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**ASSESSMENT OF DAIRY CATTLE FEED RESOURCES AND MILK YIELDS  
UNDER SMALLHOLDER FARMERS IN KERSA MALIMA WOREDA**

**MSc. Thesis**



**By**

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MSc program in Tropical Animal Production and Health**

**June, 2014  
Bishoftu, Ethiopia**

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A Thesis Submitted to the college of Veterinary Medicine and Agriculture of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Science in Tropical Animal production and Health

**By**

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**June, 2014  
Bishoftu, Ethiopia**



## Contents

DEDICATION.....	i
STATEMENT OF THE AUTHOR.....	ii
ACKNOWLEDGEMENTS.....	iii
LIST OF ABBREVIATIONS.....	iv
LIST OF TABLES.....	v
LIST OF FIGURES.....	vi
LIST OF TABLES IN THE APPENDIX.....	vii
ABSTRACT.....	viii
1. INTRODUCTION.....	1
2. LITERATURE REVIEW.....	4
2.1. Livestock Feed Resources.....	4
2.1.1. <i>Grazing lands</i> .....	4
2.1.2. <i>Crop residues</i> .....	5
2.1.3. <i>Improved forage and pasture crops</i> .....	5
2.1.4. <i>Other feed resources</i> .....	6
2.2. Feed Related Constraints of Livestock Production.....	6
2.3. Priorities and Strategies for Feed Resources Development.....	7
2.4. Supplementation.....	7
2.5. Increasing Digestibility and Nutritive Value of Crop Residues.....	8
2.6. Milk Production Systems in Ethiopia.....	9
2.7. Productivity of Milk Cattle in Ethiopia.....	11
2.8. The Role of Nutrition on Animal Productivity.....	11
2.9. Factors Affecting Milk Yield and Composition.....	13
3. MATERIALS AND METHODS.....	15
3.1 Description of the Study Area.....	15
3.1.1 <i>Geographical Location</i> .....	15
3.1.2 <i>Climate and Vegetation</i> .....	16
3.1.3 <i>Human Population</i> .....	17

3.1.4	<i>Land use and land cover</i> .....	18
3.1.5	<i>Livestock population of the woreda</i> .....	18
3.2.	Study Design .....	19
3.3.	Method of Data Collection and Sources of Data.....	19
3.3.1.	<i>Questionnaire survey</i> .....	19
3.3.2.	<i>Focus group discussions</i> .....	19
3.3.3.	<i>Field level observation</i> .....	19
3.4.	Study Procedures.....	20
3.5.	Chemical Analysis.....	20
3.6.	Data analyses.....	20
4.	RESULTS .....	21
4.1.	Dairy Cows Owner Household Characteristics.....	21
4.2.	Cattle herd size and composition .....	24
4.3.	Features of dairy production system .....	24
4.3.1.	<i>Dairy cattle housing</i> .....	25
4.4.	Reproductive and lactation performances .....	26
4.4.1.	<i>Lactation yield and lactation length of dairy cows</i> .....	26
4.4.2.	<i>Milking Practices</i> .....	26
4.5.	Feeds and Feeding Management .....	27
4.5.1	<i>Dairy cattle feed resources</i> .....	27
4.5.2.	<i>Dairy cattle feeding systems and Feeding practices</i> .....	29
4.6.3.	<i>Source of Water and watering practice</i> .....	33
4.7.	Feed Characterization.....	33
4.8.	Constraints of dairy production.....	36
5.	DISCUSSION .....	37
5.1.	Owner Household Characteristic .....	37
5.2.	Cattle and Land holding pattern .....	38
5.3.	Production system .....	39
5.4.	Lactation yield and lactation length of dairy cows .....	40
5.5.	Milking Practices.....	40
5.6.	Major feed resources for dairy cows .....	41

5.6.1. <i>Feeding system, feeding practice and conservation of crop residue</i> .....	42
5.7. Feed Characterization.....	43
5.8. Constraints of dairy production and suggested solution .....	43
6. CONCLUSION AND RECOMMENDATIONS .....	45
7. REFERENCES .....	46
8. APPENDIXES .....	53

## **DEDICATION**

*I dedicate this thesis manuscript to my Sister Shitaye Worku and my friend Endashaw Tesema for their nursing with all affection, love and for their dedicated in my success endeavor throughout my life.*

## **STATEMENT OF THE AUTHOR**

First, I declare that this thesis is my bona fide work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an advanced MSc. degree at Addis Ababa University and is deposited at the University library to be made available to borrowers under rules of the library. I declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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## LIST OF ABBREVIATIONS

ADF	Acid Detergent Fiber
ANOVA	Analysis of variance
BOFED	Bureau of Finance and Economic Development
Ca	Calcium
CF	Crude fiber
CP	Crude Protein
CSA	Central Statistical Authority
DM	Dry Matter
EE	Ether extract
FAO	Food and agricultural organization
ha	hectare
IVOMD	In vitro organic matter digestibility
Km	Kilometers
ME	Metabolizing energy
NDF	Neutral detergent fiber
NGO	Non Governmental Organizations
NPP	Net Primary Productivity
NVI	National Veterinary Institute
SD	Standard deviation
SDDP	Smallholder Dairy Development Project
SNF	Solids-Not-Fat
SNNPR	Southern Nations, Nationalities and People's Regional State
SPSS	Statistical Package for Social Science
WVE	World Vision Ethiopia

## LIST OF TABLES

Table1. Agro-climatic description of the study area.....	17
Table2. Population descriptions of the study area .....	17
Table3. Land use classification by Indigenous people and areas of land use and land cover type in Kersa malima <i>woreda</i> .....	18
Table 4: Characteristics of sampled households.....	22
Table5. Cattle herd size and composition in the study areas area. ....	24
Table 6. Proportion of farms with different cattle housing types in Kersa Malima <i>woreda</i> .....	25
Table7. Daily milk yield and lactation length of dairy cows in the study area based on farmers response in liters .....	26
Table 8. The percentage of respondents performing different milking practice.....	27
Table 9: Common dairy cows' feeds type in the study area according to utilization percentage .....	27
Table 10. Percentage and frequency of using feeding systems feed resources. ....	29
Table 11: Observed methods of utilization of different feedstuffs observed in Kersa Malima <i>woreda</i> .....	30
Table 12: Crop residues feeding practice in the study area. ....	32
Table 13: Watering practice by respondents in the study area .....	33
Table14. Chemical composition of major feeds in the study area.....	34
Table 15. Chemical composition of <i>teff</i> and barley straw in selected kebeles of <i>woreda</i> .....	35
Table16. Constraints of dairy cow production as identified by respondents.....	36

## LIST OF FIGURES

Figure 1: Map of ethiopia with Kersa Malima <i>woreda</i> .....	15
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## LIST OF TABLES IN THE APPENDIX

Appendix III: Livestock's population by *woreda* .....59**Error! Bookmark not defined.**

Appendix IV: Labor distribution with in respondents by *woreda*60**Error! Bookmark not defined.**

## ABSTRACT

*This study was conducted at Kersa Malima woreda, South West Shawa Zone, Oromia Region , Ethiopia, with the aims of assessing dairy cattle feeding and production practices of smallholder farmers; assessing milk yields of dairy cows under a smallholder system; and characterizing major available feed resources using proximate composition. One hundred dairy cow owners in study area were included in the study. The common dairy cow feeds identified at the five study kebeles were: natural pasture (100%), wheat straw(75.66%), barley straw(59.0%), teff straw (70.46%), hay (66.68%), maize straw and stover(19.34%), 'Atela'(26.62%). Dairy cattle production system in the area is crop-livestock integrated production system and the dominant breed in the area is local dairy cattle, which, can produce, in average 1.15litres/day. The study further indicated that crop pasture production and improved forage utilization is not practiced; and free grazing system was major feeding system. The type of feeds used little varied across the study area and common feeds were collected and assessed for their proximate entities. Accordingly, DM content of the feeds ranged from 95-99% and ash values from 6-11%. In the same token, CF, CP, EE and Ca ranged from 33-46%, 4-17%, 0.8-2.5% and 1.3-17%, in that order. The CP concentration of teff straw and barley straw varied significant ( $P<0.01$ ) across kebeles. On the contrary, there is no significant difference ( $P>0.05$ ) in ash, CF, EE and Ca contents of teff and barley straw. The concentration of CP of wheat straw and hay was not significantly varied ( $P>0.05$ ) across study area. Moreover, the results showed feed type difference and feeding practice variability based on feed availability and season of the study area. Conclusions were made on assessment of feed resources and milk yield, production system and characterization of main feed and appropriate recommendation were forwarded*

*Keywords; dairy cow, feed, feeding practice, milk yield*

## 1. INTRODUCTION

The estimated number of milking cows in Ethiopia is about 9 million that are in the hands of smallholder farmers and pastoralists under traditional management system (Azage *et al.*, 2000). The milk production potential of the zebu breed in the highlands mixed crop-livestock system of Ethiopia cannot exceed 400-500 kilograms of milk per lactation per cow. Milk production potential of indigenous cattle is low, ranging from 494 to 809 kg per lactation. It has also been well documented that, in breeding schemes, the raise in milk production through selection is about 1% per year or 3-4 kg per lactation (EARO, 1999, Zelalem, 2000).

Dairy products are traditional consumption items with strong demand, and the temperate climate of the Ethiopian highlands allows the crossbreeding of local cows with European dairy breeds to increase productivity (Holloway *et al.*, 2000). The highlands of Ethiopia, which are very well suited for dairying, represent almost 50% of the total highland regions of sub-Saharan Africa (Winrock, 1992).

In Ethiopia, the human and animal populations are very much affected by nutritional problems, primarily due to lack of food of high nutritional value. Therefore, to solve this problem and to ameliorate the nutritional status of the population, measures should be taken to improve animal production so as, to ensure better supply of animal protein of high nutritive value (Ashebir, 1992).

