ASSESSMENT OF FEED RESOURCES, FEEDING PRACITCE, MILK PRODUCTION AND EVALUATION OF MICROBIAL QUALITY OF MILK IN MALGA DISTRICT, SIDAMA REGIONAL STATE, ETHIOPIA

M.Sc. THESIS

BY: SAMUEL SANBATO

MAJOR ADVISOR: MERGA BAYSSA (PhD)

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN (DAIRY SCIENCE AND TECHNOLOGY)

HAWASSA, ETHIOPIA

May , 2022

ASSESSMENT OF FEED RESOURCE,FEEDING PRACITCE, MILK PRODUCTION AND MICROBIAL QUALITY OF MILK IN MALGA DISTRICT, SIDAMA REGIONAL STATE, ETHIOPIA

BY

SAMUEL SANBATO SHAWE

ADVISORS: - MERGA BAYSSA (Ph.D.)

ATHESIS SUBMITED TO THE SCHOOL OF ANIMAL AND RANGE SCIENCES,

COLLEGE OF AGRICULTURE, HAWASSA UNIVERSITY

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER

OF SCIENCE IN ANIMAL AND RANGE SCIENCES, (SPECIALAZATION: DAIRY

SCIENCE AND TECHNOLOGY)

HAWASSA, ETHIOPIA

May , 2022

HAWASSA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

ADVISORS' APPROVAL SHEET

(Submission Sheet-1)

This is to certify that the thesis entitled ***"Assessment of feed resource feeding practice and milk production and evaluation milk quality in malga District of Sidama Region*"** submitted in partial fulfilment of the requirements for the degree of Masterswith specialization in *Dairy Science and Technology,* the Graduate Program of the School of Animal and Range Sciences and has been carried out by *samuel sanbato shawe* ID.No.GpDaScR/0007/11, under my/our supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

Merga Bayssa (PhD) ________________ _______________

Name of major advisor Signature Date

EXAMINERS' APPROVAL SHEET II

(Submission sheet-II)

As members of the Examining Board of the Final MSc Open Defence, we certify that we have read and evaluated the thesis prepared by Samuel Sanbato entitled"**Assesment of feed resource,feeding practice, milk production and Evaluation of microbial Quality aspect among Dairy producers in malga district, Sidama Region, Ethiopia'**' *and* examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfilment of the requirements for the degree of Master of Science in Agriculture (**Dairy Science and Technology**).

______________________________	______________	______________
Chairperson	Signature	Date
______________________________	______________	______________
External Examiner	Signature	Date
______________________________	______________	______________
Internal Examiner	Signature	Date
Merga Bayssa (PhD)______________	______________	
Major advisor	Signature	Date
______________________________	______________	______________
SGS	Signature	Date

Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the school of graduate studies (SGS) through the school graduate committee (SGC) of the candidate school.

Stamp of SGS_______________ Date_______________________

STATEMENT OF AUTHOR

I declare that this thesis is my original work and all information and sources of materials used for this thesis have been duly acknowledged. I solemnly declare that this thesis is not done in my study area about dairy production for the award of any academic levels of institution.

By: - Samuel Sanbato Signature: - ______________

Place: - College of Agriculture, Hawassa University, Hawassa

Date of submission: - ___________________

ACKNOWLEDGEMENTS

First of all I would like to thanks my GOD for his endless help through out my study. Secondly, I would like to express my deepest gratitude to my major advisor Merga Bayssa (PhD)for his unlimited advices, constructive comments, professional guidance and immediate feedbacks as well as valuable suggestions for his fatherly approach and constructive comments provided. I sincerely acknowledge the School of Animal and Range Sciences of Hawassa University for creating conducive laboratory working environment. I also acknowledge Mr Desalegn Mamo and my classmates for their help during laboratory work.

I gratefully acknowledge my family for their financial support throughout my study. My deepest thanks also goes to Malga woreda Livestock and Fisher Office for all their cooperation during data collection.

LIST OF ABBREVIATION

AI	Artificial Insemination
ANOVA	Analysis of variance
CC	Coli form count
CFU	Colony Forming Unit
CSA	Central Statistics Agency
DM	Dry matter
FAO	Food and Agricultural Organization of the United nation
FGD	Focus group discussion
IFCN	International Farm Comparison Network
NGO	Non-Governmental Organizations
NPP	Net Primary Productivity
SNNPRS	Southern Nations, Nationalities and Peoples Regional State
SPCA	Standard Plate Count Agar
SPSS	Statistical Package for Social Studies
TBC	Total Bacteria Count

Table of Contents

List of Table

List of figures

Assessment of Feed resource, Feeding practice, Milk production and Microbial quality of milk in Malga district, Sidama Region, Ethiopia

By: Samuel Sanbato Shawe

Advisors: Merga Bayssa (PhD)

ABSTRACT

The purpose of the study was to assess feed resource, feeding practice, milk production and microbial quality in malga district of Sidama region, Ethiopia. A multi-stage sampling procedure with combination of purposive and random sampling technique was employed for selecting the study area and sampled households. Systematic sampling method was used to select respondents from each selected kebele proportionally. The study was conducted by interviewing 150 smallholder milk producers who owned local cows and crossbred which were purposively selected from five kebeles from two agro-ecologies (highland and midland) and these were followed by collecting 35 milk samples from randomly selected milk producers for microbial quality analysis. The common feed resource identified at study area natural pasture 52%, crop residue and enset leaf 12%, improved forge 23.3%, supplemental feed (concentrated feed) 12.7% while feeding system the area free grazing 76.7%, stall feeding 13.3% and both free grazing and stall feeding 10%. The overall mean for local dairy cows and crossbred dairy cows daily milk yield and lactation length were 1.75±0.08 liter/day, 5.9±0.99 months and 4.5±0.17, 7.01±0.04, respectively.The estimated mean daily milk yield based on the farmers response varied significantly (P<0.05) among the agro ecologies. The result indicated that majority of the respondents use the shared with family house, clean their barn daily and more than once a week with 82.7%, 17.3%, and 91.75% respectively. Moreover, milking without hand washing, absence of udder washing and failure to use towel to clean the udder were practiced by 14.7%, 62% and 97.9% of the respondents, respectively. Households used equipment for milking, transportation, storage and churning, clay pot, plastic, and aluminum/stainless steel utensils to keep milk and milk products. The major source of water and water frequency for cleaning and watering their animal rivers 33.3% ponds 59.3% and well water7.7%. Majority of households 68.7% watering their animal once/day respectively. Concerning microbial quality, overall mean total bacterial counts (TBC)and coliform counts (CC) values of milk from current finding were 5.455 ± 0.075 log10 cfu/ml and 4.085 ± 0.02 log10 cfu/ml, respectively.In general, milk from highland area had high total bacterial and coliform load as compared to the sample taken from the midland area. From this study it has been concluded that hygienic milk production and microbial quality of milk from the midland area is better than highland and therefore extension work should focus in creating awareness and training dairy producers in a highland about clean milk production practices..

