouse	54	28.7	77	40.95	131	34.84
	3 children	37	19.8	41	21.83	78	20.74
	4, hired	2	1	8	4.25	10	2.67
Feed collection	1 HH head	85	45.2	78	41.5	163	43.35
	2 spouses	25	13.3	18	9.5	43	11.43
	3 children	76	40.4	84	44.68	160	42.55
	4 hired	2	1	8	4.25	10	2.67
Feeding	1 HH head	88	46.8	56	29.8	144	38.3
	2 spouses	73	38.9	92	48.9	165	43.9
	3 children	25	13.3	32	17	57	15.13
	4 hired	2	1	8	4.25	10	2.67
Milking	1 HH head	2	1	20	10.6	21	5.6
	2 spouses	182	97	150	79.9	332	88.29
	3 children	2	1	10	5.3	12	3.1
	4 hired	2	1	8	4.25	10	2.67

Milk processing,	1 HH head	2	1	20	10.6	21	5.6
	2 spouses	182	97	150	79.9	332	88.29
	3 children	2	1	10	5.3	12	3.1
	4 hired	2	1	8	4.25	10	2.67
Transport, selling of milk& milk product	1 HH head	2	1	20	10.6	21	5.6
	2 spouses	78	41.5	106	56.5	184	49
	3 children	2	1	14	7.4	16	4.3
	4 hired	0	0	6	3.1	6	3.1
	5 not sell	106	56.5	42	22.4	143	38

n = number of households per agro ecology, N = total number of households in the study

4.9. Productive and Reproductive Performance of dairy Cow

The productive and reproductive performance of cattle in the study areas is indicated in Table 10.

4.9.1. Daily Milk Yield

There were significant variations in daily milk yield performances due to milking season effect in that the value of average daily milk yield was significantly higher in wet season 2.67 ± 0.03 than dry season (1.16 ± 0.02) of local cattle. The overall daily milk yield was 1.92 ± 0.03 of local cattle. The reason for variation of daily milk production might be due to the effect of feed, health, management aspect. In general, the cattle productivity, in the study areas is low in terms of milk yield which is similar to other parts of Ethiopia.

4.9.2. Lactation Length

The period through which a cow continues giving milk in one milking time is the length of lactation. In most dairy farms a lactation length of 305 days is commonly accepted as a standard. The overall estimated mean of lactation length of cows obtained in the current

study was 7.96 ± 0.14 months. Lactation length can be affected by shortage of feed, poor management practices, difference in production system, age and breed of animal.

4.9.3. Age at First Service

Age at first service (AFS) is the time or age that the body condition and sexual maturity are attained by the heifers in accepting service for the first time. It is defined as the length of time between the date of birth and the date of showing first heat in a life time of an individual cow or heifer. The overall estimated mean age of heifers at first service for the current study was 4.25 ± 0.40 years. Age at first service can be influenced by genotype, nutrition and other environmental factors including improved management levels such as good nutrition, housing and health care enhance growth rate of heifers to come on first heat at early age.

4.9.4. Age at First Calving

Age at first calving is the indicator of beginning of a cow's reproductive life and is closely related to the generation interval. There is considerable economic importance associated with the factors that control the onset of ovarian activity of cattle, having an influence on both reproductive and productive life of the female cattle, directly having an effect on her lifetime calf crop and milk production, and indirectly through its influence on cost that has been invested for the upbringing. The overall estimated mean age of heifers at first calving for the current study was 5.25 ± 0.40 years.

4.9.5. Calving Interval

The calving interval is a period between two consecutive parturitions and should ideally be in the region of 12 to 13 months. Calving intervals do have low heritability and this can be enhanced through early breeding and nutrition. This is so important to the breeders because the lowest calving interval will result into the highest lifetime for calf crop production. One of the major problems that affect

the lifetime productivity of dairy herds is extended calving interval. The overall estimated mean of calving interval for the current study was 2.02 ± 0.02 years.

Table 3. Productive and reproductive performances of cattle in study areas of Meskan district East Gurage zone.

Variables		Agro ecology			P-value
		Highland(n=188)	Midland(n=188)	Overall(N=376)	
		Mean \pm S E	Mean \pm S E	Mean \pm S E	
Milk yield	Dry season	1.00 \pm 0.5b	1.33 \pm 0.22a	1.16 \pm 0.36	0.000
	Wet season	2.5 \pm 0.25b	2.84 \pm 0.33a	2.67 \pm 0.29	0.000
LL (month)		7.60 \pm 0.18b	8.32 \pm 0.22a	7.96 \pm 0.14	0.038
AFS (year)		4.5 \pm 0.5 ^b	4 \pm 0.1 ^a	4.25 \pm 0.4	0.000
AFC (year)		5.5 \pm 0.5 ^b	5 \pm 0.1 ^a	5.25 \pm 0.4	0.000
CI (year)		2.04 \pm 0.2 ^b	2.0 \pm 0.1 ^a	2.02 \pm 0.02	0.000
DO (days)		336.25 \pm 6.03 ^b	313.09 \pm 4.45 ^a	324.5 \pm 5.24	0.000

^{b-a} = means in the same row with different letter of superscripts are significantly different ($P < 0.05$), SE=standard error, AFS =age at first service, AFC= age at first calving, CI=calving interval, LL=lactation length, DO=days open, MY= milk yield.

4.10. Constraints of Dairy Cattle Production

In the district dairy production was affected by a number of constraints as indicated in Table 11. According to the responses of the respondents of the study, shortage and high cost of animal feed, poor genetic potential of local cattle, shortage and high market price of cross bred cattle, shortage of man power because of the evacuation of young people to Addis Ababa and other towns in search of job

opportunity and animal disease were the major constraints identified for lower production and productivity of dairy cattle in the study areas.

4.10.1.Shortage of Animal Feed

The household respondents of about 22% showed that feed shortage was the first problem affecting production and productivity performance of their cattle. Shortage of land for grazing and improved forage development, encroachment of land for crop production, and expansion of urbanization were the major reasons reported by the respondent households to the encountered feed shortage. Expansions of invasive weeds such as parthenium on marginal grazing lands especially in midland agro ecology also became another bottleneck in respect to feed shortage. Long dry season and erratic and low rainfall distribution played its negative role in disturbing growth of natural pasture and crops which in turn negatively affects the amount of grass/pasture produced and crop residues production. Additionally, shortage of improved seeds to practice forage development and poor extension service provision in the study areas were other shortcomings to improve animal production and productivity..

4.10.2. High Cost of Animal Feed

About 15.9% of the respondents indicated that high market price of animal feeds affected the cattle production in the district (Table 11). The higher market price of feed reported by the respondent households generally related to the increasing demand for roughages, agro industrial byproducts and concentrate feeds. Furthermore, low availability (supply shortage) of commercial feeds and the existing inefficient marketing system have aggravated the market price of the commercial feeds in the study areas. Lower rain and erratic distribution of rain fall in the study areas also played a significant role in aggravating the market price of animal feeds of any kind.

4.10.3. Poor Genetic Potential of Indigenous Breeds

According to the responses of respondents (Table 11), about 13.5% of the participants reported that poor genetic potential of indigenous cattle breed is one of the most economic constraints that affect cattle production in the district. In spite of the low productive potential of indigenous cattle, feed shortage and harsh environmental situation also played significant role in reducing

the level of milk production per individual cow. Low production and productivity of animal products have called for deficiency of animal proteins particularly on the children which needs intervention of every stakeholder using different mechanisms of husbandry.