In this regard, milk is among livestock products whose demand continues to increase and plays a very important role in feeding the rural and urban population of Ethiopia. According to Azage *et al.* (2001), in order to meet the growing demand for milk in the country, milk production has to grow at least at a rate of 4% per annum. Which in turn entails design of appropriate and sustainable milk development strategies based on socio-economic, institutional and agro ecological circumstances that build on the demand of consumers and the needs and opportunities of producers.

Seasonal inadequacy of the quantity and quality of available feeds are the major problems facing dairy cattle production in the developing countries (Preston and Leng, 1987). Additionally the efficiency with which the available feed is utilized is constrained by failure to use recommended management practices that could improve livestock output. A variety of feed resources for ruminant livestock are unused, undeveloped and poorly utilized due to, among other reasons, lack of technical know-how, resulting in decreased livestock output (Preston and Leng, 1987). For instance, feeds such as stovers, straws and haulms (i.e. plant material left after harvesting dry grain legumes) if better utilized could make a substantial contribution to the basal feeds available to the dairy animals (Omore, 1997).

Livestock feed resources are classified as natural pasture, crop residue, improved pasture and forage, agro industrial by products, other by-products like food and vegetable refusal, of which the first two contribute the largest feed type (Alemayehu, 2003). Animals depend mainly on natural pastures for their feed requirements. Natural pastures which provide more than 90% of the livestock feed are generally very poorly managed. In the mixed farming mid-altitude areas, better soils are used for cropping and the main permanent natural pasturelands are found on the upper slopes of hills and seasonally water logged areas. Due to poor management and overstocking, natural pastures are highly overgrazed resulting in severe land degradation, loss of valuable species and dominance by unpalatable species (Alemu, 1998).

Ethiopia is known for cereal crop production and the resulting crop-residues could be used as potential feed source for feeding dairy cattle to improve milk production. Though, the country is estimated to have huge supply of crop-residues, there may be mishandling and lack of awareness about crop-residue improvement. As a result, utilization efficiency of the residues may be low. Besides, there may be lack of proper selection of feeds feeding of dairy cows for improving milk production, lack of market information about supplementary feeds and also poor managements in relation to feeding system which may lower the performance of cow. Hence, the producers may not get reasonable benefit from their dairy activity unless appropriate improvement strategies

have to be introduced. Inadequate information about livestock feed resource and milk yield of both crossbreed and indigenous dairy cattle are the main problems in the Kersa Malima woreda. There is a problem of designing appropriate livestock feeding strategies to feed crossbreed and indigenous dairy cattle. Therefore documenting the livestock feed resource and feeding systems of the area is crucial to design appropriate interventions to enhance productivity of both breed of dairy cow in the area. Feed resource assessment in the area helps to design the feeding alternatives during worse season of the year to mitigate the dairy cows feed shortage in the area.

Understanding type of feed resources and its nutritional quality are important for improving milk production for enhancing food security in study area and providing appropriate knowledge to dairy producers and smallholder farmers. Therefore, the result of this study can have important contributions to individuals or institutions working in dairy development as well as dairy policy makers. In addition, the study will add to knowledge base in the area and can serve as a springboard for the future research and development works and policy makers.

Thus, this research was conducted with the following objectives.

- To assess dairy cattle feeding and production practices in Kersa Malima woreda;
- To assess milk yields of dairy cows under a smallholder system; and
- To characterize major available feed resources in the study area.

## **2. LITERATURE REVIEW**

### **2.1. Livestock Feed Resources**

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

#### ***2.1.1. Grazing lands***

In general, grazing land productivity is declining at a higher rate because of temperature stress and scarcity of rainfall, which is favored by deforestation that denies humid environment to the area. In addition to this, the transfers of grazing lands to cultivation for cropping and poor grazing land management are some of the reasons for dry matter reductions from grazing lands. Henceforth, alternative livestock feed resources should be potentially utilized effectively after their nutritive quality is improved by different techniques along with optimizing the potential of grazing lands. This, therefore; give consideration to the dry matter production and the nutritive value of the feed simultaneously.

The factors, which affect grazing land production, are interlinked to varying degree depending upon situation. Grazing land production can be judged or assessed based on the production of dry matter, milk or butter and live weight or carrying capacity. The net primary productivity (NPP) is defined as the net change in weight of grazing land between any two points in time, usually over a year (Alemayehu, 2003).

### ***2.1.2. Crop residues***

Poor nutrition is one of the major constraints to livestock productivity in sub-Saharan Africa.

This is because animals thrive predominantly on high-fiber feeds (straw, stover's and native pasture hay) which are deficient in nutrients (nitrogen, sulphur, minerals, phosphorous etc) essential for microbial fermentation. Consequently, the digestibility and intake of digestible nutrients are low. These deficiencies can partly be mitigated by supplementing roughage diets with feeds containing the sufficient nutrients. About 12 million tones of crop residues are produced annually from 6 million hectare of farmland in Ethiopia (Daniel, 1988). Alemu *et al.* (1991) further estimated that about 10.71 million tones of dry matter (DM) of crop residues are estimated to provide about 40 to 50% of annual livestock feed requirement (Daniel, 1988). The quantity of fibrous crop residues in each country and region was observed in light of grass eaters (cattle, buffaloes, camels, sheep, goats, horses, mules, asses) since these animals have greater potential for the use of crop residues than grain eaters (pigs and poultry) (Sansoucy, 1991; Getnet, 1999).

### ***2.1.3. Improved forage and pasture crops***

Forages play varying role in different livestock production systems. In general, however, they are important as adjuncts to crop residues and natural pastures and may be used to fill the feed gaps during periods of inadequate crop residues and natural pasture supply. Even in the presence of abundant crop residues, which are often free fed to ruminants, forage crops especially legumes are needed to improve the utilization of crop residues, crop residues often provide energy while forage legumes provide proteins. Forages also provide benefits such as soil fertility through their nitrogen-fixing ability and are useful in breaking insect, weed or disease cycles, which are likely to occur when they are not supplemented. In many situations, however, forages compete with other crops. In land scarce smallholder forages ` may compete with other crops for land, in land abundant pastoral systems, they may compete for the herders labor (John McIntire and Siegfried Debrah, 1987).

In addition to contributing to soil nitrogen and providing a break in cereal-dominated rotations, forage legumes contribute significantly to livestock production in crop livestock systems. Low quality crop residues need nitrogen supplementation, often provided by forage legumes to become productive diets. In the Ethiopian high lands, for example, *Vicia faba* is not fed to livestock except in combination with cereal straw (Anderson, 1985). It is also possible that forage legumes will increase food production and thus the quantity of crop residue available for feed (John McIntire and Siegfried Debrah, 1987).

In livestock production, one of the most important factors determining profitability is to achieve optimal level of feeding. This aim is most problematic during the dry season when available feed resource is scarce and is of low quality. Therefore, livestock farmers are facing their biggest challenge during the dry season. Producing supplementary feed on farm by establishing grass/legume pastures would reduce their problem. For instance mixed grass legume pasture produced higher DM yields of better nutritive value than sole grass swards (Onifade and Akinola, 1986).

#### ***2.1.4. Other feed resources***

Livestock feed resources are classified as conventional and non-conventional, where the non-conventional ones vary according to feed habit of the community and others, e.g. vegetable refusals are non-conventional. Related to this anything used as livestock feed in the area additionally were added into the production of the feed resources to estimate its dry matter production (Alemayehu, 2003).

## **2.2. Feed Related Constraints of Livestock Production**

There are three aspects of feed problems, namely, the issue of increasing the efficiency with which the available feed is utilized (e.g. forages, crop residues, agro-industrial byproducts and non-conventional feeds), and the inability to make maximum use of the

limited total feed resources and the seasonal fluctuations in quantity, nutritive value, and water availability. The inability to feed animals adequately throughout the year is the most widespread technical constraint. Much of the available feed resources are utilized to support maintenance requirements of the animals with little surplus left for production. Poor forage quality, that is with low protein and energy content is also a serious problem. Poor quality feed causes low intake rates resulting in low levels of overall production (BoFED, 2006).

### **2.3. Priorities and Strategies for Feed Resources Development**

The feed value of forage that form the basis of ruminant feeding is a function of its nutrient content and digestibility, its palatability (which determines its consumption level) and the associative effects of other feeds (Preston, 1986). Interplay of these factors determines the effective utilization or feed value of the material. Strategies for ensuring adequate nutrition of livestock includes matching livestock production systems to available resources, selection of crops and cropping systems that will maximize biomass production and nitrogen fixation and thus minimize use of inputs external to the system. It also includes developing simple processing techniques to optimize the use of different components of crops for different end purposes. Recycling of livestock wastes making more efficient and widespread use of agricultural byproduct and industrial byproducts, as sources of ruminant feed (Preston, 1986).

### **2.4. Supplementation**

Providing feed supplements and minerals to livestock is important for improved animal performance (Winrock, 1989). A supplement is a semi-concentrated source of one or more nutrients used to improve the nutritional value of a basal feed, e.g., protein supplement, mineral supplement. Ruminant diets based on fibrous feeds are imbalanced as they are deficient in protein, minerals and vitamins; since they are highly lignified their digestibility is low. Both these characteristics keep intake and productivity low (Preston, 1986).

Therefore, in order to improve milk production levels, energy inputs such as concentrate feeds have to be considered essential for any dairy enterprise, even for those based on dual purpose systems, since reduced intake of energy by animals consuming low quality forages is the principal cause of low milk production (Getu, 2008). Recent researches has generally shown that the inclusion of by-pass nutrients at a low rate in the diets is efficient, even though, they come generally from rather expensive feeds which are either in demand for human nutrition (cereals) or whose primary products exported for foreign exchange (oil-cakes) (Preston, 1986).