Keywords *Agro ecology, feed resource, Microbial Quality, Milk Production,*

1 INTRODUCTION

Livestock industry is an important and integral part of the agricultural sector in Ethiopia. Moreover, livestock farming is vital as a supply of meat and milk, being a source of additional income both for smallholder farmers and livestock owners (Ehui et al., 2002). In a smallholder livestock production system, animals are dependent on a variety of feed resources that can vary both in quantity and quality. For optimum livestock production, feed resource available should match with the number of animals in a given area. Feed resources as reported by Tolera et al. (2012) can be classified as natural pasture, crop residue, improved pasture forage and agro-industrial by-products, of which the first two are the most important contributors. Animals depend mainly on natural pastures for their feed requirements. In Ethiopia, there are extensive areas where keeping of livestock on the natural vegetation is the only possible types of land use (Coppock, 1994).

In Ethiopia, annual milk production per cow is generally low due to reduced lactation length, extended calving interval, late age at first calving and poor genetic makeup. Another major problem to such low milk production is shortage of livestock feeds both in quantity and quality, especially during the dry season. Moreover, progressive decline of average farm sizes in response to rising human populations, encroachment of cropping land onto grazing areas,less fertile and more easily erodible lands, and expansion of degraded lands, which can no longer support either annual crops and pastures contributed to shortage of feed resources (Anderson, 1987; Alemayehu, 2005). Further poor grazing management (e.g. continuous overgrazing) contributed to shortage of feed resources as a result of replacement of productive and nutritious flora by unpalatable species (Ahmed, 2006).

Feed supply from natural pasture fluctuates following seasonal dynamics of rainfall (Alemayehu, 1998; Solomon et al., 2008a). Furthermore, quality of native pasture is very low especially in dry season due to their low content of digestible energy and protein and high amount of fiber content. This is much worse for crop residues owing to their lower content of essential nutrients (protein, energy, minerals and vitamins) and lower digestibilities and intake (Seyoum and Zinash, 1988; Chenost and Sansoucy, 1991; Zinash et al., 1995).

Milk production systems in Ethiopia may be classified into two broad categories namely: commercial systems which produce milk mainly for market and subsistence systems which produce milk mainly to meet household needs for milk products. The rural milk production system is part of the subsistence farming system and includes pastoralist, agro pastoralist and mixed crop–livestock producers, mainly in the highland areas. The system is not market-oriented and most of the milk produced in it is retained for domestic consumption (Azage Tegegne et al, 2003).

Quality milk implies the milk which is free from pathogenic bacteria and harmful toxic substances, free from sediment and extraneous substances, of good flavor, with normal composition, adequate in keeping quality and low in bacterial counts (Khan et al., 2008). Consumers need clean, wholesome and nutritious food that is produced and processed in a sound sanitary manner and free from pathogens. Hence, quality milk production is necessary for fulfilling consumers' demand (Khan et al., 2008). To sell raw milk directly to consumers or to a processing factory, it must be handled hygienically and remains fresh and capable of being heated without curdling. Hygienic milk handling includes; using clean equipment, maintaining a clean milking environment, observing good personal hygiene and preserving the quality of milk during storage and transportation to the consumer or processing plant (Kurwijila, 2006). Milk quality should not be ignored at all stages of the dairy value chain from farm to table. As the bacterial quality of raw milk is important to product shelf-life, flavor and product yield, it is important that dairy enterprises should strive to obtain the highest quality raw material possible from their own farm as well as their suppliers. It is therefore essential to produce best quality raw milk in the dairy farm in order to manufacture milk products of acceptable quality (Zelalem, 2012).

1.1 Statement of Problems

In the study area dairying is an important activity for the livelihood of farming community and other produces. Even if the study areas have potential for production of milk and milk products, little is known about the existing milk production and milk quality. This study had attempted to identify the challenges and opportunities for milk production, feed resource and milk quality in order to find possible solutions for futures development plans. The study will also serve as baseline data for agricultural office, researcher and non-governmental organization (NGO).

Inadequate information about livestock feed resource and milk yield of both crossbreed and indigenous dairy cattle are the main problems in the malga 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 could have important contributions to individuals or institutions working in dairy development as well as dairy policy makers.

1.2 Objective

1.2.1 The General objective of the study is

The general objective of this study was to assess the feed resource, feeding practice, milk production and milk quality in malga district,sidama region, Ethiopia .

1.2.2 Specific objectives

- ❖ To assess the feed resource and feeding practice in study area
- ❖ To assess the milk production in study area
- ❖ To evaluate the microbial quality of milk in highland and midland 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 Natural pasture

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. Hence, 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).

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).

2.1.5 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).

2.2 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 bTsehay, 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).

2.2.1 Milk qualities assess.

Quality milk implies the milk which is free from pathogenic bacteria and harmful toxic substances, free from sediment and extraneous substances, of good flavor, with normal composition, adequate in keeping quality and low in bacterial counts (Khan et al., 2008). Consumers need clean, wholesome and nutritious food that is produced and processed in a sound sanitary manner and free from pathogens. Hence, quality milk production is necessary for fulfilling consumers' demand (Khan et al., 2008).

To sell raw milk directly to consumers or to a processing factory, it must be handled hygienically and remains fresh and capable of being heated without curdling. Hygienic milk handling includes; using clean equipment, maintaining a clean milking environment, observing good personal hygiene and preserving the quality of milk during storage and transportation to the consumer or processing plant (Kurwijila, 2006).

Milk quality should not be ignored at all stages of the dairy value chain from farm to table. As the bacterial quality of raw milk is important to product shelf-life, flavor and product yield, it is important that dairy enterprises should strive to obtain the highest quality raw material possible from their own farm as well as their suppliers. It is therefore essential to produce best quality raw milk in the dairy farm in order to manufacture milk products of acceptable quality (Zelalem, 2012).