Table 4 Constraints of dairy cattle production in the Meskan district of East Gurage zone

Variables	Agro ecology					
	High land		Midland		Over all	
	n = index	Rank	n = index	Rank	N = index	Rank
Shortage of animal feed	68 (0.18)	1	98 (0.26)	1	166 (0.22)	1
poor genetic potential of local bred	60 (0.159)	2	42 (0.111)	3	102 (0.135)	3
High cost of feed	56 (0.149)	3	64 (0.170)	2	120 (0.159)	2
Shortage of improved cattle breed	40 (0.106)	5	10 (0.026)	12	50 (0.066)	7
Shortage of manpower	22 (0.058)	8	28 (0.074)	5	50 (0.066)	8
Animal disease	24 (0.063)	7	32 (0.085)	4	56 (0.074)	4
Reproductive problem	16 (0.043)	9	20 (0.05)	7	36 (0.048)	10
Inadequate extension and Training service	52 (0.138)	4	22 (0.068)	6	74 (0.098)	5
Limited access and high cost of dairy heifer or cow	2 (0.005)	12	12 (0.031)	11	14 (0.018)	12
Milk market linkage challenge	8 (0.01)	11	9 (0.047)	8	22 (0.029)	10
AI Technicians Limitation	52 (0.069)	6	8 (0.042)	9	42 (0.056)	9
Limitation of Nitrogen and Bull semen	6 (0.016)	10	7 (0.037)	10	20 (0.026)	11

n = number of households per agro ecology, N = total number of households in the study, figures in the bracket are index values

4.10.4. Animal Disease

Animal disease and veterinary service in the Meskan district of East Gurage zone indicated in Table 12. Depending on the reports collected from the respondent households, the most prevailing livestock diseases in the study areas include Parasite, Pneumonic Pasteurollosis, Lump Skin Disease (LSD), Mastitis, Foot and Mouth disease, Blackleg and Anthrax. The incidence of pneumonic Pasteurollosis, Mastitis and Parasites were higher in midland agro ecology than that of highland areas of the study. Based on the reports obtained from the current study, the delivery of almost all veterinary services of diseases prevention and treatments were done by the local government. About 98% of respondent households have appreciation on the availability (access) of the veterinary services, but they don't have satisfaction on the quality of services delivery.

Table 5 Animal disease and veterinary service in the Meskan district of East Gurage zone

Major disease type		Agro ecology					
		High land		Midland		Over all	
		n(index)	Rank	n(index)	Rank	N(index)	Rank
1	Parasite	110(0.123)	1	156(0.160)	1	266(0.1340)	1
2	Pneumonic Pasteurollosis	70(0.078)	2	112(0.115)	2	182(0.115)	2
3	Mastitis	40(0.045)	3	64 (0.067)	3	104(0.046)	3
4	Foot and Mouth disease	28(0.03)	4	15(0.015)	4	43(0.009)	4
5	lumpy skin disease (LSD)	12(0.143)	5	12(0.012)	5	24(0.016)	5
6	Blackleg	-		9(0.009)		9(0.009)	
7	Anthrax	-		5(0.005)		5(0.005)	

n = number of respondents per agro ecology, N = total number of respondents in the study

Dairy Cattle Management

4.11.1. Types of Livestock Feeds and Feeding System

Major feed resources available in the Meskan district were indicated in Table 13. In highland and midland agro ecologies of Meskan district cattle production system is characterized by extensive system of production. Households in the study areas largely depend on feeding of crop residue and natural pasture. According to the results obtained from current study, the common

crop residues available in the district were maize stover, wheat straw, teff straw, and barley straw. Even though it was not insignificant in number some of households in the study area fed their animals on crop weeds for their animals during the main rainy season to supplement the inadequate feed supplies from grazing.

Enset leaf and leaf midribs was also used as animal feed in highland agro ecology during long dry season to supplement the inadequate feed supplies from natural pasture and crop residue. In this regard, *Ensete ventricosum* is not commonly used as animal feed source and the households in the study areas are entirely focused on production of enset as human food source. In both highland and midland agro ecologies of the study areas households largely depend on grazing lands and crop residues to feed their livestock. Based on the responses of interviewed HHs (Table 15) about 43% and 57% from high land and 72% and 28% from midland agro ecology had a practice of individual and group feeding system, respectively

Table 6; Major livestock feed resource and feeding system in the study area.

Feed resources	Agro ecology					
	Highland (188)		Midland (188)		Overall	
	n (index)	Rank	n (index)	Rank	N (index)	Rank
Natural pasture only (NP)	2(0.01)	5	1 (0.005)	4	3 (0.007)	5
Crop residue only (CR)	**	**	12(0.064)	3	12(0.031)	4
IBP only	**	**	**		**	
Enset only	2 (0.01)	4	**	**	2 (0.005)	6
NP & CR	24(0.127)	2	43(0.228)	2	67 (0.178)	3
NP, CR & IBP	19(0.10)	3	132(0.702)	1	151 (0.402)	1
NP, CR, IBP & Enset	141(0.75)	1	**	**	141(0.375)	2
Feeding system in %	%		%		%	
Individual feeding	43		72		57.5	
Group feeding	57		28		42.5	

IBP=Industrial byproduct, NP=Natural pasture, CR= Crop residue n = number of households per agro ecology, N = total number of households in the study

4.11.2. Feed Conservation Practice

In the study area of Meskan District in Gurage zone the major conserved feed resources were crop residue. Collection and storage of crop residues start soon after crop harvesting. In the high land agro ecology almost all respondents stored collected crop residues in temporary shelter with roofing. On the other hand, in midland agro ecology all interviewed respondents heaped the

residues in conical shape with roofless shelter (fencing) made of local materials to reduce damage by animals and other calamities.

4.11.3. Chemical composition and nutritive value of feeds

Table 14 shows the nutritional value (DCP (g/kg), IVDMD% ME (MJ/kg DM%), and chemical composition (DM%, ASH%, CP%, EE%, NDF%, ADF%, and ADL%) of the primary feed stuffs (maize stoven, wheat straw, enset, teff straw, natural pasture, and barley straw) in the research region utilized for cow feeding. In the highland, the dry matter (DM) content of all feeds that were accessible for feeding cattle varied from 90.43% wheat straw to 92.53% enset, whereas in the midland agroecology, it varied from 91.12% wheat straw to 92.87% maize stoven and natural pasture. Barley straw had a dry matter (DM) content of 92%, whereas natural pasture on the highlands had a DM content of 91.23%.

The crude protein (CP) content of crop residues varied from 3.56 % in wheat straw to 9.07% in barley straw for high land and 3.09% in wheat straw to 5.87% in teff straw for midland agroecology. The CP value (9.92%) in high land and (8.19%) in midland was obtained from natural pasture. The CP content of natural pasture was higher in high land agroecology than in midland agroecology. The CP value (8.51%) obtained from enset leaf and leaf midribs was higher than the minimum CP value (7%) required for optimum rumen microbial function. The ash content of crop residues in the study area ranged from 9.11% barley straw to 9.22% wheat straw in the highlands and 9.09% teff straw to 9.37% wheat straw in the midlands. The ash content of natural pasture is 10.11% in the highlands and 11.47% in midland agroecology, respectively. The organic matter content of feed stuffs ranged from 88.53 percent natural pasture in mid-land to 92.83% enset in high-land, in which the enset leaf had the highest (92.83%). The organic matter content of crop residue ranges from 90.78% wheat straw to 90.89% barley straw in high land and 90.03% maize stoven to 90.91% teff straw in mid-land agroecology.

The fat content (EE) of feed stuffs ranged from 0.27% wheat straw to 6.84% enset in highland, where enset had the highest EE content (6.84%). The (EE) contents of crop residues in midland

are maize stover (0.47%), wheat straw (0.76%), and teff straw (2.75%). The EE content of natural pasture in midland (1.9%) and high land (1.56%) .