## **2.5. Increasing Digestibility and Nutritive Value of Crop Residues**

Low-quality forages are a major component of ruminant diets in the tropics. Thus, much progress can be made by improving the roughage component of the ration. The characteristic feature of tropical roughages is their slow rate of microbial breakdown in the rumen (Preston, 1986) with the result that much of the nutrients of the feed are voided in the faeces. The slow rate of breakdown also results in reduced outflow rate of feed residues from the rumen, which consequently depresses feed intake.

At present, the main treatment methods for forages such as cereal straws are mechanical (e.g. grinding), physical (e.g. temperature and pressure treatment) and a range of chemical treatments of which sodium hydroxide or ammonia are among the most successful. For instance, in a study conducted in *Kuyu* district of North Shewa Zone, Ethiopia doubled the CP content from 4.3 to 8.9% due to retention of ammonia N (binding of ammonia) to the straw ( Mesfin *et al.*, 2009).

Similarly, there was also an increase in IVOMD by 7.9% (from 53.2 to 57.4%) when teff straw was treated with urea which was due to better solubilization of hemicelluloses and swelling of cellulose during urea ammonia treatment. Regarding the cell wall constituents, urea treatment reduced the NDF, ADF and hemicelluloses contents of teff straw by 6.04%, 8.76% and 26.69%, respectively which were due to binding of ammonia with the straw and also due to solubilization of hemicelluloses by the action of ammonia

evolved from urea. Moreover, improvement in DM digestibility of urea treated wheat straw by 10-15% has been achieved (Sundstøl, 1978). According to Getu (2008), Urea treatment is technically effective and feasible on-farm technology to improve the nutritive value of fibrous crop residues.

## **2.6. Milk Production Systems in Ethiopia**

In the highland areas, agricultural production system is predominantly smallholder mixed farming, with crop and livestock husbandry typically practiced within same management unit. Among the systems, milk production system is the most biologically efficient system that converts large quantities of roughage, the most abundant feed in the tropics, to milk, the most nutritious food known to man (Belete, 2006).

Milk production systems in Ethiopia may be classified into two broad categories viz: commercial system, which produces milk mainly for market and subsistence systems, which produce milk mainly to meet household needs for milk products (Azage *et al.*, 2003). The commercial system generally operates in urban and peri-urban areas with or without holdings of land for feed production. Whereas, the rural milk production system is part of the subsistence farming system and includes pastoralists, agro pastoralists, and mixed crop-livestock producers. Specifically, they are classified into four major systems.

These are pastoralist, the highland smallholder, urban, peri-urban, and intensive milk production systems. Pastoralist milk production system is a system mainly operating in the rangelands where the peoples involved follow animal-based life styles that requires them to move from place to place seasonally based on feed and water availability. Even though information on both absolute numbers and distribution vary, it is estimated that about 30% of the livestock populations are found in the pastoral areas (Belete, 2006).

Pastoralism is the major system of milk production in the lowland areas. However, because of the rainfall pattern and related shortage of feed availability, milk production is low and highly seasonal and range condition dependent (Zegeye, 2003; Ketema and

Tsehay, 2004). Pastoralists typically rely on milk for food and also use animals to save wealth. This system is not market oriented and most of the milk produced in this system is retained for home consumption. The level of milk surplus is determined by the demand for milk by the household and its neighbors, the potential to produce milk in terms of herd size, production season, and access to a nearby market (Getachew, 2003).

The surplus is mainly processed using traditional technologies and the processed milk products such as butter, ghee, cottage cheese and sour milk are usually marketed through the informal market channel after the households satisfy their needs (Tsehay, 2001).

The highland smallholder milk production is found in the central part of Ethiopia where milking is nearly part of subsistence, smallholder mixed crop and livestock farming (Sintayehu *et al.*, 2008). The smallholder milk production system is dominated by subsistence farming (Belete, 2006 and Asaminew, 2007).

In this system, all feed requirement is derived from native pasture and a balance comes from crop residues and stubble grazing. Cattle are the main source of milk even though they are kept primarily as draught power source with very little or no consideration given to improving their milk production capabilities (Zegeye, 2003). About 93% of the total milk production in Ethiopia is produced by, the smallholder milk farmers living in the villages and exercising traditional milking (Tsehay, 1998).

Urban and per-urban milk farming system is concentrated in and around major cities, and towns characterized by a high demand for milk. This system has been developed in response to the fast growing demand for milk and milk products around urban centers (Asaminew, 2007). The system is estimated to consist of 5,167 small, medium and large milk farms, with about 71% of the producers selling milk directly to consumers (Tsehay, 2001).

The per-urban milk production system includes most of the improved milk stocks (Ahmed *et al.*, 2003). In urban and per-urban milk production system, the main feed resources are agro-industrial by-products. The total milk production from this system

accounts to 34.649 million liters /annum. Of this total, 73% is sold, 10% is left for household consumption, 9.4% goes to calves and 7.6% is processed mainly into butter and *ayib* (Azage and Alemu, 1998).

The most specialized and high-tech system is intensive milk production system. It is practiced by, state sector and very few individuals on commercial basis. These are concentrated in and around Addis Ababa. Urban, per-urban and intensive systems account 2% of the total milk production of the country (Belete, 2006).

## **2.7. Productivity of Milk Cattle in Ethiopia**

Average milk production of indigenous cattle per cow is very low. Milk production potential of indigenous cattle such as Boran, Barca, Arsi and Fogera is low and it ranges from 494-809 kg per lactation (Mukasa Mugerwa, 1989).

Total milk production is further affected by relatively, short lactation length, and extended postpartum anoestrus period resulting, in lower reproductive efficiency. This is due to the fact that, these animals have been selected primarily for survival trait and possess well-established adaptive traits to the environment in which they are expected to survive and produce. In general, the reproductive efficiency of a breeding cow is determined by factors like age at first calving, calving interval and number of services per-conception (CSA, 2005).

## **2.8. The Role of Nutrition on Animal Productivity**

Three factors, viz. genetic makeup, nutrition and management decide the productivity of an animal (Sethumadhavan, 2004). Improvements of genetic make up only contribute up to 30% to production, while the 70% is dependent on nutrition and management. Unfortunately, indigenous animals are low milk producers because of the shortage of

nutrition. Poor nutritive values of feeds lower the production capacity and fertility potential of animals (Sethumadhavan, 2004).

In Ethiopia animal production systems are primarily based on native pasture and crop residues (Firew, 2007). Crop residues including cereal straws of teff, barley, wheat, oats and cereal stovers from maize, sorghum and millet and haulms from pulse crops including peas, beans, lentils, chick peas and vetch are very important feed resources (Rihirahe, 2001). However, the feed supply is seasonal and the shortage of green grass is one of the major causes of drastic deterioration of livestock nutrition (Rihirahe, 2001). They are inherently low in crude protein, digestibility and intake and are deficient in minerals (Rihirahe, 2001). The lower nutrient contents reduce rumen efficiency, rumen micro-fauna and milk production performance. Lactating cows for example are unable to meet their nutritional requirements i.e. they lose weight and body condition during lactation due to high nutrient demand for milk production (Firew, 2007).

The problem is further exacerbated by the associated poor husbandry practices that lower productivity further. One of the ways to bridge this gap is to chemically treat crop residues, the most suggested method in the tropics and utilize concentrates for supplemental feeding for farm animals (Firew, 2007).

Agro-industrial by-products are fed as supplement to roughage-based diets, particularly in livestock production system for milking or peri-urban fattening activities. Concentrates rich in energy are feedstuffs such as grain, bran from different cereals, maize and middling. Concentrates rich in protein include noug seed cake, linseed cake, cotton seed cake, brewers' grains, etc. How much energy and protein a concentrate mixture should contain will depend on the quality of the basal roughage and the level of production. As a rule of thumb, 1 kg good concentrate will increase milk production by 1.5 kg (SDDP, 1999).

## **2.9. Factors Affecting Milk Yield and Composition**

Milk composition and production are the interaction of many elements within the cow and her external environments. High milk yield of satisfactory composition is the most important factor ensuring high economic returns. If the composition of milk varies widely, its implication is that nutritive value and its availability as a raw material will vary. Chemical composition of milk is variable and influenced by intrinsic factors like breed, species, parity, stage of lactation; external factors like environmental stress, changes in feeding, etc. However, it is generally accepted that the milkman can alter many of these factors to achieve milk production and increase profit (O'Connor, 1994).

Breeds of milk cattle show obvious differences in their milk composition and yield. Differences among individuals among a breed are often greater than differences within breeds, such differences are due to genetic and environmental factors (O'Connor, 1994). The milk from indigenous cows contains 6.1% fat, 3.3% protein, 4.5% lactose and 0.7% ash (Alganesh, 2002).

Nutrition has also major effect on milk composition. According to O'Connor (1993), underfeeding reduces the amount milk production, the fat and solids-not-fat (SNF) contents of milk produced. As a general rule, any ration that increases milk production usually reduces the fat percentage of milk. It is also believed that the fat content is influenced more by roughage intake and the SNF content can fall if the cow is fed a low energy diet, but it is not greatly influenced by protein deficiency, unless the deficiency is acute (O'Connor, 1994).

The fat, lactose and protein contents of milk also vary according to stage of lactation. In temperate type cows, the fat and SNF percentages tend to be higher in the early weeks of lactation, dropping by the third month then rising again as milk yield gradually declines. The milk immediately after calving contains a very high percentage of total solids (up to 19%) mainly due to the very high fat and milk protein contents (O'Connor, 1993).

The age of the cow has slight, but definite effect on the composition of milk. O' Connor (1994) suggested that as cows grow older, the fat content of their milk decreases by about 0.02 percentage units per lactation while the fall in solid-non-fat is about 0.04 percentage units. The decrease in SNF content seems to be due to a decline in casein content.