2.2.2 Microbial Properties of Raw Whole Milk in Ethiopia.

Earlier researches conducted in different parts of the country revealed that the microbial counts of milk and milk products produced and marketed are generally much higher than the acceptable limits (Zelalem, 2010). These were evidenced by milk collected form smallholder producers in Southern Ethiopia the total bacterial count (TBC) reported by Abebeet al. (2012) 9.82 log cfu/ml in Gurage zone, Asaminew and Eyassu, 2010) 7.58 log cfu/ml in Bahir Dar Zuria and Mecha districts,; and Solomon et al. 2013) 7.07 log cfu/ml in DebreZeit town, Ethiopia.Other research findings also reported similar values of aerobic mesophilic counts milk sampled from udder, milking bucket, collection center, milk vending shops and cafeteria is range between 7.28 and 10.28 logcfu/ml (Godefaye and Molla, 2000; Haile et al., 2012). In all cases increasing trend of counts as the milk passed through udder, milking bucket, collection centers and upon arrival at the processing plant. This could be due to improper handling, storage and transport time after the milk leaves the dairy farms. Milk produced under hygienic conditions from healthy cows should not contain more than 4.69 log cfu/ ml (O' Connor, 1994).

However, raw milk samples from different part of the country TBC counts greater than the counts which is given by international standard set for minimum acceptable level of bacterial count (105 cfu/ml) in milk (IFCN, 2006). In other words, the above indicated count of milk samples collected from the country were considered to be below the standard set for good quality milk. This implies that the sanitary conditions in which milk has been produced and handled are substandard subjecting the product to microbial contamination and multiplication.

As indicated by (Chambers, 2002) total bacterial count is a good indicator for monitoring the sanitary conditions practiced during production, collection, and handling of raw milk. Hence training of milk handlers about hygiene can significantly reduce the bacterial load in milk. A good example worth mentioning is a reduced total bacterial count observed in milk sampled from farmers who received training on hygienic milk production and handling, and who used recommended milk containers as compared to that produced by the traditional milk producers (Rahel, 2008).

Coliform count, on the other hand, is especially associated with the level of hygiene during production and subsequent handling since they are mainly of fecal origin (Omoreet al., 2001). Previous workers reported similar values of coliform counts in raw cow milk sampled from different part of the country that range between 4.03 log cfu/ml to 6.57 log cfu/ml (Fekadu, 1994; Alganesh, 2002; Zelalem and Faye, 2006; Asaminew and Eyassu, 2010).

Even if, it is not practical to produce milk that is always free of coliforms. Their presence in raw milk may therefore be tolerated. However, if present in large numbers, say over 100 coliform organisms per milliliter of raw milk, it means that the milk was produced under improper procedures (Walstraet al., 2006).

2.3 Sources of Microbial Contamination of Milk

The common predisposing factors of milk contamination by microorganisms are milking environment, cows, milking personnel, milking equipment, and water (Mbabazi, 2005).

2.3.1 Milking environment

Maintaining the sanitary condition of the milking area is important for the production of good quality milk (Zelalem, 2010). Dirty milking places tend to breed flies, which may fall in milk causing contamination and thus spoilage may occur (Mbabazi, 2005).When a cow urinates or defecates in the course of milking some of its urine or dung particles may drop into the milk (Mbabazi, 2005)

2.3.2 Cow (Udder)

Cleaning the udder of cows before milking is one of the most important hygienic practices required to ensure clean milk production (Zelalem, 2010). This is important since the udder of the milking cows could have direct contact with the ground, urine, dung and feed refusals. Cleaning and removal of soil particles, bedding material and manure from the udder and flanks is necessary to prevent the entry of many types of bacteria into the milk (O'Connor, 1995). Udder washing with clean water and drying using hand towels reduces milk contamination by transient bacteria located on the udder (Robert, 1996). Special care must be given to the cloths used for cleaning the udder. The re-use of cloths for cleaning and sanitizing may result in re-contamination of the udder. It is therefore recommended that separate cloths be used for cleaning and sanitizing and, if possible, each cloth should be used for one cow only) (O'Connor, 1995. Not washing the udder before milking can impart possible contaminants into the milk. A maximum reduction of teat contamination of 90 % can be achieved with good udder preparation before milking. This depends on the initial level of contamination and the way of udder preparation. So with high initial contamination levels this90% reduction might not be reached (Murphy, 1996).

2.3.3 Milker's hygiene

Milk handling personnel (milker) may contribute various organisms including pathogens especially when they are careless, uninformed, or willfully negligent, directly to milk (Ashenafi, 1994). Organisms may drop from hands, clothing, nose, and mouth and from sneezing and coughing. It is important for milk men to be in good health so that they can be asource of infectious diseases such as tuberculosis (Kurwijila, 1998).

2.3.4 Milking equipment's

Poorly cleaned and sanitized milking utensils may be the source of many microorganisms (Banwart, 1989). Milk drops left on the surface of milking equipments act as excellent media for the growth of a variety of bacteria (Bramley and McKinnon, 1990). Milk equipment is not properly cleaned and sanitized after use. Milk residues left on equipment and utensil surfaces provide nutrients to support the growth of many microorganisms, including pathogens (Bryan, 1983). In case cracked milking equipments large number of bacteria enter and grow in the cracks, are difficult to clean (Thomas et al., 1966). The bacterial load of milk increases during transportation and if the transportation equipment is not appropriate the bacterial counts increase causing spoilage before milk reaches its destination (Grilletet al., 2007). Milking equipment should be easy to clean. Aluminum and stainless steel equipment are mostly preferred (Zelalem, 2010).

2.3.5 Water

Water serves as primary sources of microorganism's contamination (Mbabazi, 2005). If Water is obtained from an open water supply care should be taken to prevent drainage that may contain human feces and other contaminants gaining entry into the source (Jay, 1992).

2.4 Control Measures of Microbial Contamination Raw Milk

To prevent or retard growth of bacteria in milk and to maintain its quality for domestic consumption or during transport to the processing plant, it is essential to cool the fresh milk as quickly as possible (O'Connor, 1995). Prompt cooling or chilling of milk at a temperature of 5°C or below is necessary to minimize microbial growth and prevent milk quality deterioration during handling, storing and transporting before the raw milk being processed. In order to facilitate bulking of raw milk supply and transport the incoming milk, refrigeration facilities are provided at points of collection and transport means to maintain the temperature as much as possible (Getachewet al., 2008). In the tropical countries of Africa with high ambient temperatures, lack of refrigeration facilities at the farm and household level imply that raw milk will acidify very fast (Godefay and Molla, 2000).