The neutral detergent fiber (NDF) content of the straws of cereal crops in the current study was between wheat straw (64.83%) and teff straw (75.21%) in midland and barley straw (51.25%) in high land agroecology. The neutral detergent fiber (NDF) content of natural pasture is 75.93% in high land and 76.64% in midland agroecology. The neutral detergent fiber (NDF) content of maize stover is 77.35% in mid land and ensset leaf is 61.82% in high-land agroecology. The ADF content of crop straws varied from 51.6% in barley straw to 67.12% in wheat straw on high land. And teff straw 58.44% to 63.33% wheat straw in mid land agroecology. Whereas the ADF content for native grass in the dega and weinadega agroecologies, respectively, was 51.02 and 43%. The ADF percentage in maize stover in the study area was found to be 53.44% in midland, while the percent ADF in ensset was 53.5% in highland agroecology. The acid detergent lignin (ADL) contained in different crop residues found in the study areas ranged from 7.52 percent wheat straw in midland to 8.6% barley straw in highland agroecology. The highest concentration of lignin was found in barley straw (8.6%), followed by teff straw (8.53). The lignin percentage in the maize stover of the study area was found to be 8.11, while the percent lignin of native grasses in the dega and weinadega agroecologies, respectively, was 8.93 and 9%, which is greater than the limiting lignin content of 7%. The ADL in the leaf of ensset (*E. ventricosum*) in the current study was 9.71%, which is higher than the maximum level of 7%. The digestible crude protein (DCP) content of natural pasture in the current study was 88.68% (g/kg) in high land and 72.6% (g/kg) in midland agroecology. Whereas the digestible crude protein (DCP) content of crop residues in the current study ranged from 25.23% (g/kg) for wheat straw in midland to 80.78% (g/kg) for barley straw in highland agroecology. The digestible crude protein (DCP) value reported for the leaf and leaf midribs of *ensset* (*E. ventricosum*) from highland areas of the study was 75.58% (g/kg). The digestible crude protein (DCP) value reported for maize stover from the midland area of the study was 35.54% (g/kg).

The IVDMD reported in the current study for natural pastures was 59.19% and 59.93% in highland and midland agroecologies, respectively. The IVDMD for maize stover reported in the current study was 54.53%. The level of IVDMD from the leaf and leaf midribs of the ensset in the current study was about 57.16%. The IVDMD content of crop residue ranged from 52.23% to

56.3%, with Teff straw having the highest (56.3%). The IVDMD content reported for wheat straw was 54.04% in highland and 52.23% in midland agroecology (Table 16), which was lower than all reported IVDMD values of crop residues in the current study. The level of IVDMD in the leaf of the enset was about 57.16%. The IVDMD of straws from cereal crops ranged from 52.23 to 56.3%, with teff straw having the highest (56.3%) content, followed by barley straw (54.12%).

The metabolic energy (ME) content of natural pasture in the current study was 8.88 MJ/kg DM in high land and 8.99 MJ/kg DM in midland agroecology. The energy content of crop residues in the current study ranged from 8.11 MJ/kg DM for wheat straw to 8.45 MJ/kg DM for teff straw. The energy value reported for the leaf and leaf midribs of *enset* (*E. ventricosum*) from highland areas of the study was 8.57 MJ/kg DM.

Table 7 Chemical composition and nutritive value of feed stuffs in study area of Meskan district East Gurage zone

Feed stuffs	Agro ecology	Chemical composition of feed stuffs								Nutritive value of feed stuffs		
		DM%	CP%	ASH%	OM%	EE%	NDF%	ADF%	ADL%	DCP(g/kg)	IVDMD%	ME (MJ/kg DM)
NP	Highland	91.23	9.92	10.11	89.89	1.56	75.93	51.02	8.93	88.68	59.19	8.88
	Midland	92.87	8.19	11.47	88.53	1.9	76.64	43	9	72.6	59.93	8.99
WSt	Highland	90.43	3.56	9.22	90.78	0.27	67.49	67.12	8.02	29.59	54.04	8.11
	Midland	91.12	3.09	9.37	90.63	0.76	64.83	63.33	7.52	25.23	52.23	7.83
BSt	Highland	92.22	9.07	9.11	90.89	2.01	51.25	51.6	8.6	80.78	54.12	8.12
	Midland	**	**	**	**	**	**	**	**	**	**	**
TSt	Highland	**	**		**	**	**	**	**	**	**	**
	Midland	92.57	5.87	9.09	90.91	2.75	75.21	58.44	8.53	51.05	56.3	8.45
MSv	Highland	**	**	**	**	**	**	**	**	**	**	**
	Midland	92.87	4.2	9.97	90.03	0.47	77.35	53.44	8.11	35.54	54.53	8.18
Enset	Highland	92.53	8.51	7.17	92.83	6.84	61.82	53.5	9.71	75.58	57.16	8.57
	Midland	**	**	**	**	**	**	**	**	**	**	**

DM = Dry matter, CP = Crude protein, OM = Organic matter, EE = Ether extract, NP = natural pasture, WSt = wheat straw, BSt = barley straw, TSt = Teff straw, MSv = maize stover, NDF = Neutral detergent fiber, ADF = Acid detergent fiber, ADL= Acid detergent lignin ** = not available in the area

4.11.4. Estimated Annual Feed Supply, Demand and Balance

Estimated annual nutrient supply of feed stuffs in highland and midaltitude agro ecology in the study area used for cattle feeding was indicated in Table 15. The annual nutrient supply of DCP of wheat straw, barley straw, enset and natural pasture (6.9 kg, 17.59 kg, 16.5kg and 19.24kg) respectively in high land agroecology and the annual nutrient supply of DCP of wheat straw, teff straw, maize stover and natural pasture ;8.97kg, 17.04kg, 12.19kg and 23.76kg respectively in midland land agroecology. The annual nutrient supply of dry matter of wheat straw (483.80ton) and natural pasture (12.54ton) in the high land area comparable from the annual nutrient supply of dry matter of wheat straw (494.21ton) and natural pasture (10.45ton) from midland agro ecology and also the annual

nutrient supply of TME (MJ) of wheat straw (3,348,218.85 MJ) and natural pasture (86,785.17 MJ) in the high land area of same row with different letter of superscripts are significantly different ($P<0.05$), from the annual nutrient supply TME of wheat straw(3,632585.94 MJ) and natural pasture(76810.51 MJ) from midland agro ecology of the study area. The total annual nutrient supply of DCP (60.23 kg), Dry Matter (1333.30 ton) and TME (9,227,325.74 MJ) respectively in the high land agro ecology different from the annual nutrient supply of DCP (61.96 kg), Dry Matter (1795.48 ton) and TME (13197295.5 MJ) respectively in midland agro ecology of the study area. The total estimated nutrient supply, requirement and feed balance in the district were indicated in Table 16. The daily requirement of DM, DCP, ME per tropical livestock unit (TLU) of animal for maintenance were estimated based on the recommendations of Kears (1982) and McCarthy (1986) for one TLU. In the highland agro ecology the estimated available feed supply satisfies only about 68.9%, 44.83% and 69.46% of the maintenance level of DM, DCP, ME requirement of animals per year. In the midland agro ecology, on the other hand, the amount of feed (dry matter) available only serve for 79.7% of total maintenance requirement of animals found in the study areas. In the same way, total annual DCP and ME produce in the study areas, respectively, satisfy 39.36% and 83.36% of the total requirements of animals found in midland areas of the study. The negative balance observed in the district resulted from shortage and poor quality of roughages as well as unavailability of byproducts shortage of supplement feeds.

Table 8. Estimated annual nutrient supply of feed stuffs in highland and midaltitude agro ecology in the study area of Meskan district in East Gurage zone.