When milking is done at longer intervals, the yield is also more with a corresponding smaller percentage of fat, whereas milk drawn at short intervals yield smaller quantities with higher amount of fat. The effect of milking interval is mainly on fat percentage rather than the SNF. The fat content of milk is usually lower in the morning than in the evening milking, because there is usually a much shorter interval between the morning and evening milking than between the evening and morning milking. Solid-not- fat content varies little even if the intervals between milking vary (Rai, 1985).

### 3. MATERIALS AND METHODS

#### 3.1 Description of the Study Area

##### 3.1.1 Geographical Location

The study was conducted in five selected kebeles of Kersa Malima *woreda*, south west Shewa zone of Oromia Regional state, in the eastern part of the zone. Geographically the *woreda* is located between latitudes of  $8.36^{\circ}$  N to  $8.71^{\circ}$  N and with longitudes of  $38.34^{\circ}$  E to  $38.71^{\circ}$  E. The *woreda* is located at 60 Km south west of Addis Ababa with the total area of 58613 hectare ( $586 \text{ Km}^2$ ). Elevation varies from 1839 to 3568m a.s.l. It is bounded with S.N.N.P. national regional state to the south west, East Shewa Zone to the east, Sodo Dachi, Alemgena, and Tole *Woredas* to the south, north east and north west, respectively, and the total length of the boundary line is about 220 km (WVE, 2009).

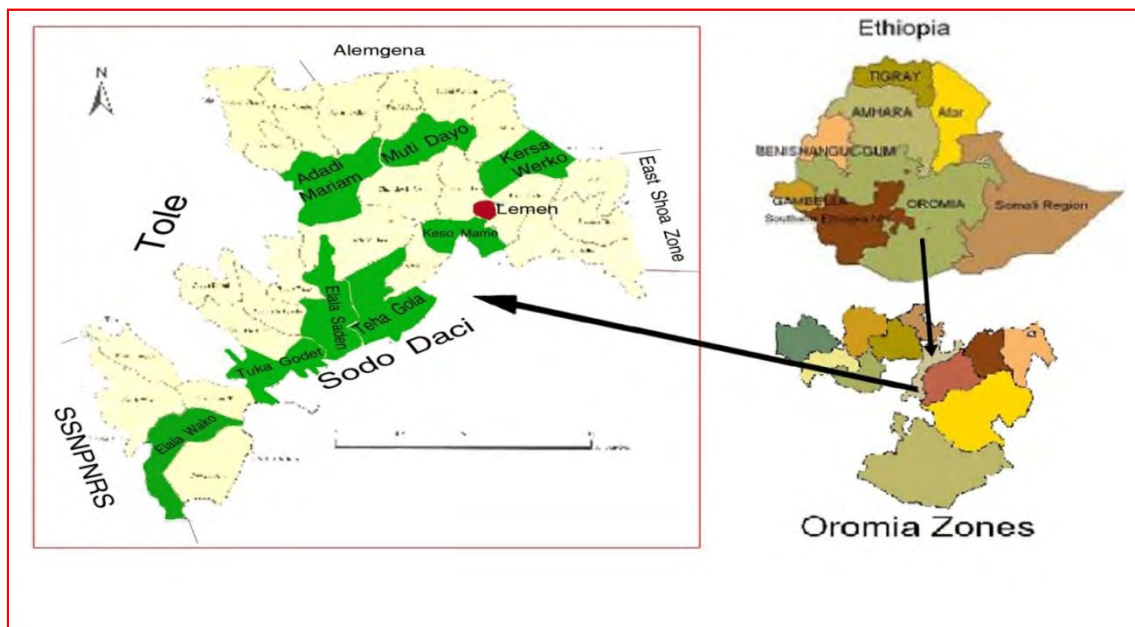


Fig.1. Map of Ethiopia together with Oromiya zones and south west Shewa Zone indicating the study site Kersa Malima *woreda*.

### 3.1.2 Climate and Vegetation

The study area is characterized by tropical and warm to cold humid temperate climates. These areas are characterized by an average temperature that ranges from 10-19 °C and the rainfall that ranges from 974-1319 mm. The highland part of the *woreda* is characterized by; moderate an average temperature 10-15 °C and 1170-1319 mm rainfall. The vegetation type in the *woreda* is juniperous forest, podocarpus, sub afro alpine region with discontinuous canopy and larger trees limited in spatial cover (WVE, 2009).

Most parts of the woodland are interspersed with cultivated land. The cultivated landscape includes home gardens in the living quarters, small-scale nearby farms and distant farm that stretch out from the residential sites. The spatial layout in home gardens, crop fields, and adjacent areas presents a complex pattern of crop distribution. Only a small proportion (12.91 %) of the land is under dense shrub-open grassland. Bush, shrub, and grassland are often intermixed with intensively and moderately cultivated land in the buffer zone between the highland and midlands especially in northeast part of the *woreda*. The climate of a year is characterized by two rainy seasons, mainly summer and spring. Summer season lasts for five months (June to October) while spring season lasts for three months (March to May) bimodal rainfall pattern prevails (WVE, 2009).

Based on the traditional classification, the *woreda* is divided into two agro-ecological zones, locally called *Dega*, (41.6 %) and *Woynadega* (58.4 %), which means highland and midland respectively. There is wide variation in altitude, temperature, and rainfall across the agro-ecological zones. It is also characterized by diverse landscape that ranges from steep slope, plateau to mountainous and gorges dissected by rivers. This makes the area to have good opportunity for the inhabitants to involve in various agricultural productions (WVE, 2009). The mean monthly minimum and maximum temperature and rainfall for the agro-ecological zones of the study area are shown along with altitudinal variations in (Table1). The *woreda* is characterized by variable rainfall pattern. The variability of the rainfall regime of the study areas affects cultivation, planting and harvesting activities.

Table1. Agro-climatic description of the study area

Agro-climatic zone	Temperature range ( <sup>0</sup> C)		Altitudinal range (m)		Annual rainfall (mm)	
	Min	Max	Min	Max	Min	Max
Dega	10	15	2,900	3,568	1,170	1,391
Woynadega	16	19	1,838	2,900	974	1,170

Source: - World vision Ethiopia atlas of Kersa Malima *woreda*, 2009

### 3.1.3 Human Population

According to the population and housing census by CSA (2007), the total population of the *woreda* is 81,649. The rural population is 92.5 % and the urban population is 7.5 % (Table 2). This shows the majority of the population lives in the rural areas, depending on crop farming. A large number of people are settled, and the population is more evenly distributed on the plateau than in the rugged areas where unevenly distributed settlements are common.

Table2. Population descriptions of the study area

Description	Rural		Urban		Total	
	Number	Percent	Number	Percent	Number	Percent
Male	37,902	51	3464	53	41,366	51.06
Female	36,577	49	3072	47	39,649	48.94
Total	74,479	92.5	6536	7.5	81,015	100

Source: - population and housing census made by CSA (2007)

According to the population and housing census by CSA (2007), the average family size is five persons/household. Currently, high population density (150 persons /Km<sup>2</sup>), land degradation and periodic drought are major constraints limiting food security (WVE, 2009).

### **3.1.4 Land use and land cover**

The study area covers a total of 586 Km<sup>2</sup>, and the land is largely used for agriculture. Indigenous people of the study area categorize their surroundings into different systems: home garden, crop field, grazing land, forest/shrub land and fallow land. The land under cultivation accounts for nearly 86 % of the *woredas'* total area (Table3); (WVE, 2009).

Table 3. Land use classification by Indigenous people and areas of land use and land cover type in Kersa malima *woreda*

<b>Land use type</b>	<b>Hectare</b>	<b>Percent</b>
Cultivated land	50865	86.78
Open Grass land	7565	12.91
Urban Land	183	0.31
Total	58613	100

Source: - World vision Ethiopia atlas of Kersa Malima *woreda*, 2009

The *woreda* has high potential for rain-fed and irrigable agriculture. Also has a wealth of drainage and water basin. For instance Awash basin and Lemen River drains in the district (WVE, 2009).

### **3.1.5. Livestock population of the *woreda***

Farmers in the *woreda* have an estimated total 116083 head of cattle 42048 sheep, 31045 goats, 6425 horses, 2463 mules, 17551 asses, 58565 poultry of all species, and 4308 beehives.

### **3.2. Study Design**

A cross sectional study design were employed to assess dairy animal feed resources and their quality and milk yield of cows under a smallholder system in Kersa Malima *woreda*.

### **3.3. Method of Data Collection and Sources of Data**

Both primary and secondary data were collected following qualitative and quantitative research methodologies involving surveys, focus group discussions and feed composition analysis and farm visits. Descriptions of the methods are presented in the subsequent sub-sections.

#### ***3.3.1. Questionnaire survey***

Household level data and dairy cows' milk were collected employing questionnaires. The questionnaires will be pre-tested and readjusted before the actual data collection started. Moreover, field observations on feed resource type, feeding practice, and milk yield from dairy cows will be an important component of the study process. The contents of the questionnaires focused primarily on dairy cows feed resource and milk yields of dairy cows associated with feed resources and feeding practices the study areas (Appendix I).

#### ***3.3.2. Focus group discussions***

Group discussions consisting of 9-11 participants were conducted. The group discussions involved 1 group in each kebeles and the researcher facilitated the discussions at all sites. The main points for discussion included availability of feed resources and their relative abundance over time, major constraints and possible options and milk yields of cross and indigenous dairy cows (Appendix II).

#### ***3.3.3. Field level observation***

During the questionnaire administration, dairy cows' husbandry practices (handling, watering point and welfare conditions) and feed resource type, milking practice and feeding systems were observed.