Therefore the collection systems must be designed to move the milk to the cooling and/or processing center in shortest possible time. In addition every effort should be made to use available systems such as water cooling, air circulation or shaded areas to reduce milk temperature (Dello Castillo, 1990). Boiling: It is the easiest and most practicable method of making milk safe in every home. As soon as raw milk is produced or delivered, it should be boiled. Boiling involves raising the temperature to the boiling point and maintaining at this temperature for a few minutes. Then the milk should be cooled immediately. The temperature should be maintained below 10ºc.

Since this may be impracticable at home, preferably the milk must be consumed as soon as possible after cooling and not an extended period of time after it has been boiled and cooled (Gebra-Emanuel,1997,Linton,1982).

Pasteurization: it is the main safeguard against pathogenic organisms in milk. The combination of pasteurization, care in production and processing, and improved storage has resulted in relatively safe milk supply. Milk borne diseases like tuberculosis, diphtheria, and scarlet fever have been practically eradicated. Also, the shelf-life of milk has been increased from a few days to a few weeks (Vasavaoa and Smith, 1987).

2.5 Microbial Analysis of Raw Milk

2.5.1 Standard plate count:

The standard plate count is generally accepted as the most accurate and informative method of testing bacteriological quality of milk (Kurwijillaet al., 1992; Godefay and Molla, 2000). The total plate count of microbes in milk provides useful general information on the microbiological quality of milk. Total or aerobic plate count shows only the mesophillic aerobic organisms as incubation is done under normal atmospheric conditions at 35°C for 48 hours (Jay, 1992). The number of bacteria in aseptically drawn milk varies from animal to animal and even from different breasts of the same animal. On average, aseptically drawn milk from healthy udders contains between 500 and 1000 bacteria ml/l. High initial counts (more than 105bacteria ml/1) are evidence of poor production hygiene (O'Connor,1994).

2.5.2 Coli form bacteria:

Coli forms are aerobic or facultative anaerobic, Gram-negative, nonspore forming rods that ferment lactose to produce gas when incubated on agar for 48 hours at 35°C (FAO, 1986). Coli forms are important mastitis pathogens (Hogan and Smith, 2003) and are widely distributed in the farm environment (Hogan et al., 1989; McKinnon et al., 1990; Sanderson et al., 2005). Coliform count (CC) is a non regulated test that has been used historically to assess milk production practices such as milk refrigeration, milking machine sanitation, and pre milking udder hygiene (Guterbock and Blackmer, 1984; Davidson et al., 2004). Coli form organisms contaminate raw milk from unclean milker's hands, improperly cleaned and unsanitized or faulty sterilization of raw milk utensils especially churns, milking machines, improper preparation of the cow's flecks or dirt, manure, hair dropping in to milk during milking, udder washed with unclean water, dirty towels and udder not dried before milking(Ombuiet al., 1995). The presence of coli form organisms in milk indicates unsanitary conditions of production, processing or storage. Hence their presence in large number in dairy products is an indication that the products are potentially hazardous to the consumers' health (Godefay and Molla, 2000). Coliform count provides an indication of unsanitary production practices and/or mastitis infection. A count less than 100 Colony Forming Units (CFU)/ml are considered acceptable for milk intended to be pasteurized before consumption. Counts of 10 CFU/ml or less are achievable and desirable if raw milk will be consumed directly (Ruegg, 2003).

3 METHODOLOGY

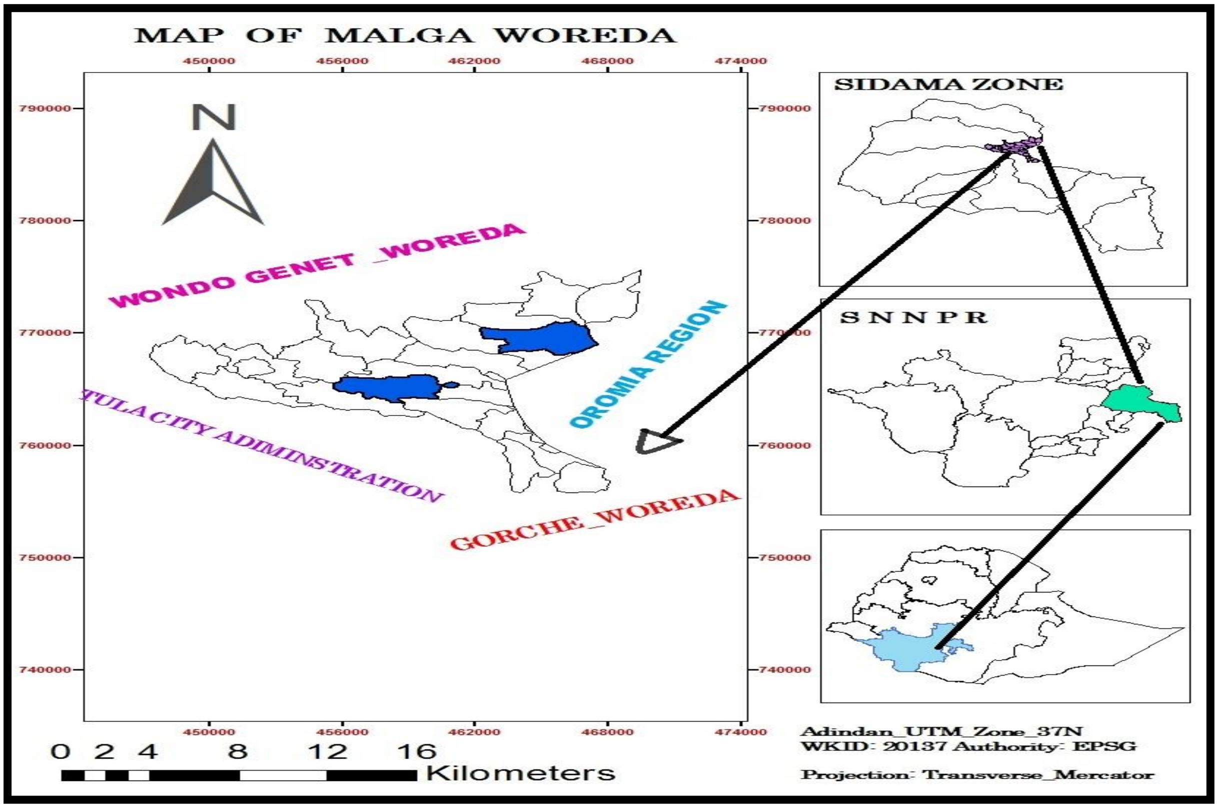
3.1 Location of the Study Area

Malga Woreda is one of the district in Sidama Region of Ethiopia. It is capital town of the woreda Manicho located 297 kilometers South of Addis Ababa and 27 kilometers South-west of regional city, Hawassa. It is located at 29°15’36” E to 33°06’36’’ E and 3°54’36”N to 7°22’48” N. It is bordered on the North by Wondo Genet Woreda, on the South by Gorche Worada, on the West by Hawassa city administration, and on the East by Oromia regional state. The altitudinal range of the woreda goes from 1501-3000 masl (woreda communication office, 2019).