Feed stuffs	Agro ecology						P-value
	High land			Mid land			
	DCP(kg)	DM(t)	TME (MJ)	DCP(kg)	DM(t)	TME (MJ)	
Wheat	6.90(11.45%)	483.80 ^a (36.28%)	3,348,218.85(36.28%)	8.97(14.48%)	494.21 ^b (27.52%)	3,632585.94(27.52%)	0.04
Barley	17.59 (29.2%)	400.49(30%)	2,771,658.06(30%)	**	**		0.00
Teff	**	**		17.04(27.5%)	454.22(25.3%)	3,338,647.92(25.3%)	0.00

Maize	**	**		12.19(19.67%)	836.60(52.16%)	6,149,251.13(46.59%)	0.00
Enset	16.50(27.39%)	436.47(32.75%)	3,020,663.66(32.74%)	**	**		0.00
Natural pasture	19.24(31.94%)	12.54 ^a (0.92%)	86,785.17(0.94%)	23.76(38.35%)	10.45 ^b (0.58%)	76810.51(0.58%)	0.03
TOTAL	60.23(kg)	1333.30(t)	9,227,325.74(MJ)	61.96(kg)	1795.48(t)	13197295.5(MJ)	

^{b-a} = means in the same row with different letter of superscripts are significantly different ($P<0.05$), ** = not grown in the area, HHs = households, TME=total metabolisem energy ,DCP=Digestable crude protein,DM=Dray matter

Table 9 Estimated annual nutrient supply, requirement and balance of animals in the study area of Meskan district East Gurage zone

Livestock in TLU in Agroecology	Annual nutrient supply			Annual nutrient demand			Annual nutrient supply and demand balance		
	TDM(t)	TDCP(t)	TME (MJ)	TDM(t)	TDCP(t)	TME (MJ)	TDM(t)	TCP(t)	TME (MJ)
Highland = 1220.9	1333.3	60.23	9,227,325.74	1935.13	134.35	13,284,373.4	-601.83	-74.12	-4057047.6
Yetebon = 640.4	734.57	33.17	5,058,563.45	1015.03	70.47	6968066.76	-280.46	-37.3	-1909503.31
Mrab Meskan =580.5	598.73	27.06	4,168,762.29	920.1	63.88	6316306.61	-321.37	-36.82	-2147544.32
Midland = 1569.2	1795.48	61.96	13197295.5	2252.8	157.42	15,852607.2	-457.32	-95.46	-2655311.72
Msrak Meskan =432.2	517.29	17.82	3802117.44	620.48	43.38	4366235	-103.19	-25.56	-564117.56
Dobo Tuto =362	422	14.56	3101910.32	519.7	36.32	3657050.6	-97.7	-21.76	-555140.29
Beresa =393	440	15.18	3189507	564.2	39.43	3970223.5	-124.2	-24.25	-780716.45
Debub Shershera =382	416.19	14.35	3103759.93	548.41	38.32	3859097.6	-132.22	-23.97	-755337.67

TDM = total dry matter, TDCP = total digestible crude protein, TME = total metabolizable energy, MJ = mega joule, (t) = ton

5. DISCUSSIONS

5.1. Demographic Characteristics of Households

According to the results obtained from this study, the proportion of male to female households in the highland areas were 95.75% male, 4.25% female. Whereas the percentage of households in the midland areas of the study were about 97.87% male and 2.13% female with the overall average of about 96.81 % male and 3.19% female households in the current study. This result was relatively comparable with the results of 84.62% male and 15.38% female headed household reported by Gatwech (2012) in Gambella, south west Ethiopia, and 83.6% male and 16.4% of the female headed households reported by Dirsha (2019) in Gurage zone southern Ethiopia. However, the overall average results of households (96.81%) male and (3.19%) female obtained in the current study is different from results of 67% male and 33% female reported by Azage (2004), in Addis Ababa; 75.6% male and 24.4% female headed households reported by Megersa (2016) in west Shoa zone of Oromia, Ethiopia. The difference shown between male and female household in the study areas might be related with cultural conditions that promotes the power of ownership of male household over the family holdings.

The results of the current study indicated that the majority (96.81%) of the household respondents were married and about 3.19% single. The result obtained in the current study was relatively comparable With the values of 97.4% married, 1.3% single and 1.3% divorced reported by Bernabas *et al.* (2018) for Quara Districts in Northern Ethiopia. The average age of the HHs within the age interval of 21-80 years was 43.5 ± 0.9 which is similar with the average age of 43.4 ± 1.0 reported by Seid and Berhan (2014) in Burji Woreda, Segen Zuria Zone of SNNPRS, Ethiopia. This result has indicated that majority of the household were at the productive age groups and can manage their cattle. The result of current study on the educational status HHs disclosed that 85.1% of the respondents had an opportunity of getting education which was relatively comparable with the values of 80.8% reported by Nigussie (2006) but higher than the result of 40% reported by Ketema (2014) in Kersa Malima Wereda. However, the level of education of HHs reported in current study was lower than 90% reported by Beriso *et al.* (2015) in Aleta Chukko District, Southern Ethiopia. Adoption of technology particularly

dairy was associated with the level of farmers' education. It could be said that dairy smallholder farmers with higher education level were more likely to accept training on dairy management, including herding, feed collection, feeding, milking, milk processing, health management and breed improvement.

The overall mean family size per household in study areas was 6.72 ± 0.20 which was similar to the family size of 6 persons per household reported by Abebe *et al.*, (2014) in *Ezha* Districts of the *Gurage* Zone, Southern Ethiopia and 6.07 person per household reported by Misgana *et al.* (2015) in East Wollega Zone, Ethiopia but lower than 7.71 family size per HH reported by Dirsha (2019) in Gurage zone southern Ethiopia, and 7.4 person per HH reported from Shashemene and Dilla by Sintayehu *et al.*, (2008). In the district, having greater number of children probably associated with wealth status of households with the assumption of realizing different activities of livestock and crop production.

5.2. Landholding and Land Use System

The average land holding per household was 1.32 ± 0.5 ha in highland and 1.25 ± 0.25 ha in midland agro ecology. The overall average land holding in the study area, was 1.29 ± 0.375 ha which was lowest when compared with 2.91 ± 0.18 ha reported by Andualem *et al.* (2015), in Essera Woreda, Dawuro Zone, Southern Ethiopia and 2.7ha was reported by Asaminew and Eyassu (2009) in North western highlands of Ethiopia. However, the reports of current study on the land holdings per HH was similar with 1.015ha reported by Ayalew (2017) in south Wollo Zone Amhara region Ethiopia, 0.9ha reported by Abebe *et al* (2014) in Ezha districts of the Gurage zone southern Ethiopia and lower than 2.5ha reported for the Dendi District in Oromia Region by Belay *et al.* (2012).

5.3. Livestock Population and Herd Structure

Cattle population owned by the respondent farmers in the study areas was varied which could be related to several factors of shortage of feed, feed cost, poor genetic potential of local breed, Animal disease, market linkage challenge, scarcity of grazing land and shortage of man power to manage cattle. The percentage of crossbreed cattle 26.68% indicated in Table 6 was higher than the reported results of 4.45% by Dirsha (2019) in Gurage Zone, Southern Ethiopia. The holding

size of local cattle was higher than the size of cross breed animal particularly in highland agro-ecology of the study areas due to lack of breed improvement practices. In highland areas, about 82.04% of households participated in the study kept local cattle breed that could be due to lack of awareness to use artificial insemination and improved bull service. However, the percentage of local breed ownership reported in this study was lower than 98.5% of local cattle ownership reported by Minale and Yilkal (2015) in Kucha Districts Southern Ethiopia. of the study. Similarly, the average household's ownership of 3.38 ± 0.28 cows was higher than 1.4 cows per HH reported by Abebe *et al.*, (2014) in Ezha Districts of Gurage Zone, Southern Ethiopia and 1.22 cow per HH reported by Ayantu, (2006) in Wolaita Zone Ethiopia.

5.4. Purpose of Dairy Cattle Keeping

The major objectives of dairy cattle keeping in the district was milk and milk product consumption (64.1%), milk sale (35.9%) and manure production. The result of current study was relatively similar with Fasil and Workneh (2014) reported in east and west Gojjam zones of Amhara region.