### **3.4. Study Procedures**

A single-visit formal survey method was followed to gather data. The survey focuses on list and types of feed resources, their utilization and management, and milk yield. Following a ranking exercise in focus group discussions, at least five major feed resources used for feeding dairy cows were identified for quality analysis. For this study, of 32 *kebeles* of Kersa Malima *woreda*, 5 *kebeles* were selected randomly. A total of 100 farmers (Twenty farmers from each *kebeles*) were selected purposively.

### **3.5. Chemical Analysis**

Analysis of feed samples was undertaken for DM, CP, CF, EE and Ash and Ca at the National Veterinary Institute (NVI) Bishoftu, Ethiopia according to the proximate method (AOAC, 1990), with the objective of determining the chemical composition of the major feed resources for dairy cows. For Dry Matter, Crude Protein, Crude Fiber, Ether Extract and Ash and Calcium determination feed analyzed as shown below. The nitrogen was determined by kejldhahe method.  $CP = N \times 6.25$

### **3.6. Data analyses**

The data collected from individual farmers were stored in Microsoft excel spread sheet. Descriptive statistics (mean, standard deviation, percentages, cross tabulation and t-test) were employed to summarize data on household characteristics; feeds and feeding systems, and dairy cow production/management systems. Moreover, ANOVA (one-way) was run to see the effect of location difference on the chemical composition of common feedstuffs using the SPSS software version 20 (SPSS 2011).

## **4. RESULTS**

### **4.1. Dairy Cows Owner Household Characteristics**

The household level survey results are presented in Table 4. The sex of respondents in the selected *kebeles* were 80% males and 20% females. The proportion of the respondents with the age range between 20-40 years were 26%; and those within the age range of 41-60 years were 44% whereas those in the range of 61-80 years were 30% in all *kebeles* of the *woreda*. The observed level of illiteracy was 60%. The proportion of respondents who are capable of reading and writing only was 30% whereas 10% of the respondents attended formal education (1-8 grades). Regarding marital status, all respondents were married. Farming is the major occupation in the *woreda* that was 76% and the rest 24% of the respondents were having additional jobs.

Table 1: Characteristics of sampled households

Variable	Baye giche (N=20)	Gutu urji (N=20)	Ta'a gola(N=20)	Kusaye bodha (N=20)	Ilala saden (N=20)	Total (N=100)
<b>Sex of respondents (%)</b>						
Female	20	25	10	20	25	20
Male	80	75	90	80	75	80
<b>Age of the respondents (years)</b>						
20-40	40	15	20	20	45	26
41-60	40	45	50	40	15	44
61-80	20	40	30	40	40	30
<b>Educational level of respondents (%)</b>						
Illiterate	65	50	70	65	50	60
Read and write	25	40	20	25	40	30
Elementary school	10	10	10	10	10	10

High school	0	0	9	0	0	0
Marital status of the respondents (%)						
Married	100	100	100	100	100	100
Unmarried	0	0	0	0	0	0
Major occupation (%)						
Farmer	90	65	70	80	75	76
Business man	10	35	30	20	25	24
Government or private employee	0	0	0	0	0	0
Retired person	0	0	0	0	0	0
Average family size of the respondent (mean±SD)	3.68±2.33	3.34±2.11	3.02±1.78	3.92±2.31	3.58±2.23	4.94±2.2

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*N=number of respondents, SD= standard deviation*

## 4.2. Cattle herd size and composition

The overall average cattle herd size was (7.5 heads/household) in which, more than two-third were indigenous (96%). The cattle herds is dominated by oxen, of which, the majority were indigenous. Cows also comprised a significant proportion of the cattle herd size and almost all of which were indigenous (Table 5).

Table 5. Cattle herd size and composition in the study areas area

Variable	(N=100)	
	Mean	%
Herd size	7.5	100
Cows	3.36	27.00
Local	3.25	93.62
Cross	1.02	6.38
Heifers	1.22	12.20
Oxen	3.93	30.4
Calves	1.72	14.8
Bulls	2.01	15.6

## 4.3. Features of dairy production system

The dairy production system in the study area is mixed crop-livestock type. According to the survey results, cows are not specialized for milk production. However, they are reared for the sake of breeding to have draught oxen. Tuber crops such as potatoes and ensets are also commonly used in the study area. Residues of these crops are commonly used as animal feeds. There is little practice (tradition) of developing improved forages in the.

The vast majority (93.62%) of the cows are indigenous the proportion of crossbred cows being only 6.38%.

#### **4.3.1. Dairy cattle housing**

A list of types of housing for cattle in the study area is shown in Table5. About 82% of dairy barn cattle shed were open barns made with simple wooden materials and about 96.5% of the farms had hardened soil floors.

Table 6. Proportion of farms with different cattle housing types in Kersa Malima *woreda*

Parameter and their categories	Over all % (frequency)
<b>Type of house</b>	
Open barn(only fence)	35
Separate enclosure	62.50
Within family house	2.5
<b>Floor type</b>	
Concrete	0
Stone slab	3.5
Hardened soil	96.5
<b>Ventilation</b>	
Good	95.0
Poor	5.0

#### 4.4. Reproductive and lactation performances

##### 4.4.1. Lactation yield and lactation length of dairy cows

The daily milk yield and lactation length of local and crossbred cows in the study area are shown in Table 7. The average estimated daily lactation yield of local and cross bred dairy cows was found to be  $1.15 \pm 0.386$  and  $4.73 \pm 3.2$  liters, respectively, and the overall average lactation length of local and crossbred cows was 9.8 and 10.1 months, respectively.

Table 7. Daily milk yield and lactation length of dairy cows in the study area based on farmers response in liters

No	Cow genotype	Milk yield (liters/day)	SD	Minimum	Maximum	Average Lactation length (month)
1	Local cows	1.15	0.386	0.94	2.79	9.8
2	Cross bred	4.73	3.2	1.13	15.08	10.1

*SD=standard deviation*

##### 4.4.2. Milking Practices

Considerations related to milking practices in the study area are summarized in Table 8. Before milking, the calves are allowed to suckle their dams in order to initiate milk let down. Majority (98%) of the respondents indicated that cows are milked on the average twice a day.

Table 8. The percentage of respondents performing different milking practice

Activity during milking	Percentage of respondents (%)
Calf suckling	
Once (before milking)	4.25
Once(after milking)	5.32
Twice	90.43
Milking frequency/day	
Once	1.46
Twice	98.00
>2	0.54
Washing teat before & after milking	
Yes	5.6
no	94.4

## 4.5. Feeds and Feeding Management

### 4.5.1 Dairy cattle feed resources

The major sources of feed for dairy cows in the study area were natural pasture, crop residues, hay and non-conventional feedstuffs (Table 7). Also During group discussion, farmers were asked to provide the types of feed resources available in the area. Accordingly, natural pasture, aftermath grazing, crop residues and hay were the major feed resources of the study area.

Table 9: Common dairy cows' feeds type in the study area according to utilization percentag

Feed type	Baye giche N (20)	Gutu urji N (20)	Ta'a gola N (20)	Kusaye bodha N (20)	Ilala saden (N=20)	Total (N=100)
Percentage (%)						
Natural pasture	100	100	100	100	100	100
Barley straw	57.8	98.0	97.0	68.2	100	59.0
Wheat straw	100	96.4	52.4	100	29.5	75.66
Teff straw	100	67.9	84.4	100	77.2	70.46
hay	25.7	89.8	75.3	48.4	94.2	66.68
Maize straw and stover	53.2	23.1	34.4	43.5	25.7	19.34
'Atela'	23.1	33.9	26.2	15.7	34.2	26.62

*N= number of respondents*

#### 4.5.2. Dairy cattle feeding systems and Feeding practices

Free grazing was practiced in the study area. But, for crossbred cattle, farmers graze their animals for 2- 4 hours per day in the morning and evenings when sun light drops and use cut and carry system of feeding for the remaining periods of time.

Table 10. Percentage and frequency of using feeding systems feed resources.

Feeding systems	Baye giche	Gutu urji	Ta'a gola	Kusaye bodha	Ilala saden	Total
Free grazing (fulltime ) (%)	100	100	100	100	100	100
Stall feeding (%)	1.2	2.3	4.5	2.5	3.5	4.5
Stall feeding with limited grazing (%)	5.4	3.4	8.3	2.3	4.2	7.36

*N=100 (total number of respondents)*

The methods of utilization of different feedstuffs observed are given in Table 11. All respondents use crop residue of different types for feeding their dairy animals. Additionally, food refusals and *atela* were also used in planned feeding. None of the respondents follows a planned feeding practice for animals that graze on natural pasture or on improved forages.

Table 11: Observed methods of utilization of different feedstuffs observed in Kersa Malima *woreda*

Feed resources	Baye Biche (n= 20)	Gutu Urji (n=20)	Ta'a Gola (n=20)	Kusaye Bodha (n=20)	Ilala Saden (n=20)	Total (N=100)
<b>Agro-industrial byproduct (%)</b>						
Yes	0	0	0	0	0	0
No	100	100	100	100	100	100
<b>Crop residue (%)</b>						
Yes	100	100	100	100	100	100
No	0	0	0	0	0	0
<b>Non-conventional feeds (Yes %)</b>						
Yes	6	14.7	11	5.7	25.9	35.9
No	94	85.3	89	94.3	74.1	64.1

*N=number of respondents*

#### *4.6.2.1. Crop residues and non convectional feed resources feeding practice*

Crop residues constitute, the second most important feed source for dairy cattle and were utilized year round (Table 12). When there is surplus crop residue, 100% of the respondents reported that they conserve for use during times of scarcity using different methods as shown in the Table12. Non-convectional feeds like residues of local drinks, coffee, *areke*, *tella* and *enset* byproduct were used in feeding plan in the study area. *Atela* and coffee residue (*ashara*) have been used mixed with other feeds or alone.