The agro-climatic zone of the Woreda consists Woinadega (22%) and Dega (78%). The mean annual rainfall ranges from between 1201mm to 1600mm per annum with average temperature varing from 4.10^0c-22.4^0c.The area has two rainy seasons Kiremt (summary) and Belg (autumn). Most of the rainfall is received during June –September and the short rainy season (autumn) extends from March- May. The highest temperature is received during December, February and March (NMA, 2019).

According to CSA (2007), the total population of Malga Woreda is estimated 109,793 of which 55,676 are male and 54,117 are female. The urban population is only 4,017 or 3.66% with a total of 34,399 households.Livestock are reared by many people living in the rural area in extensive or semi- intensive production system. The Livestock reared in the area are cattle (200324), Sheep (77025), Goat (12567), Poultry (110720), Horse (2867), and Mule (68)(MWLFO 2012).

Figure 1: map of malga woreda



3.2 Sampling techniques and sample size

A stratified random sampling technique was used for data collection from (PA) peasant association and milk sample collection for microbial quality analysis. Five (5) Kebeles namely *Guguma, sintaro,manicho, kocho, and katana* were selected purposively based on agro-ecology and their potential for dairy cattle production district. Then, 150 households were selected from rural five Kebeles using proportional sampling method.

This study followed a simplified formula provided by Yamane (1967) to determine the required sample size at 95% confidence level and level of precision= 7% (0.07).

Yamane Formula

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{N}{1 + N(e)2}$$

$$n = \frac{575}{1 + 575(0.07)^2} = \frac{575}{1+575(0.0049)} = \frac{575}{1+2.82} = \frac{575}{3.82}$$

n=**150**

Where n is the sample size, N is the population size (total household), and e is the level of precision. The respective numbers of households were allocated for each sampled Kebele based on probability proportional to size (PPS) of each selected Kebeles from rural area**.**

Table 1: Sample size of rural households per each selected Kebeles

No	Name of sample Kebeles	Total households	Sample size of households
	HIGHLAND		
1	GUGUMA	**194**	$\frac{194}{575} \times 150=$ **51**
2.	KATANA	**80**	$\frac{80}{575} \times 150=$ **20**
	MIDLAND		
3.	KOCHO	**86**	$\frac{86}{575} \times 150 =$ **23**
4.	SINTARO	**83**	$\frac{83}{575} \times 150 =$ **21**
5.	MANICHO	**132**	$\frac{132}{575} \times 150=$ **35**
	Total	**575**	**150**

3.3 Data collection

3.3.1 Type and source of data

This study used both qualitative and quantitative data collected from primary and secondary sources. Primary data was collected through household survey, focus group discussions and key informant interview among highland and midland dairy cattle producers and as secondary data was collected from published document of malga woreda Fishery and Livestock office such as, the total livestock population and the numbers of local and crossbred type of dairy cattle and challenges related to dairy cattle production in the dry season.

3.3.2 Household Survey

Pre-tested questionnairewas used to collect primary data from each selected respondents. The questionnaires were pre-tested. The information collected through household survey include:-

challenges (feed, water, grazing land, breed type, disease problem, challenges related with milk quality) and hygienic milk production practice (such as house cleaning, personal hygiene and whole management aspects around the study area)

3.3.3 Focus group discussion

Focus group discussion (FGD) was undertaken in each of the selected kebele. The total 20 FGD were taken from selected five (5) kebele to know the challenges of dairy production and characteristics of the hygienic milk production practices.

3.3.4 Key informant interview

Key informant interviews were conducted to gather important information from those who were knowledgeable and have better experience on dairy cattle production. Member of key informant are kebele resident, model dairy farmer, processor and trader who discussed about dairy production challenges and hygienic practices as the main factors influencing milk quality.

3.3.5 Milk sampling technique

A total of 35 raw fresh milk samples (14 from highland and 21 midland households) were taken directly from the udder and milking bucket/plastic materials in order to analyses microbial quality such as total bacterial count (TBC) and coliform count (CC) in the raw fresh milk. From each selected highland and midland kebele 50ml of raw fresh milk was taken in the morning and aseptically using sterile sampling bottles labeled and stored in an ice box and transported to Hawassa University College of Agriculture, dairy science and technology laboratory and kept in refrigerator until the time of analysis. The bacterial count was performed within 24 hours after sampling (Alganesh *et al*., 2016).

3.4 Milk Microbial Analysis

3.4.1 Total bacteria count (TBC)

For total bacterial count analysis one ml of milk sample was addinto sterile test tube containing nine ml peptone water up to serial dilution of 10^{-5} and mixe thoroughly. Then one ml of diluted sample homogenate dropped on petri dish and 15 -20ml standard plate count agar which have been autoclaved at 121º C for 15 minutes and cool to about 50^{0}c was added. The sample and the agar were gently mixed in clock and anti-clockwise rotations. The mixtures were allowed to stand for 10 minute until solidified. Then the plates were inverted and incubated at 37°C for 24hrs and dilutions wereselect so that the total number of colonies on a plate were between 30 and 300 (Richardson, 1985). Finally, colony count was made by using colony counter and expressed as colony forming units per ml (CFU/ml) using the following mathematical formula as recommended by IDF (1987).

3.4.2 Coliform count (CC)

For coliform bacteria analysesone ml of milk sample was added in to sterile test tube containing nine ml peptone water up to serial dilution of 10^{-5} and duplicate samples (1ml) are pour plated using 15-20 ml Violet Red Bile Agar solution (VRBA). After thoroughly mixing, the plated samples were allowed to solidify and then incubated at 37ºC for 24 hours. Finally, colony counts are made using colony counter and typical dark red colonies were considered as coliform colonies.