5.5. Labor Division towards Cattle Production

The study indicated that household members of the study area had involved in different activities and responsibilities in the husbandry practices of dairy animals including herding, feed collection, feeding, milking, milk processing and selling of milk and milk products. About 43.35% of feed collection was the task of male household, children 42.55% whereas the remaining 14.1% of feed collection was done by wives and hired person. Cattle herding (41.75% and 34.84%) and feeding (38.3% and 43.9%) were practiced by adult males and females, respectively. About 88.29% of milking and milk processing in most cases performed by females and the remaining 11.71% was done by Male household head and children which is comparable with results (80%) reported by Beriso *et al.* (2015) from Aleta Chukko District of Southern Ethiopia and Abebe *et al.* (2017) who reported milking was done predominantly by housewives in the selected Central Highlands of Ethiopia.

5.6. Reproductive and Productive Performance

Based on the reports obtained from the respondent households in the current study, 73.32% of the cattle breeds owned by HHs were indigenous cattle, which are characterized by low milk yield and are small in size, while the rest (26.68%) were crossbred. The overall estimated daily milk yield obtained in current study was about 1.92 ± 0.03 liters/day/cow which was relatively similar to the result of 1.97 ± 0.24 liters reported by Sintayehu (2007) in Shashemene-Dilla area and Zereu; Lijalem (2016) who reported 1.989 ± 0.06 liters in Wolaita Zone, Southern Ethiopia and 1.7 liters for local cows in Guraghe Zone, Southern Ethiopia reported by Ayalew and Feyisa. (2017) but less than the average daily milk yield of 2.4, 3.0, 2.6, liters/cow/day for first, second and third lactation reported by Minale and Yilkal (2015 in Chench district and Samuel *et al.*, (2017) who reported 2.26 liters/cow/day in Bahir Dar Zuria, Mecha and Yelmana Densa Districts of Amhara Region.

The overall estimated mean lactation length of cows obtained in the current study was 7.96 ± 0.14 months, which was similar to the reported average lactation length of 7.8 months for Horo cows by Gebreegziabher (2013); 7.90 ± 0.08 months reported by Ayalew and Feyisa (2017) for Guraghe highland cows; and 217 days for the local breed reported by Dirsha (2019) at Gurage Zone, southern Ethiopia. However, it is less than the average lactation length of 10.5 months reported by Lemma *et al.* (2005) for local cows in the in the East Shoa zone of Ethiopia.

The overall estimated mean age of heifers at first service for the current study was 51 months, which is less than the average value of 60 months for Horo heifers reported by Gizaw *et al.* (1998) but higher than the average age of 42.61 ± 2.82 months at first service reported by Abera *et al.* (2018) in the selected District of Sidama Zone; 44 ± 8 months reported by Gidey (2001) for Fogera heifers at Andassa Livestock Research Centre; and 33.51 ± 0.70 months for Gurage highland cows reported by Ayalew and Feyisa (2017).

The mean age at first calving (AFC) for heifers in the study areas was 5.25 ± 0.40 years (63 months), which is similar to the values of 54.1 months for local animals at Bench Maji Zone, Ethiopia; 54.7 months for Fogera cattle in north Gonder Zone; 52.25 months for local heifers in West Shoa Zone, Oromia, Region; and 60–64 months for local breed animals at Gurage Zone of southern Ethiopia, respectively, reported by Tekele (2005), Zewdu (2010), Megersa (2016), and

Dirsha (2019). The overall estimated mean calving interval for the current study was 24.24 ± 0.02 months, which was similar to the results of Mersha (2006), who reported 24 months in the Abergele breed; Mulugeta and Belayeneh (2013), who reported 748 days (24.9 months) for indigenous cows in the North Shoa Zone of the Amhara Region; and Mengistu (2021), who reported 24.24 months in the East Gojjam Zone, North Western Ethiopia. However, it was higher than the reported value of 22.03 ± 0.37 months by Ayalew and Feyisa (2017) for the Gurage highland cow. The present study also indicated that the age at first calving (AFC) of native cattle was longer than the finding reported by Kumar (2014) (39.4 ± 1.7). Tigray, Gebriel (1983), 33.8 months in the Arsi breed, and Mulugeta (2013), 40.9 ± 6.6 months. However, it was comparable with the results of Belay *et al.* (2012) at 50.59 ± 6.94 and Menale *et al.* (2011) at 50.8 ± 0.36 . The observations are in line with those of Masama *et al.* (2003), who reported that the management and nutrition status of the cows influence their pre-pubertal growth rates and later their productive and reproductive status.

5.7. Constraints of Dairy Cattle Production

Based on the responses of the respondents and personal observation, the quality and productivity of natural pastures are too poor to satisfy the nutrient requirements of the cattle. Prolonged dry periods and erratic distribution of rainfall, particularly in midland agroecology, affected crop production and the regrowth of natural pasture. The result of the current study is in line with results reported by Abera *et al.* (2018), who reported that feed shortage was one of the major constraints in selected districts of Sidama Zone, Southern Ethiopia; Dirsha (2019), who reported that feed shortage was one of the major challenges that affect the productive and reproductive performance of local dairy cows in Gurage Zone, Southern Ethiopia; Musa and Mummed (2020), who indicated that shortage of quality feed supply was the prior problem in the west Hararghe zone of Oromia region, Ethiopia.

The poor genetic potential of indigenous breeds was the third major constraint on the production and productivity of dairy cattle. It was emphasized that indigenous animal breeds in the area are generally characterized by being small in size, low milk yield, slow growth rate, and remaining unproductive for a long period of time. The amount of milk obtained per day per cow was 2.6

litters, which is insufficient to satisfy family consumption. During the group discussion, the participants recommended that the application of selection to indigenous cattle with better body condition and relative productivity, together with an adequate supply of feed, veterinary services, AI, bull service, and shelter, might help to improve the productivity of indigenous stock.

As it was responded to by respondents to the study, livestock disease was one of the major problems affecting dairy cattle production. According to the responses of respondents and veterinary technicians, among livestock diseases, the most common economic dairy cattle diseases in the district were parasites, mastitis, and pneumonic pasteurellosis. Disease results in the in the death of animals, weight loss, poor fertility, and stunted growth. More over, the majority of the respondents in the district reported that they do have the opportunity to vaccinate and de-warm their animals for different types of diseases and parasites, including anthrax, blackleg, lumpy skin disease, as well as internal and external parasites.

According to the responses of households included in the study, the delivery of veterinary services, including vaccination, treatment, animal drug provision, and other clinical services, was delivered by the government of the local administration. Vaccination was taken twice a year, early before and at the end of the main rainy season. The result of the current study is comparable to the results of Yetera *et al.* (2018), who reported that activities related to veterinary services, including treatment, vaccination, and extension services given to farmers, were provided by the Bureau of Agriculture. Members who participated in the group discussions, on the other hand, indicated that the activities associated with the delivery of veterinary services in the district have a lot of drawbacks, including a shortage of veterinary inputs, vet technicians's skill gaps, and a lack of government and other stakeholder attention, which is in agreement with the findings of Mengistu (2021) in Debay Tilat Gin District, East Gojjam Zone of Amara Region.

5.8. Dairy Cattle Management

5.8.1. Types of livestock feed resources and feeding systems

The availability of feed resources in the study area depends on the season. However, crop residues, natural pasture, and industrial byproducts (in most cases in mid-altitude) were

commonly used as cattle feed resources in the study areas. In addition to the aforementioned feed resources, feed from enset leaves and leaf midribs has been another opportunity to feed animals in the study area of highland agroecology. The result of the current study is comparable to the result of Getu (2019), who reported that roughages including natural pasture, grass hays, crop residues, and non-conventional feed resources are major feed resources for dairy animals in Sebeta, Bedele, and Debre-Berhan areas.