Table 12: Crop residues feeding practice in the study area

	Baye Giche (N=20)	Gutu Urji (N=20)	Ta'a Gola (N=20)	Kusaye Bodha (N=20)	Ilalal Saden (N=20)
Year round utilization (%)					
Yes	100	100	98	100	96
No	0	0	2	0	4
Milking time feeding (%)					
yes	75	45	70	50	70
no	25	55	30	50	30
Storage of crop residue during surplus (%)					
Yes	100	100	100	100	100
No	0	0	0	0	0
Way storage of crop residue during surplus (%)					
Stacked out side	40	30	0	35	26
Stacked under shade	60	70	100	65	74

*N=number of respondents*

### 4.6.3. Source of Water and watering practice

Source of water and way of utilization in the study area are presented in Table 12. The main source of water for cattle is river and watering frequency in the *woreda* is once per day;

Table 13: Watering practice by respondents in the study area

	Baye Giche (N=20)	Gutu Urji (N=20)	Ta'a Gola (N=20)	Kusaye Bodha(N=20)	Ilala Saden(N=20)
Source of water (%)					
River	100	100	100	100	100
Pond	0	0	0	0	0
Average liters per day (mean±SD)	NS	NS	NS	NS	NS
Average number of watering per day (mean±SD)	1.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0

N=number of respondents, NS= not specified

### 4.7. Feed Characterization

The chemical composition of major feeds in the study area is presented in Table 13 and feeds that have significant difference were presented in table 14. The overall mean dry matter content of all crop residues at Baye giche, Gutu urji, Ta'a gola, Kusaye bodha and Ilala saden are nearly the same. The overall mean crude protein content of *teff* straw and barley straw are varying between ILala Sadeen and Baye Giche as well as Kusaye bodha. From the analysis of variance results shown in Table 14, it is evident that the variation in crude protein content of teff straw and barley straw across Ilala saden and Kusaye bodha/Baye giche was highly significant. But there is no significant difference in dry matter, ash, crude fiber, ether extract and calcium Table 14.

Table 14. Chemical composition of major feeds in the study area

Main feed resource	Kebeles	DM%	Ash%	CF%	CP%	EE%	Ca%
Teff straw	Baye giche	97.13	8.30	38.60	12.46	1.71	2.74
	Gutu urji	98.12	8.11	37.67	11.32	2.04	1.72
	Ta'a gola	97.55	7.79	40.00	12.02	1.78	3.00
	Kusaye bodha	96.89	7.97	39.01	12.47	1.69	2.80
	Ilala saden	97.56	9.01	37.89	9.01	2.54	2.32
Wheat straw	Baye giche	97.33	8.76	43.25	6.38	1.33	1.71
	Gutu urji	97.26	10.17	43.08	5.74	0.96	17.13
	Ta'a gola	96.43	9.11	42.08	5.23	1.04	16.98
	Kusaye bodha	97.54	8.89	43.67	6.53	1.23	17.12
	Ilala saden	95.99	7.34	52.01	4.56	0.82	19.21
Grass hay	Baye giche	96.06	9.57	36.43	15.15	1.56	1.38
	Gutu urji	98.12	10.43	34.76	16.57	1.22	1.54
	Ta'a gola	98.23	10.01	35.34	15.89	1.32	1.43
	Kusaye bodha	97.10	9.65	36.66	15.23	1.53	1.40
	Ilala saden	98.51	10.67	33.98	17.00	1.11	1.73
Barley straw	Baye giche	96.86	6.55	45.62	10.23	1.36	8.54
	Gutu urji	97.76	7.68	42.76	14.22	1.23	9.00
	Ta'a gola	97.12	7.22	43.47	12.78	1.43	8.11
	Kusaye bodha	96.73	6.74	45.87	9.78	1.78	8.19
	Ilala saden	98.12	7.93	44.89	15.54	1.64	9.44

**N.B:-** DM-Dry Matter, CF-Crude Fiber, CP-Crude Protein, EE-Eter Extract, Ca-Calcium

Table 15. Chemical composition of *teff* and barley straw in selected kebeles of *woreda*

Feed type	<i>Kebeles</i>	DM	Ash	CF	CP	EE	Ca
<i>Teff</i> straw	Baye Giche	97.13±0.55	8.30±0.43	38.60±0.80	12.46±1.30 <sup>a</sup>	1.71±0.41	2.74±0.51
	KusayeBodha	96.89±0.22	7.97±0.32	39.01±3.9	12.47±1.79 <sup>a</sup>	1.69±0.68	2.80±3.14
	Ilala Saden	97.56±0.18	9.01±0.26	37.89±3.2	9.01±1.36 <sup>b</sup>	2.54±0.56	2.32±2.54
Significance		NS	NS	NS	**	NS	NS
Barley straw	Baye Giche	96.86±0.69	6.55±1.57	45.62±3.18	10.23±3.13 <sup>a</sup>	1.66±0.21	8.54±0.52
	KusayeBodha	96.73±0.69	6.74±1.57	45.87±3.18	9.78±3.13 <sup>a</sup>	1.68±0.21	8.19±0.52
	Ilala Saden	97.56±0.84	9.01±1.47	44.89±2.28	15.54±2.13 <sup>b</sup>	1.64±1.21	9.44±0.32
Significance		NS	NS	NS	**	NS	NS

<sup>a,b</sup> Means in a column followed by different superscripts are significantly different (p<0.01).

#### 4.8. Constraints of dairy production

Livestock disease was mentioned as the most important constraint by most of cattle owners (95.5%) followed by scarcity of improved genotype (94.5%), feed shortage by (82.15.5%), lack of space (43.5), water shortage (28.0%) and milk market (8.78%) Table 15.

Table 16. Constraints of dairy cow production as identified by respondents

<b>Constraints</b>	<b>Percentage</b>
Scarcity of improved genotype	94.15
Disease	95.5
Water shortage	48.0
Milk market	8.78
Feed shortage	82.15
Lack of space	43.5

## 5. DISCUSSION

The results obtained on different aspects of the study have been discussed as follows.

### 5.1. Owner Household Characteristic

Dairy cows' owner household characteristics (Table 4) indicated that male respondents were higher (80%) than female respondents. This reflected the facts that, male mainly heads *woreda* cattle production. This result is in line with the Azage *et al.* (2003) finding reporting that, most of the households sampled for the study were male headed households (77.5–97.4%) and Assefa *et al.*, (2013), reported that, the majority (85%) of the respondents were male household heads. Also in agreement with the Ethiopian Society Animal production (2009) among the farmers, (21.43 %) were female-headed households while the rest 78.57 % were male-headed households. The average age of household heads, which observed to be greater than 25years, this shows most of the dairy cow husbandry were headed by adult and older group of the society.

The study further indicated that 60% of the respondents were illiterate, while the rest (30 and 10) had be educational background for basic education and elementary education respectively. Thus, acceptable educational level of basic education was not obtained. Consideration of the education status of dairy cow owner is useful for successful dairy cow husbandry improvement strategies and other development works, but most of the respondents were illiterate which had negative effect on the development of dairy husbandry practice in the study area. This result is in line with the Asaminew and Eyassu (2009) finding, in which the majority of the household members were illiterate, and this will have a negative effect on the development of dairy sector. According to respondents, 76% of them took farming as a major occupation and all of the respondents rear other livestock asides, like sheep, goat, donkey and poultry (Appendix III).

The major farming activity in the study area was crop production followed by cattle rearing. Cattle are the most important component of the mixed-farming system in the study area since they provide draught power, milk, meat and income to the farmers. These functions were reported by (Mukasa-Mugerwa, 1989) in the central highlands of Ethiopia and (Yitaye *et al.* 2001) in southern Ethiopia.

The major purpose of keeping cattle in the study area was to provide draught power followed by milk production. Cows provide the only source of milk whereas milk from small ruminants is not consumed in the area because of cultural taboo. The average family size of the respondents in the study area was less than 6.4 individuals. It is lower than result (7.71 persons/household) reported by Asaminew ( 2007).

The result obtained from the respondents indicated that 100% of activities such as stable cleaning, selling and buying, feed collection and feeding, milking were performed by owners, while watering and herding activity was performed by herder or children. (Appendix VI).

## **5.2. Cattle and Land holding pattern**

The size of land holdings ranged from about 0.5 ha in the case of marginal farmers to about 8.0 ha per household in the case of wealthy farmers and the average was 3.68 ha of which 69.42 % was allocated for crop cultivation ( 24.27%), for grazing and the rest 6.31 % was reserved for hay production. The average individual household land holding in this area (3.68ha) is greater than what was reported by Jayne et al. (2003) for the whole country as 1.17ha per households. Nearly 14.29% of the households have 0.5 - 0.75 ha of land, 7.14% have 1.25 ha, 50% have greater than 2.5ha and the rest 28.57%, of the households have 1.75 - 2.25 ha of land. Therefore the smallholders in particular were dependent on land leased from other farmers for crop and hay production, and for livestock feed they have to purchase native hay or straw from other farmer. The land lease paid per unit of land is a negotiated amount that is fixed by considering the rainfall condition and the fertility of the land. The majority of the respondents belonged to small and medium land ownership categories; 50.0 % were marginal farmers (having 0.5 to 2.75 ha of land) and 28.57% were medium farmers

(having 4 to 5 ha of land). Only 21.43% of farmers were in the large land size-holding category, having more than five ha.

The average number of milk cows kept by farmers were 3.36, ranging from 2 to 7, of which then (93.62%) were local dairy cows while only 6.38% were crossbred dairy cows. The average milk production per households has a direct relationship to farm size. All the participant farmers sell their milk and milk products (butter and/or cheese) for consumers in the local markets since there were no other market options.