3.5 Data Analysis

Data collected from survey questionnaire and microbial quality analyses were analyzed using SPSS version 20. Microbial counts were transformed in to log10, using Microsoft office excel 2007, and counts of microbes were expressed as colony forming units per ml (CFU/ml) using the following mathematical formula as recommended by IDF (1987).

$$CFU/ml = \sum C /(1*n1 + 0.1*n2)\ d$$

Where: $\sum C$ = sum of all colonies on all plates counted,

n1 = number of plates in first dilution counted,

n2 = number of plates in second dilution counted,

d = dilution factor of the lowest dilution used

The following statistical model wasused to identify the independent and response variables

$Y_{ij} = \mu + \beta_j + e_{ij}$ Where,

Y_{ij}=individual observation of highland and midland for each test

μ=the overall mean

βj= the i^{the} Raw milk producers (highland and midland)

e_{ij}=the error term

Using General Linear Model (GLM) of SPSS Version 20 descriptive statistics such as Frequencies and percentages were computed to describe relevant variables and the results were summarized in tables and graphs. The Least Significant Difference (LSD) value was used for means differences for significance at $P<0.05$

4 RESULT AND DISCUSSION

4.1Households characteristics of the dairy cattle producer

The sex, age and educational levels variation between highland and midland household respondents indicated in Table (3). Out of the total interviewed dairy producer farm households in the study area (91.3%) were male-headed households and the remaining 8.7 were female headed .This finding is similar to the finding of Tegegne et al,(2013) who reported that most of the households sampled in rural highlands of dairy production system of Fogera and Bure were male headed households (77.5–97.4%).

The highest proportions of the respondents (58%) are aged between 40-60 years while the rest were blow 40 (32.7%) and above 60 (9.3%), this is one of the household characteristics that is describing the working age (productive age). This study is similar to - a review report by Tegegne *et al.* (2013), who indicated the average age of the household heads in the Ethiopian smallholder farmers ranged from(39.7 to 51.9) years, which was within the range of the productive age.

The respondents in the study area had different educational status, (19.3%, 52%, 18 % and 10.7%) were illiterate, primary, secondary and high school respectively. Education is an important entry point for empowerment of rural communities and an instrument to sustain dairy development. In this context, educational level of the farming households may have significant importance in identifying and determining the type of development and extension service approaches. The role of education is clear in affecting household income, adopting technologies, demography, health as well as a whole socio-economic status of the family (Kerealem, 2005). This shows the expansion of educational coverage which provides better opportunity to increase dairy production system in the study area. This is also in agreement with report from Illu Aba Bora Zone, Southwest Ethiopia (Bereda *et al.*, 2013), where the educational level attained by the majority of the household heads falls between illiterate and primary school.

Table 3: Household characteristics of dairy producer in the study area (N=150)

Variable	highland (n=71)	midland (n=79)	total (n=150)
Sex(%)			
Male	94.6	88.6	91.3
Female	5.6	11.4	8.7
Age of households (%)			
20-40	32.4	32.9	32.7
40-60	63.4	53.2	58
>60	4.2	13.9	9.3
Educational level (%)			
Unable to read and write	18.3	20.3	19.3
Read and write	56.3	48.1	52
elementary	23.9	12.7	18
High school	1.4	19	10.7

n=sample from population,

4.3 Feed resource and feeding practice of dairy cattle in the study area.

The feed resources of dairy cattle in the study areas were from own source and market which included concentrate feed, improved forage, enset leaf, crop by-products, green leaf. Present study shows that, most(%) of midland milk producer households and some(%) of highland milk producer household practice development of improved forage like, Desho grass, Elephant grass and Rhodes grass for their dairy cattle. Out of the 150 respondents under the current study, 52% natural pasture land at wet season for cattle, 12% crop residue and enset leaf at dry season and 23.3% improved forage, 12.7% of them supplementary feed (Table 4).The current result is in agreement with the report in the mixed-crop production system where majority 53.7% of the households use animal feeds from their own crop farm, while 23.7% use acombination of own farm and communal grazing (Sintayehu *et al*.,2008). Feeding systems of dairy cattle practiced in the study area is indicated in. About 97.1 and 58.2% of dairy producers who live in highland and midland areas free grazeing,2.8 and 22.8% stall feeding,0 and 19% feeding both free grazing stall feeding their cattle respectively.

Table 4: Major feed types and feeding system for dairy herd in the study area (N=150)

variable	Highland (n=71)	Midland (n=79)	Overall (n=150
Feed Types			
Natural pasture %	62	43	52
Crop residue and enset leaf	11.3	12.7	12
Improved Forage %	21.1	25.3	23.3
Supplemental Feed (concentrate feed) %	5.6	19	12.7
Feeding system			
Free grazing %	97.2	58.2	76.7
Cut and carry system %	2.8	22.8	13.3
Both free grazing and stall feeding %	0	19	10

Source*: Own survey (2019), N=number of respondents,*

4.3.1 Challenges related to feed availability in the study area

The overall main challenges related to improved forage availability in the highland and midland areas were, lack of awareness, lack of forage cultivated land and lack of forage seedling with 47.3%, 34%, and 18.7% proportion respectively.

Table 5: Challenges related to feed availability in the study area (n=150)

Variable	highland(n=71)	midland(n=79)	Average (n=150
Challenges of forage feed (%)			
Lack of awareness	57.7	38	47.3
Lack of forage land	18.3	48.1	34
Lack of forage seedling	23.9	13.9	18.7

N=Number of respondents, %=percentage

4.3.2 Purpose of dairy cattle keeping in the study area

The purposes of dairy cattle keeping in the study area were for home consumption purpose, milk selling, and both consumption and selling which were 55.6%, 13.1% and 31.3% respectively (figure 2).

Variable	highland	midland	overall
Home consumption only	60.6	50.6	55.6
Milk selling only	8.8	17.7	13.1
Consumption and selling	31	31.6	31.3

4.3.3 Dairy cattle breed and its improvement in the study area

Dairy cattle kept in the study area are local breed and crossbreds. Local dairy cattle were the dominant type in highland part of the study area as compare to midland area (Table 6). From the total respondents in the study area 59.3%, kept local breed and 40.7% kept crossbreds. The total dairy cattle improvement system in the study area such as using locale bull, crossbred bull and AI service were 54%, 29.3%, and 16.7% respectively. The number of dairy herd and breed improvement observed in the present study were significantly different (P<0.05) between highland and midland smallholder household.