5.9. Chemical Composition and Nutritive Value of Feeds

The chemical composition and nutritive value of the major feedstuffs utilized for cattle feeding in the study areas were indicated in Table 16, and the dry matter (DM) content of the feeds available for livestock feeding in both highland and midaltitude agroecologies was above 90%, which corresponds with the reported results of different scholars in different parts of the country (Ahmed, 2006; Sisay, 2006). The dry matter (DM) content of all feeds available for cattle in the district was 90.43–92.87 percent, which is similar to the results of 92.40%–94.03% in Dirsha (2019) in the Gurage Zone of southern Ethiopia and Zewdie (2010) in the central Rift Valley.

The ash content of the major cereal crop residues in the study area ranged from (9.09%) teff straw to (9.97%) maize stover in midland, in which the maize stover had the highest ash content (9.97%) in midland, followed by wheat straw (9.37%) in highland agroecology (Table 16). The ash content reported for barely straw in this study was lower than the value (14.6%) reported by Yitaye (1999) and Solomon (2004), but similar to the value (9.11%) reported by Mekuanint and Girma (2017). On the other hand, the value of ash content for wheat straw (9.37%) was similar to 9.34% reported by Mekuanint and Girma (2017), but higher than 8.94% reported by Alemu *et al.* (1989) and 8.22% reported by Solomon (2004). The ash content of the maize stover recorded in this work (9.97%) is far greater than the result reported by Yitaye (1999), which was 7%. The variations observed in the ash contents of crop residues of cereal crops could be associated with environmental factors such as rainfall, soil character, temperature, and contamination of the residues by other external factors. The ash content of native grasses was 10.11% for highland and 11.47% for midland agroecology (Table 16). The variation observed could possibly be due to variation in the agroecology of the study areas, which corresponds with the report of Little (1982), who stated that the ash content of natural grasses increases as elevation in altitude

decreases, and such variations could possibly arise from differences in climate and soil types. However, Mekuanint and Girma (2017) reported (10.99%) ash content of native grasses from highland (dega) and (9.89%) from midaltitude (midland), which disagreed with the statement made by Little (1982) and the results recorded in the current study.

In general, except for barley straw, the percentage of CP obtained from crop residues that are considered available feed resources for livestock feeding in the study areas is much lower than that set as a minimum level of nitrogen (7%) to limit intake (Milford and Minson, 1966; Van Soest, 1982). The CP content reported in the current study from the same residues of crops (Table 16), however, is at a lower level to fulfill the optimum CP requirement of livestock, which agreed with the general statement made by Preston and Leng (1984), which indicated that some cereal crop residues have a low nitrogen content and are composed of cell wall components with little soluble cell contents. Grasses from the highland and midland agroecologies of the study areas, respectively, had CP contents of 9.92% and 8.19%. The value for CP content of grasses from highland agroecology was higher than that of midland areas. Such differences may be associated with the reduction in the proportion of legumes in the pasture with a decrease in altitude, and this is in line with the findings of Alemayehu (1985) and Mekuanint and Girma (2016). The CP values from natural grasses are closer to the minimum value reported by Milford and Minson (1966) and Van Soest (1982), required for optimum rumen microbial function; hence, they can support the maintenance requirements of ruminants with slight supplementation.

The crude protein contents, except barley straw, of the crop residues reported in the current study are extremely lower than the minimum level of CP (7%) required for optimum rumen microbial function (Milford and Minson, 1966; Van Soest, 1982). The CP value (8.51%) obtained from enset leaf and leaf midribs was higher than the minimum CP value (7%) required for optimum rumen microbial function (Milford and Minson, 1966; Van Soest, 1982). The results of the current work agree with the report of Seyoum and Fekede (2008) that cereal crop residues are normally characterized by low digestibility and energy value, which are both inherent in their chemical composition. The CP contents of enset leaf and midribs obtained in the current study area are lower than the average CP value of 10.37% reported by Dirsha (2019) in Gurage Zone, Southern Ethiopia, and 13.15% reported by Mohammed *et al.* (2013).

The *in vitro* dry matter digestibility (IVDMD) for maize stover was 54.53%, which is lower than the value reported for maize stover (58.65%) by Chalchissa *et al.* (2014). The value reported for wheat straw (52.23%) in this work (Table 16) was lower than that from all reported values for the straws of cereal crops in the current study and higher than the results (41.92%) in Gassera and (42.22%) in Ginnir districts in the Bale zone of the Oromiya region reported by Mekuanint and Girma (2017). The mean *in vitro* digestible organic matter in the dry matter (IVDOMD) for cereal crop residues ranged from 52.23% to 56.3% wheat straw and teff straw in the district. The results of the current study on IVDMD of crop residues were in line with the reports of Buxton and Russell (1988) and Seyoum and Fekede (2008), who reported that cereal crop residues are normally characterized by low digestibility and energy value, which are both inherent in their chemical composition. The IVDMD for maize stover reported in the current study was 54.53%, which was lower than the reported value of 58.65% by Chalchissa *et al.* (2014).

The average energy contents of straws in this study were within the range reported by Solomon (2004) and Yitaye (1999), but the ME recorded in the current study is much higher than the ME content of 5.96 MJ/kg DM for wheat straw reported by Chalchissa *et al.* (2014). The energy content of native grass in the current study was (8.88 MJ/kg DM) in dega and (8.99 MJ/kg DM) in weinadega agroecology, which is comparable with the reports of Zinash *et al.* (1995) (8.19 MJ/kg DM) and Yitaye (1999) (8.17 MJ/kg DM). The energy content of the maize stover in the study area (8.18 MJ/kg DM) was higher than the report of Yitaye (1999), which was 7.33 MJ/kg DM, but lower than that reported by Chalchissa *et al.* (2014), which was 8.79 MJ/kg DM. The observed variations in the value of the energy content of crop residue among agroecologies could probably be associated with differences in the agroecology, rainfall, environment, soil type, and the type of crop grown in each agroecology.

The neutral detergent fiber (NDF) content of the straws of cereal crops in the current study was between teff (75.25%) and barley (51.25%), lower than the value reported by Sisay (2006), which reported greater than 70% average NDF contents for cereal crop residues. Comparable results of 79.4 and 72.98% were reported for the straws of cereal crops, respectively, by Alemu *et al.* (1989) and Solomon (2004). The NDF contents of 78.6, 81.5, and 82.13%, respectively, for wheat straw, teff straw, and maize stover were reported by Chalchissa *et al.* (2014). Roughage feeds with an NDF content of less than 45% are categorized as high quality, 45–65% as medium

quality, and those with more than 65% as low quality (Singh and Oosting, 1992). The NDF content of barley straw identified in this study (Table 16) is found in the range of 45–65% and could be classified as medium-quality roughages that may not impose drawbacks on animal performance. The NDF content of leaf enset was 61.82% for dega agroecology, which was laid between the ranges of 45 and 65%, and it could be classified as medium-quality livestock feed (Singh and Oosting, 1992). The NDF content of the maize stover in the current study (77.35%) is less than the NDF content of the maize stover (82.13%) reported by Chalchissa *et al.* (2014). The NDF content of native grass reported in this study (75.93%) in dega and (76.64%) in weinadega was closer to the values reported by Ahmed (2006) and Solomon (2004). The higher NDF content could be a limiting factor on feed intake since voluntary feed intake and NDF content are negatively correlated (Ensminger *et al.*, 1990), and therefore, feeds with an NDF content greater than 65% in the current study could be classified as having low quality roughages, which could impose limitations on feed intake and animal production.

The ADF content of the maize stover was 53.44%. Kellems and Church (1998) categorized roughages with less than 40% ADF as high quality and those above 40% as low quality. The results of the ADF content of feeds in the current study were higher than the ADF values reported by Yitaye (1999) for barley straw (39.45%), native grasses (29.98%), and maize stover (44.22%). Variation in ADF content could be attributed to differences in temperature, crop management, and soil type. The ADF content of maize stover (51.72%), reported by Chalchissa *et al.* (2014), was lower than the reported ADF value of 53.44% in the current study.