### 5.3. Production system

The production system in the study area is mixed crop-livestock production system. Both components (crop cultivation and livestock production) are complementary. Livestock provides power for land preparation and crop transportation after harvest and manure as fertilizer, while crop by-products represent an important source of animal feed. The predominant feed types available and provided to cattle are different in different production systems. In this area, different cereal crops predominantly produced includes teff, wheat and barley. Tuber crops such as potatoes and enset are, also commonly used. Residues of these crops are commonly used as animal feeds which is in line with Tesama et al (2003) in the mid highlands of Ethiopia. Crop farming in this area is mainly practiced using oxen and oxen are given due attention better than lactating cows particularly with regard to better feeding. In general, traditional grazing on natural pasture is used as the main source of feed for the livestock followed by crop residues. Which are also, reported by Tolera (2009) and Funte *et al.*, (2010) in different area of study.

Animals kept for multipurpose use produce milk and, feed production and utilization is limited to grazing land and crop residues. Dairy products such as buttermilk, butter and cottage cheese are produced and used as source of income to buy farm inputs and family needs while cattle are an asset-securing farmers at the time of emergency.

The housing condition of animals was variable. In rural areas, almost all (86.4%) floors were hardened soil and only 13.6% of the houses are with stone slab floors. Muddy floors are difficult to clean and creating drainage problem. This condition predisposes animals to disease (Chamberlain, 1989). The management of the dairy

cows is poor even in some *kebeles* there was no cattle housing which really further exposes the cattle to cold stress which directly affects the productivity of the animals.

#### **5.4. Lactation yield and lactation length of dairy cows**

The average estimated daily lactation yield of local and cross bred dairy cows was found to be  $1.15 \pm 0.386$  liters and  $4.73 \pm 3.2$  respectively and the overall average lactation length of local and crossbred cows was 9.8 and 10.1 months, respectively in the study area. The reported average daily milk yield of local cows in the present study is lower than the value reported by (ILDP, 2004) which was 4 liters and that reported by (CSA, 2005) which was 1.23 liters elsewhere in the country. In addition to improved nutrition and management, selection for milk yield traits within the indigenous breeds should be planned as a long-term objective in order to increase milk yield from indigenous cattle. However, in order to meet the immediate demand for milk, crossbreeding indigenous cattle with exotic cattle breeds can be planned and implemented. The lactation length of the indigenous cows observed in this study is longer than the national average of 7 months (CSA, 2005). The lactation length of crossbred cows observed in this study is slightly shorter than the lactation length of 11.7 months reported for crossbred cows in the central highlands of Ethiopia (Zelalem *et.al.*, 2001). In general, the lower average daily milk yield per cow and the variation in lactation length observed in the present study may be attributed to feed shortage and poor genetic potential of the local cows.

#### **5.5. Milking Practices**

Before milking took place, the calves are allowed to suckling their dam in order to initiate the milk let down. Majority (98%) of the respondents indicated that cows are milked on the average twice a day. Suckling of the calf is practiced twice before and after milking. These results were in agreement with (Zelalem and Inger, 2000) and (Asaminew and Eyassu, 2009) who reported that cows are milk twice a day. All the respondents indicated that for milking to take place calves have to suckle their dam for 2-3 minutes to stimulate milk let down, otherwise it results in low milk yield. Milking is entirely done by hand with twice a day milking frequency and is the

responsibility of female members of the households. Kedija (2007) observed that traditional hand milking is the major type of milking practice and was the task of women members of the households. In the study area, milking was done unhygienically that there was no washing of udder and hand before milking. Only (5.7%) farmers were washing udder before milking of their cows. The current study was agreed with the report of Lemma (2004) who indicated that udder of the cow is washed before milking only by few farmers (5.6%). The respondents stated that teat gets washed when the calf suckles.

### **5.6. Major feed resources for dairy cows**

Crop residues, natural pasture and aftermath grazing were the major feed resources for dry season, in their descending order. In general, crop residues and natural pasture are the major feed resources of the area which agree with the report of (Tolera *et al.*, 2012), and in line with the findings of (Seyoum *et al.*, 2001) who reported that the major basal feed resources for cattle in the highlands of Ethiopia are natural pasture, crop residues and stubble grazing. Generally, crop residues from cereals such as wheat, barley and *teff* were common. *Teff* straw is available in large mass in Baye Giche, Kusaye Bodha and Ta'a Gola, but barley straw is found in small amount in Baye Giche and Kusaye Bodha *kebeles* in contrast it is found in large mass in Ilala Saden, gutu urji and ta'a gola *kebeles*. Communal grazing lands provide the major feed to cattle followed by crop residues and hay. Other important feed resources in the surveyed areas were local brewery by-products (*tella and areke*) namely *Atella*. According to the respondents, *areke atella* is frequently used supplement as compared to *tella Atella* and farmers use them as substitute to conventional concentrate feeds. In view of the high costs of concentrate feeds, use of these non-conventional feedstuffs might be a viable alternative.

In the study area, the availability of feed resources varied in seasons with respect to quality, quantity and type of feed. The principal dry season feed resources available to dairy cattle include crop-residue, stubble grazing, natural pasture and hay in their descending order of magnitude. Whereas, during the wet season, the principal feed resources were natural pasture, weeds in the crops, crop-residue and hay in their

descending order of intensity of use by farmers. However, types of feed resources were not significantly different between kebeles of the *woreda*.

#### **5.6.1. Feeding system, feeding practice and conservation of crop residue**

Grazing and crop residues are the major feed resources in the area. Farmers in all *kebeles* mostly use graze communal grazing lands and crop aftermath during the dry season and supplement in the morning and evening during milking time. All farmers conserve crop residues and hay for dry season feeding. However, from the focus group discussion, almost no participants adopted the practice of supplementing their animals with concentrate mixture that would improve production and reproduction. Instead, they supplement their lactating cows only with traditional brewery residue (*Tela atella*) and/or traditional liquor residue (*Arege atella*) to the roughage-based diet. Common salt was also, provided to the animals by mixing with the *atella*. The same practice of supplementing, with '*atella*' (as protein and energy source) was reported by Yoseph Mekasha *et al.* (2002) during milking time in addition to straw/hay for better milk yield and improving their body condition. However, the quantities of *atella* supplemented seemed to depend on the availability of the material rather than with purpose to supply better quality feed to their cows.

The results for feeding practices in indicated that there was no utilization of feeding plan. The reason behind this is that the feed availability was varying seasonally particularly crop residues, and small number of feed types. The entire respondents in the study area indicated that they use free grazing and no use of improved forage feeding practice for their dairy cows. Similarly, Tesheger *et al.* (2013), the feeding system practiced in the chaweka district was pre dominantly free grazing.

All respondents in the study area were utilized crop residues year round. This indicates that crop residue contributed a substantial proportion of feeds sources for dairy cows in the study area. As Getnet (1999), the availability of crop residues is closely related to the farming system, the type of crops produced and intensity of cultivation. More than 96% of respondent's store, when there is surplus crop residue

this is in agreement with Tesfaye and Charatanayuth (2007) found that more than 90% of the respondents collect and store their straws.

All most all of the respondent's get water for their cows from river water. This indicated that dairy cows get insufficient and unclean drinking water. The respondents provided water for their cow once per day. This finding is disagree with the Teshager *et.al*, (2013) which reported that majority (90.6) of the respondents water their cattle twice a day.

### **5.7. Feed Characterization**

*Teff* straw and barley straw in Baye Giche and Kusaye Bodha on dry matter and crude protein in relation with Ilala saden *kebele* were slightly significant. However, there is no significant difference in ash, crude fiber, ether extract and calcium. This is due to little change in chemical composition of feed across different *kebeles*. This difference may be due to the method of conserving and soil. Wheat straw and hay has almost the same chemical composition. It is spot on that, the nutritional values of crop residues vary according to; the type, species and varieties of crop used in addition to soil type and conservation method. There is a preference for wheat and barley straw which has a higher crude protein level than other fodders, but *teff* straw is also in demand as it is highly palatable and digestible, this in agreement with Thehay (2002).

### **5.8. Constraints of dairy production and suggested solution**

Livestock disease was mentioned as the most important constraint by most of cattle owners (95.5%) followed by scarcity of improved genotype (94.5%), feed shortage by (82.15%), land shortage (43.5%), water shortage (28.0%), and milk market (8.8%). The most prevalent diseases reported in the area include pasteurellosis, blackleg, mastitis, parasite and anthrax. The interaction of these constraints affects the overall milk production in the area. This is in agreement with Zemenu *et al.*(2014) and Solomon (2006).

The demand for crossbred cows in the study area was high but supply is far below the demand. Furthermore, those farmers who own crossbred cows complain about inadequate artificial insemination services. Therefore, to alleviate these problems and increase milk production, integrated work between all actors (farmers, extension workers, veterinarians and researchers) aimed at genetic improvement of local cows. Either, by selection or crossbreeding with improved breeds, better health management, supplementing poor quality feed resources particularly crop residues with concentrate feed and/or improved forage species, efficient heat detection and timely insemination and development of organized market are necessary.

## 6. CONCLUSION AND RECOMMENDATIONS

The study showed that smallholder mixed crop-livestock production system is the most known cattle production system in the study area. The major feed resources that are used for dairy cow feeding in the study area were grazing land, crop residues, hay and non-conventional feedstuffs. Moreover, wheat straw, barley straw, *teff* straw and hay are the most common feed resources that are consistently present across the study area. The study revealed that free grazing of natural pasture is practiced and improved forage utilization is not practiced. The amount of feeds that are offered to cows as well as the frequencies of feeding is not specified in the study area. The reported average daily milk yield of local cows in the present study is lower than the value reported elsewhere in the country

The proximate analysis of the feeds indicated that there is little significant difference in percentage concentration of the various entities across study areas. The major constraints in dairy cow feeding management across the study areas were shortage of feed, high cost and lack of awareness on appropriate way of feeding. Based on the findings of the current study, the following recommendations are forwarded;

- To increase dairy cows' milk yields there needs to be an urgent intervention by concerned development actors and partners for strengthening the feeding system;
- The farmers have to get awareness on how to use and process locally available feeds for improving the performance of local dairy cows;
- Technical interventions to support smallholder cattle production need targeting improving technical and institution constraints via adequate delivery of veterinary services, improved fodder cultivation, proper conservation and improvement of crop residues, adequate extension service and improved availability of water. Fodder conservation practices, particularly hay and silage making, should be encouraged in order to enable a stable feed supply throughout the year. Smallholder dairy farmer should be trained up with the concept of feeding interventions and use of concentrate and urea supplementation with crop straw.