Table 6: Types of dairy cattle breed and its improvement system in the study area (N=150)

Variable	highland (n=71)	midland (n=79)	Average (n=150)
Dairy cattle type (%)			
Local cattle	66.253.2	59.3	
Crossbreed 33.846.8 40.7			
Dairy cattle improvement (%)			
Using Local bull	67.6	41.854	
Cross breed bull	21.1	36.729.3	
AI service	11.3	21.516.7	

N=Number of respondents, %=percentage

4.4 Milk production potential and lactation length in the study area

The estimated mean daily milk yield based on the farmers response varied significantly (P<0.05) among the agro ecologies (Table 7). The variation in daily milk yield could be due to availability of feed and the difference in the practice of keeping selected cows among farmers in different agro ecologies. The present estimated average daily milk yield of local and cross bred dairy cows were 1.75 and 4.5 liter/day respectively. The result was in agreement with Zewidie (2010) who reported 1.5±0.3 kg/day for indigenous dairy cows in Ziway area.The result is also higher than the reported overall mean estimated milk yield of 1.45 liter/day reported by Beriso *et al.*, (2015) in Chuko district, southern Ethiopia and also with that of Demissu *et al*., (2014) who reported 1.52±0.86 liter/day at Guduru livestock production and research center and its surroundings indigenous cows. On the other hand, the result of the current finding was higher than the report by Merha (2006) who noted average daily milk yield of 0.75 liters for Abergele cattle and 1.15 ± 0.386 liters estimated by Ketema (2014) for cows under smallholder farmers in Kersa Malima district.In term of lactation length of local and crossbred in the study area averagely5.9 and 7 month in a year respectively. These results were also lower than the overall average lactation lengths of local and crossbred cows which were 9.8 and 10.1months, respectively in Burie district (Adebabay, 2014). .

Table 7:Milk yield and lactation length of dairy cow in the study area (N=150)

	Highland		Midland		
Variable	Min	Max	Min	Max	Average

Milk yield(L/day)					
Local cattle	1.5	2	2	2.5	2.3
Cross breed	3.5	4	3.5	4.5	3.9
Lactation length in a month					
Local cattle	5.5	6	5.5	6.5	5.9
Cross breed	6.5	7.5	6.5	7.5	7

Min=Minimum, Max=Maximum

4.4.1 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:Milking practices of dairy cattle in the study area

Variable	Highland (n=71)	Midland (n=79)	Average (n=150)
Activity during calf suckling %			

Once (before suckling)	2.8	2.5	2.7
Once (after suckling)	4.2	8.9	6.7
Twice	93	88.6	90.7
Milking frequency/day			
One	2.8	2.5	5.3
Twice	97.2	92.4	94.7

N=Number of respondents, %=percentage

4.4.2 Challenges related to Dairy cattle health in the study area

The main animal health problem reported in the study area include lack of inadequate veterinary drugs 73.3%), lack of timely vaccination of animals 11.3%) and lack of skilled technicians (15.3%) in the study area(Table 9) .This finding is in line with the finding of Asaminew (2011) at Mecha and Bahir Dar zuria district. The sources of veterinary services in the study area were government (66%), private (16.7%) and both government and private (17.3%).

Table 9: The animal health problems in the study area (N=150)

Variable	highland (n=71)	midland (n=79)	Average (n=150)
Animal health problem(%)			
Inadequate of veterinary drug	84.5	63.3	73.3
Lack of timely vaccination	9.9	12.7	11.3

Lack of skilled human technician	5.6	24.1	15.3
Source of veterinary services(%)			
Government	69	63.3	66
Private	21.1	12.7	16.7
Both government and private	9.9	24.1	17.3

N=Number of respondents, %=percentag

4.4.3 Hygienic condition of cows and milker in the study area

The milker can be an important source of milk contamination. Therefore, keeping good personal hygiene being in good health during milking operation is very important (Zelalem, 2010). Most of the interviewed dairy producers (85.3%) washed their hands before milking while the rest (14.7%) did not wash their hands. Milker in the study areas did not cover their hair and dressing gown during milking. Cleaning of the udder of cows before milking is one of the most important hygienic practices required to ensure clean milk production. This is important since the udder of the milking cows could have direct contact with the ground, urine, dung and feed refusals (Zelalem, 2010). As observed in this study, 16.7% of the dairy producers washed their cow's udder before milking and 83.3% were not washing simply allowing their calves to suckle before milking. The current result was different from Haile *et al.* (2012) who reported 82.5% of the small size farm owning households in Hawassa city practice pre milking udder washing. The use of individual towel and following essential cleaning practices during milking is important for the production of quality milk (Zelalem, 2010). However, about 97.9% of the smallholder households did not use towels for udder drying while 2.1% were practiced towels for udder drying (Table10). Milking in dry condition significantly reduces bacterial count. It is because no surplus water remains in the surface of the udder to drip into the milk and due to less chance of leaching dirt and bacteria from udder, teats and hands into milk. Cleaning of the udder followed by drying with a clean cloth was effective adhering in reducing the number of bacteria in milk contributed from soiled teats which showed significance difference(P<0.05

Table 10: Hygienic condition of cows and milker in the study area (N=150)

Variable	highland (n=71)	midland (n=79)	Average (n=150)
Hand washing(%)			
Before milking	73.4	98.6	85.3
No washing	26.6	1.4	14.7
Udder washing (%)			
Before milking	39.4	36.7	38
No washing	60.66	3.3	62
Towel used for(%)			
Yes	-	4.1	2.1
No	100	95.9	97.9

N=Number of respondents, %=percentage

4.4.4 Milk equipment, sanitary and milking practices in the study area

According to current Study 70.4%, 14.1%, and15.5% of the producers in highland and 49.4%,30.4%and 20.3% in midland have used Clay Pot, Stainless steel and Plastic respectively as milking Equipment (Table 11).Similar study has also reported that clay pot was majorly usedto store milk in the Mid Rift Valley of Ethiopia (Negash *et al*., 2012).

In highland area clay pot was largely used as milking utensil because it is locallymade, easily available and affordable even for lower income households .Equipment used for milking, processing and storage determine the quality of milk and milk products. Traditional milk equipment are reported to be often porous and therefore a reservoir for many organisms and difficult to clean (O'Connor 1994). Proper metal milk containers are expensive, milk producers use plastic containers which are difficult to clean and disinfect and thus it might contribute to poor quality of the milk (Omore *et al*., 2005). The left-over of milk and other dirt particles within the container may result in the contamination of milk. Omore *et al. (*2005) had also reported that lack of formal training and use of plastic containers are the main factors that contribute to the low quality of raw milk sold by producers and informal milk traders.

Traditional containersnot designed for easy and proper cleaning.Moreover, its porous nature easily harbors bacteria and also makes hygienic cleaning inconvenient andineffective. As a result, it is more likely to inflict milk spoilage, and consequent quality deterioration and health risks.Aluminum and stainless steel equipment are mostly preferred. Some of dairy midland raw milk producer households practice milking with improved milking equipment.