5.10. Estimated Annual Feed Balance

The annual available feed was compared with the annual requirements of the livestock population. The daily requirements of DM, DCP, and ME per TLU for maintenance were estimated based on the recommendations of Kearl (1982) and McCarthy (1986) for TLU. The overall estimated feed supply in the study area satisfies only 74.3%, 42.09%, and 76.37% of the maintenance requirements of DM, DCP, and ME in livestock, and it was 25.7%, 57.91, and 23.63 deficits per year, respectively, for DM, DCP, and ME (Table 18). Estimates on the amount of available feed supply and demand per year per agroecology were made, and there were differences in available feed demand and supply. In DEGA agroecology, the available feed

supply met only about 68.9% DM, 44.83% DCP, and 69.49% ME of the maintenance requirement of livestock per farm per year. In Weinadega agroecology, on the other hand, the available feed supply satisfied about 79.7% DM, 39.36% DCP, and 83.25% ME of the maintenance requirements of livestock.

Within dega agroecology, the available feed on a year-round basis in Yetebon PA satisfied about 72.37% DM, 47.08% DCP, and 72.95 ME maintenance requirements, while in Mrab meskan PA of dega agroecology, livestock feed balance and the available feeds could only satisfy the maintenance requirements of 65.07% DM, 42.35% DCP, and 66% ME, respectively. On the other hand, in PAs of Msrak Meskan, Dobo Tuto, Beresa, and Debub-shershera found in Weinadega agroecology, the available feed can only satisfy the maintenance requirements of 83.37%, 81.25%, 77.99%, and 75.89% DM; 41.17%, 40.11%, 38.51%, and 37.47% DCP; and 87.08%, 84.82%, 81.46%, and 79.27% ME, respectively. It was indicated in Table 18 (contradictory with above) that the total estimated annual feed supply in the study area of Meskan district in Gurage zone met only about 74.3% (DM), 42.09% (DCP), and 76.37% of the of the maintenance requirements of livestock. The greater feed deficit encountered in the district might be associated with poor quality of roughages and the absence of supplements from different agro-industrial products. The observed negative feed balance in DM requirement in the current study agrees with the report of Dawit *et al.* (2013) from selected Kebeles of Adami Tullu Jiddo Kombolcha District of East Showa Zone in Oromiya region and Selamawit *et al.* (2017) from north Achefer district in Amhara region. However, it disagrees with the report of Sisay (2006), who reported a surplus DM supply compared to the total annual livestock requirement in the North Gondar zone of Ethiopia.

6.CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The study was conducted in the two agro ecologies of the district because the two areas are well known for its higher number of cattle population in the District.. In the district no research has been conducted to gives information about the production , reproduction performances and the major feed resources available at different agro ecologies of the study area of dairy cattle, so the study is justifiable to have recorded and realistic information for future development work. .A total of 376 lactating cow owner respondents were purposefully selected and data were collected through a questionnaire, interview, focus group discussion, and personal observation. The result of the study showed that the dairy production system in the district was a mixed crop-livestock production system. The overall family size per household of 6.72 ± 0.20 , the cattle population of 7.17 ± 0.3 heads (6.84TLU), and the land holding of 1.29 ± 0.325 hectares per household were obtained in this study. About 64.1% and 35.9% of households in the study areas indicated that the producing milk and milk products were used for consumption and sale, respectively. In the highland agroecology of the study areas, the major feed resources of cattle were crop residue, natural pasture, IBP, enset leaf, and leaf midribs, while it was natural pasture, crop residue, IBP, and maize Stover in midland agroecology. Annual feed supply in the district satisfies 68.9%, 79.7% TDM, 44.83%, 39.36% TDCP, and 69.46%, 83.25% TME of the maintenance requirement of livestock in TLU per year in highland and midland agroecologies, respectively. Major dairy cattile constraints are shortage of feed , poor genetic potential of indigenous breed, high-cost feed ,inadequate extension and trainig service,limitation of AI technicians ,Nitrogen and Bull semen , animal disease , reproduction problem and shortage of manpower. The major cattle diseases observed in the district were parasites, mastitis, black leg, lumpy skin disease, and anthrax. It was concluded that, due to poor husbandry practices, the productive performance of local cows was low. Therefore, intervention in husbandry practices, mainly improvement of feed and breed, should be done to increase milk production and productivity. Cattles feed deficit was serious and needed strong intervention and attention.

6.2. Recommendation

Therefore, based on the above conclusions, the following recommendations are forward;-

- For more efficient utilization of crop residues, practical trainings that give understanding towards feed treatments and conservation should be introduced and practiced, and focus should be given on low-cost feed ration formulation.
- Implement strong and committed extension and training services to alleviate the skill gap observed among dairy farmers and development agents treating animal disease.
- Productive and reproductive performance of local cows was low do to this improvement of feed and breed, should be done to increase milk production and productivity and focus on breed improvement through the provision of efficient and effective AI and bull services.
- Cattles feed deficit was serious and needed strong intervention and attention.

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9. APPEDICES

Appendix Table 1: Conversion factors of livestock number to tropical livestock unit (TLU)

Livestock species	TLU
Local oxen/bulls	1.1
Cross bred oxen/bulls	1.9
Local cows	0.8
Crossbred cows	1.8
Local heifers	0.5
Crossbred heifers	0.7
Local calves	0.2
Crossbred calves	0.4
Sheep	0.1
Goats	0.1
Horses	0.8
donkeys	0.5

Source: Gryseels (1988) and Bekele (1991), TLU=Total Livestock Unit

Appendix Table 2: Total daily nutrient requirement of livestock per livestock species

Livestock species	DM (kg)	CP(g)	ME (MJ)
Oxen	4.8	361.3	33.0
Bulls	4.8	361.3	33.0
Cows	4.4	227.8	29.7
Heifers	3.3	232.0	21.7
Calves	1.9	144.0	13.0
Sheep	0.65	53.0	4.3
Goats	0.64	49.0	5.0
Horses	5.3	400.4	27.6
Donkeys	2.5	192.5	14.9

Source: Kears (1982) and McCarthy (1986)



Appendix Figure 1 Feed conservation methods in midland area of Meskan district



Appendix Figure 2, conservation methods in midland area of Meskan district



Appendix Figure 3 Housing and feeding of dairy cattle in Meskan district EastGurage zone

Appendices3 (QUESTIONNAIRE)

Section A. Instruction to the Enumerator

Questionnaire given to livestock owner to study the ASSESSMENTS OF DAIRY CATTLE PRODUCTION, REPRODUCTION PERFORMANCES AND THE MAJOR FEED RESOURCES AVAILABLE AT DIFFRENT AGRO ECOLOGIES OF MESKAN DISTRICT, EAST GURAGE ZONE, CENTRAL ETHIOPIA REGION.