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## 8. APPENDIXES

Appendix I: Questionnaire used to collect data.

### **Topic of research: Assessment of Dairy Cattle Feed Resources and Milk Yields Under Small Holder Farmers in Kersa Malima Woreda**

#### **Section one: General information (household characterization)**

- Date of the interview \_\_\_\_\_
- Region \_\_\_\_\_ Zone or Woreda \_\_\_\_\_
- Kebele \_\_\_\_\_
- house hold head full name \_\_\_\_\_
- Sex: \_\_\_\_\_ Age: \_\_\_\_\_
- Literacy status (encircle for one)
  - i. Illiterate      ii. Read only      iii. Elementary (1-8 grades)      iv. Secondary (9-12)      v. Above secondary (colleges and Universities)
- Major occupation (encircle one)
  - i. Farmer      ii. Business man      iii. Government /private employee      iv. Retired person      v. Other (specify) \_\_\_\_\_
- Marital status      i. Married      ii. Unmarried
- How many individuals depend on the income from the dairy cow products?
  - Children (<18 years) \_\_\_\_\_; Adult (18-65) years) \_\_\_\_\_
  - Dependent (> 65 years) \_\_\_\_\_

#### **Section two: Holding characteristics**

1. How many dairy cows do you have? \_\_\_\_\_
2. How many cows are milked? \_\_\_\_\_
3. For how long do you owned them? \_\_\_\_\_
4. For how many time do you milk your cow per day? \_\_\_\_\_
5. Where do you keep your cows after and before milking? \_\_\_\_\_
6. Who is responsible for the different activities of milking cow husbandry?
  - i. Herding \_\_\_\_\_
  - ii. Feed collection and feeding \_\_\_\_\_
  - iii. Watering \_\_\_\_\_

iv. house cleaning \_\_\_\_\_

v. Health care \_\_\_\_\_

7. Do you own other species of animals? 1. Yes 2. No

8. If yes, list them.

\_\_\_\_\_ and number \_\_\_\_\_

\_\_\_\_\_ and number \_\_\_\_\_

\_\_\_\_\_ and number \_\_\_\_\_

### Section three: Feed Resources

3.1. List most commonly used feed resources for your cows in a ranking order from top most.

i. \_\_\_\_\_

ii. \_\_\_\_\_

iii. \_\_\_\_\_

iv. \_\_\_\_\_

3.1.1. If grazing is used, please respond to the following:

a) What is the type of grazing land in the area? \_\_\_\_\_

b) What is the status of the grazing land used?

i. Decreasing      ii. Increasing      iii. No change

c) Do you have private grazing land? 1. Yes 2. No

d) If yes, what type? \_\_\_\_\_

e) State the frequency of grazing (morning/afternoon/evening/whole night) hours/day? \_\_\_\_\_

f) List/rank major problems related to grazing other than shortage. \_\_\_\_\_.

3.1.2. If improved forage and pasture crops are used, please respond to the following:

a) Do you plant improved forage? 1. Yes 2. No

b) If yes, what are they? \_\_\_\_\_

c) If yes, how do you utilize your improved pasture/forage?

i. Grazing      ii. Cut and carry system      iii. Both

d) If you do not plant improved pasture, why?

- i. Shortage of land
- ii. Shortage of forage seed
- iii. Water shortage
- iv. Lack of knowledge
- v. Other (specify) \_\_\_\_\_

3.1.3. If crop residue is fed, please respond to the following:

- a) How many cropping seasons do you have per annum? \_\_\_\_\_
- b) Do you get enough / sufficient year round supply of crop residues? 1. Yes 2. No
- c) If no, what is the reason? \_\_\_\_\_
- d) Do you store surplus crop residues? 1. Yes 2. No
- e) If yes, how?
  - i. Stacked outside
  - ii. Stacked under shed
  - iii. Baled outside
  - iv. Baled under shed
  - v. Others (specify) \_\_\_\_\_
- f) What type of crop residues are commonly used as cows feed?
- g) Which types of crop residues are favorably selected by your cows? do you know why?

3.1.4. If Agro-industrial byproduct is used, please respond to the following:

- a. Do you give agro-industrial byproduct to your milking cows? (1) Yes (2) No
- b. If yes, tell type of agro-industrial byproduct and how you feed them. List them down according to volume of use.
  - i. \_\_\_\_\_ how \_\_\_\_\_
  - ii. \_\_\_\_\_ how \_\_\_\_\_
  - iii. \_\_\_\_\_ how \_\_\_\_\_
  - iv. \_\_\_\_\_ how \_\_\_\_\_
  - v. \_\_\_\_\_ how \_\_\_\_\_
- c. How often do you feed agro-industrial byproducts? \_\_\_\_\_
- d. How much a milking cows takes at a time? \_\_\_\_\_
- e. Are agro-industrial byproducts accessible in your area? (1). Yes (2). No
- f. If no, what is the reason for problem of accessibility:
  - i. High price
  - ii. Shortage on market
  - iii. Long distance from the source
  - iv. Others \_\_\_\_\_

3.1.5. If non-conventional feed resources are used, please respond to the following:

a. Do you use other feed sources (residuals)? (1) Yes (2) No

b. If yes, please list common ones

i. \_\_\_\_\_

ii. \_\_\_\_\_

iii. \_\_\_\_\_

iv. \_\_\_\_\_

v. \_\_\_\_\_

c. How much a cows takes per day? \_\_\_\_\_

d. How often do offer to a cow feed per day? \_\_\_\_\_

e.

**Section Four: Feeding System**

4.1. Do you use a feeding plan for your horse? 1. Yes 2. No

4.2. If Yes , fill the table;

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

4.3. If No, for Q4.2 why?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ .

4.4. Do you feed your cow at milking time? 1. Yes 2. No

4.5. If yes, what type of feed and how much?

\_\_\_\_\_

\_\_\_\_\_ .

4.6. Do you feed grain for your cow? 1. Yes 2. No

4.7. If yes, what are the predominant types / sources of grain and much do you feed a cow per day? \_\_\_\_\_

- 4.8. How often do you feed grain and at what time? \_\_\_\_\_
- 4.9. Do you feed hay for your cow? 1. Yes      2. No
- 4.10. If yes, what are the predominant sources of hay and how much do you give per day? \_\_\_\_\_
- 4.11. How often do you feed hay? \_\_\_\_\_
- 4.12. Do you feed salt?      1. Yes   2. No
- 4.13. If yes, how do you feed the salt? \_\_\_\_\_
- 4.14. How often do you feed salt? \_\_\_\_\_
- 4.15. What are the sources of water for your cow? \_\_\_\_\_
- 4.16. How often and how much do you water your cow per day? \_\_\_\_\_

## 5. Milk yields and measurement

5.1. What is the average milk yield per day of your household throughout an average year?

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Total average milk yield local breed (litres/day)												
Total average milk yield exotic breed (litres/day)												
Available feed resources												
Supplementary feeds												

Appendix II: Guideline for group discussion

Name of kebele \_\_\_\_\_

1. What are the major feed resources of milking cows in the town? rank in order.
2. How do you see the availability of natural feed resources in the area (trend in the last ten years)?
3. Rank/list the months of a year according to feed availability.
4. What are the critical problems facing your milking cows?  
What is your method to prevent as well as reduce those problems?
5. What are your sources advices on health and husbandry practices for your milking cows?

Appendix III: Livestock's population by *woreda*

Variable	Baye Giche N (20)	Gutu Urji N (20)	Ta'a Gola N (20)	Kusaye Bodha N (20)	Ilala Saden N (20)
Other livestock rearing (%)					
Yes	100	100	100	100	100
No	0	0	0	0	0
Type of livestock (%)					
Sheep	11.88	45.78	35.89	31.87	87.65
Goat	89.11	55.95	56.76	93.92	43.76
Cattle	100.00	100.00	100.00	100.00	100
Donkey	100.00	98.56	95.43	100	79.65
Poultry	98.45	97.12	94.37	89.89	98.89

*N=number of respondents,*

Appendix IV: Labor distribution with in respondents by *woreda*

Variable	Baye Giche (N=20)	Gutu Urji (N=20)	Ta'a Gola (N=20)	Kusaye Bodha (N=20)	Ilala Saden (N=20)
<b>Herding (%)</b>					
Owner	1	4.5	5.0	7.1	1.7
Family member	5.9	10.9	10.4	10.0	11.8
keeper	93.1	84.5	84.6	82.9	86.5
<b>Feed collection and feeding (%)</b>					
Owner	93.1	84.5	84.6	82.9	86.5
Family member	5.9	10.9	15.4	17.1	11.8
keeper	1	4.5	0.0	0.0	1.7
<b>Watering (%)</b>					
Owner	1.00	4.5	0.0	0.0	1.7
Family member	5.9	10.9	15.4	17.1	11.8
keeper	93.1	84.5	84.6	82.9	86.5
<b>House cleaning (%)</b>					
Owner	93.1	84.5	84.6	82.9	86.5
Family member	5.9	10.9	15.4	17.1	11.8
keeper	1.0	4.5	0.0	0.0	1.7
<b>Buying and selling of dairy cows (%)</b>					
Owner	99.0	97.3	97.4	99.0	98.3
Family member	1.0	2.7	2.6	1.0	1.7

*N=number of respondents*