Enumerator Name _____ Date _____

Section B. General Information

1 Name of interviewee _____ Sex _____ age _____

2. Marital status of the household 1 = Single 2= Married 3= divorced

3. Educational level 2.1 Illiterate 2.2 Read &write 2.3 Primary school 2.4 Junior school
2.5 High school 2.6 Above high school

4. Family size 4.1 Male ----- 4.2 Female ----- 4.3 Total-----

5. Total Number of Household member by age group

Age group	Male	Female	Total
<5			
5-10			
11-20			
21-40			
41-60			
>60			

6. Land holding (farm size in hectare).

1 Crops land -----

2 Grazing land -----

3 Forest -----

4 Fallow land -----

5 Homestead-----

6 Total size -----

7. What was the trend of land holding for the last ten years?

1= increasing

2= No change

3= Decreasing

8. If you say decreasing what is the reason?-----

9. Land utilized for major types of crops

a. Wheat-----ha.

b. Barley-----ha.

c. Tef -----ha

d. Maize-----ha

e. Sorghum-----ha

f. bean-----ha

g. Field Pea -----ha

h. Chick pea -----ha

10. Grain yield obtained from major crops

a. Wheat-----Quintal.

b. Barley-----Quintal.

c. Teff -----Quintal

d. Maize ----- Quintal

e. Sorghum ----- Quintal

f. bean-----Quintal

g. Field Pea -----Quintal

h. Chick pea ----- Quintal

11. Number of Livestock & importance by type,

S/N	Livestock Type		Breed type		Total	Importance
			Local	Cross		
1	Lactating cows					
2	Dry cow					
3	Heifer					
4	Oxen					
5	Bulls					
6	Calf	Male				
		Female				
7	Sheep					
8	Goat					
9	Equines	Horse				
		Mule				
		Donkey				
10	Poultry					

12. What is the trend of herd size in the last ten years (increased or decreased?)

13. If you say increase or decrease Specify the reason for the change in the trend -----

14. Specify the composition of your cattle herd

S/	Type of cattle	Local breed	Crossbred	Total
1	Cow			
2	Heifers			
3	Bulls			
4	Oxen			
5	Calves			
	Total			

15. What is your major farming activity? 1 = Livestock production 2 = Crop production 3 Mixed crop-livestock production

16. Purpose of keeping dairy cattle: - 1 Milk sale 2 Milk consumption 3 asset 4 others:-

17. Who is responsible for following dairy cattle management activities?

17.1. Herding: - 1. Head 2. Spouse 3. Children 4. Workers

17.2. Fodder harvesting: - 1. Head 2. Spouse 3. Children 4. Hired

17.3. Feeding: 1. Head 2. Spouse 3. Children 4. Hired

17.4. Milking: 1. Head 2. Spouse 3. Children 4. Hired

17.5. Transport of milk and milk products to market:- 1. Head 2. Spouse 3. Children 4. Hired

17.6. Processing of milk: 1. Head 2. Spouse 3. Children 4. Hired

Section C. Dairy cattle Production and Reproduction

1. What type of dairy breeds do you have?

1. Local 2. Cross 3. Pure exotic

2. How many (total number) milking cows do you have currently?

1. Local cows----- 2. Cross breed----- 3. Pure exotic-----

3. How many times on average do you milk the cows a day?

1) One Times a day 2) Tow Times per day 3) Three times per day

4. Do you estimate milk yield performance of your dairy cow daily? 1) Yes 2) No

If your answer is yes, what is the average daily estimate of milk/cow? 1. Wet season 2. Dry season

5. What is the reproductive and productive performance of your indigenous, crossbred and pure exotic dairy cow?

S/N	Reproductive & productive performance trait	Indigenous	Cross breed	Pure exotic
1	Age at 1 st service (year)			
2	Age at 1 st calving (year)			
3	Calving interval (year)			
4	Day open (days)			
5	Lactation length (month)			

6. What is the amount of milk produced from your crossbred cow per day in litter?

7. What is the amount of milk produced from your local cow per day in litter? _____

8. What is the amount of milk produced from your pure exotic cow per day in litter?

9. How do you use the amount of milk produced (in liter)?

1) Consumed at home _____ 2) selling _____ 3) processing _____ 4) others (specify)

10. What is your breeding system? 1) Natural mating 2) Artificial insemination (AI) 3) combination of natural and AI

11. If your breeding system is natural, what mechanism do you use?

1) Use your own bull to breed your cows (uncontrolled mating)

2) Select bulls from your neighbor to breed your cows (controlled mating).

12. Which breed do you consider suitable bull for cross breeding with local breeds in your area?

1. Holstein 2. Jersey 3. Graded crossbreed

13. Do you have an experience of using AI? 1) Yes 2) No

14. If yes, why do you use it?

1) I do have access to AI service 2) It is cost effective than raising a bull

3) It is simple to use than a bull service 4) I do not have a bull

5) others (specify) -----

-----.

15. If AI is your choice of breeding your cows, who delivers AI service? .1 Government 2, NGOS 3, Private

16. Have you ever faced failure of any cross breeding program (AI)? 1. Yes 2. No

17. If yes, what do think the reason for the failure of AI service? Rank the problem

1 Heat detection problem

2 AI technician efficiency problems

3 Distance of AI/bull service center

4 Shortage of AI technicians

18. Have you participated in synchronization program? 1. Yes 2. No

19. If yes, what is your opinion on the regular AI service versus the synchronization program?-----

20. Is synchronization more efficient than regular AI service? 1. Yes 2. No

21. If yes, what is your reason/s synchronization to be better efficient than the regular AI service? -----

22. Do you agree that crossbreeding is useful on the improvement of your livelihoods?

1. Yes 2. No

23. If yes, what are the earnings obtained due to the utilization of crossbreeding of your cows?

Section D. Feeding management of animals

1. What are the major feed resources available for dairy cattle in your area? -----

1) Natural pasture 2) Crop residue 3) Industrial by product 4) Hay .

2. Do you have any experience of delivery of measured amount of feed dry matter to your cows?
 1. Yes 2. No
3. If yes, How much kg of dry matter do you feed your cows of crossbred per day _____
 local _____ and pure exotic _____ per day?
4. Does feeding differ during early, mid and late lactation period? 1) Yes 2) No.
5. If yes, how much kg of dry matter do you feed your cows during early lactation _____
 mid lactation _____ and late lactation period _____ per day?
6. Do you have market opportunity for concentrate feed purchase for your animal? 1. Yes 2.
 No
7. If yes, who are the suppliers? 1. Bureau of Agriculture 2. Traders 3. Cooperative 4. NGOs
8. Is there forage development practice in your area? 1. Yes 2. No
9. If yes, who provides extension service? 1. Government 2. Cooperatives 3.
 NGO
10. Who provides a technical and other supports regarding to improved forage development?
 1. Government 2. Cooperatives (Union) 4. NGO
11. Have you any experience in practicing forage conservation? 1. Yes 2. No
12. If yes, in what type of forage conservation do you have experienced?
 1. Hay making 2. Silage making 3. By feed processing
- 13., What is the estimated Kg/lit of concentrate feed purchased annually?
 1) Wheat bran _____ 2) Balanced ration (concentrate) ----- 3) Molasses _____
 4) Hay----- 5) straw-----
14. What type of feeding system do you apply in feeding of your dairy animals?
 1) Individual feeding system 2) Group feeding system 3) Randomly feeding system
 4) Other specify please: -----

15. What are the constraints on dairy cattle raring? 1. Feeds are not-available, 2. Feeds are
 very costly 3. Lack of knowledge. 4, Shortage of man power 5, Shortage of improved dairy cattle
 breed 6, Animal disease

Section F. Animal Health

1. What are the major health problems of cattle in the area? List in the order of importance

2. How do you manage cattle health problems? 1) Taking to local veterinary clinic
 2) Taking to a traditional healer 3) other (specify) -----
 3. Do you give vaccines to your cattle? If yes, against which diseases? -----

 -
 4. Do you get veterinary services? 1) Yes 2) no
 5. If yes, what kind of service?-----

 6. If no, explain the reason for the absence of veterinary services-----

 7. Is there any reproductive health problem in your cattle you have? 1. Yes 2. No
 8. If yes what are the reproductive health problem? Rank them
 1. Reproductive disorders ____ 2. Mastitis ____ 3. Abortion ____
 4. Dystocia____ 5. Uterine prolapsed____ 6. Others (specify)____, _____, _____
 9. If there is a prevalence of mastitis, which type of mastitis has prevailed in your herds/cow/s?

 10. How is the adequacy of veterinary service in your area? 1) Adequate 2
 Inadequate

Points for Focus group discussion

1. What are the major constraints of dairy production in your locality?
2. What are your suggestions to alleviate the above mentioned constraints?
3. What are the opportunities of dairy cattle production in your community?
4. Types and status of communal grazing land
5. Breed type exist in your locality
6. Methods of feed conservation system and most crop residues used as cattle feed