The present study result is comparable with reported by Depiazzi and Bell (2002) who reported pre-milking udder preparation and teat sanitation play important part in the microbial load of milk, infection with mastitis, and environmental contamination of raw milk during milking. The milkier can be an important source of milk contamination. Therefore, keeping good personal hygiene and milkier should be in good health during milking operation (Zelalem, 2010). Rizwan *et al.* (2011) had reported that contamination of raw milk originates during milking, transportation and storage. Among the different direct means of milk contamination factors, unclean hands and milking equipment are the most important ones. As a result, milk is contaminated because it is not common to clean the udder and hind quarters of the cow (Alganesh, 2002).The use of detergent and good-quality water for cleaning could be expected to remove milk remains, including microorganisms that affect the microbial quality of milk.

Table 11: Milk equipment, sanitary and milking practices in the study area (N=150)

Variable	highland (n=71)	midland (n=79)	Average (n=150)
Milking equipment (%)			
Clay pot	70.4	49.4	59.3
Plastic/bucket	15.5	30.4	23.3
Aluminum container	14.1	20.3	17.3
Washing milk equipment (%)			
Before every use	59	59.2	59.1
After every use	31	40.8	35.9
No before and after use	10	-	5

N=Number of respondents, %=percentage

4.5 Housing system and cleaning practice in study area

According to the present study from highland milk producer 88.7% and from midland 77.2% of the interviewed households shared the same house with their animals while about 11.3% from highland and 22.8% from midland milk producer used separate house overall households 82.7% shared the same house with their animals. The housing types of floor in the study area were wooden bedded (66%), natural earth (14% while the remaining (20%) was concrete type (Table

12). Most of the respondents (91.8%) removed manure daily while remaining (8.2%) removed three times a week. This result is contrary to result reported indicating about 47% of the respondents clean their barn three times a week in Gurage Zone, Ezha district Abebe *et al.* (2012).

Table 12: Housing system and cleaning practices in the study area (N=150)

Variable	Highland(n=71)	Midland (n=79)	Average
Housing type (%)			
Separate/fenced house	11.3	22.8	17.3
Shared with family	88.7	77.2	82.7
Housing floor type (%)			
Wooden bedded	74.6	58.2	66
Natural earth	18.3	10.1	14
Concrete	7	31.6	20
House cleaning (%)			
Daily	89.9	93.6	91.75
Three times a week	10.1	6.3	8.2

N=Number of respondents, %=percentage

4.6 Water sources and watering frequency in the study area

Water sources and watering system by respondent is presented. In Table 13,Water is a determining factor for all activities of animals' water problem in amount and quality and can cause problems like constipation, dry digestive tract, reduce metabolically activities with emaciated body condition (Tsedeke2007). In the study area, most of the respondents used river as major water source for their cattle (56.3%) even though its quality and availability are season dependent. As observed during the survey, households that use river water for their animals do not treat it, or it is not filtered and some farmers were used deep well and pond water. In closed to current result Asrat *et al* (2013) reported from Bodit, Ethiopia; rivers, tap water and spring were importances of water sources for dairy cattle. Dessalegn (2015) also reported similar result in Bench-Maji Zone, Southwest Ethiopia farmers had used rivers, borehole water and dam/pond as main sources of water for their cattle during the dry and wet season. In lined with present study Teshager *et al* (2013) had reported similar result from Ilu Aba Bora Zone of Oromia Regional State, South Western Ethiopia; the main sources of water for cattle are river, pond, and well. Regarding on frequency of watering to dairy animals varies from one agro ecology to another, which might be affected by different factors, among which season, accessibility (getting easily), performance and/or breed of the animals and type of predominant feed (dry or wet) and feeding systems (indoor or outdoor where some water is available). Most of the respondents have said that they gave water for their cattle only once per day (68.7%); the highest proportion was found in highland (87.3%) through midland (51.9%). In the other way, some famers (31.3%) gave water for their dairy cattle twice per day and relatively more were found in midland areas. This might be related to heat effect on the environment (feed type) and animals. According to respondents, this was especially more sound in winter season due to heat effect at that period.

Thus more water is needed by animals similarly results have reported by Tsedeke (2007 from Aleba Woreda, Ethiopia and Asrat *et al* (2013) from Bodit, Ethiopia

Table 13: Water sources and watering frequency for dairy cattle

variables	Highland (n=71)	midland (n=79)	average
Water sources %			
Rivers	56.3	24.1	33.3
Pond	43.7	62	59.3

Wells	0	13.9	7.3
Watering Frequency			
Twice per day	12.7	48.1	31.3
Once a day	87.3	51.9	68.7

N=Number of respondents, %=percentage

4.7 Total bacterial load of raw milk.

According to Ethiopian Standard Agency (ESA, 2009), the bacteriological quality of raw cow milk is to be less than $2x10^5$ and $2x10^5$-$1x10^6$Cfu/ml for very good and good quality while $1x10^6$-$2x10^6$ and above $2x10^6$Cfu/ml for bad and very bad milk quality, respectively.

4.7.1 Total Bacteria Count (TBC):

The average total bacteria counted from raw milk samples collected from highland and midland household were 5.81and 5.1 log10 cfu/ml respectively with overall average value of 5.46 log10 cfu/ml which was significantly different (P<0.05) (Table14). This high level of contamination of milk might be due to initial contamination of milk originating from the udder surface, source of cleaning water, milkier hygienic condition and milking utensils. The present study result is lower than the finding of Fikrineh *et al*., (2012) who reported 7.08 log10 cfu/ml of TBC in mid Rift valley Ethiopia and Asaminew and Eyassu, (2011) who reported 7.58 log 10cfu/ml of TBC in cow milk sampled from around Bahir Dar and Mecha district. Higher results have been reported by other scholars such as by Zelalem (2010) in the central highlands of Ethiopia (9.10 log cfu/ml) and Abebe *et al.* (2012) in Southern Ethiopia (9.82 log cfu/ml). The variation could be attributed to the milk handling and management associated with the milking and handling process. Therefore, total bacterial count is a good indicator for monitoring the sanitary conditions practiced during production and handling of raw milk (Chambers, 2002). A good instance merit mentioning was reduced total bacterial count observed in milk sampled from farmers who received training on hygienic milk production and handling, and who used recommended milk containers as compared to that produced by the traditional milk producers (Rahel, 2008; Sintayehu *et al*., 2008).The bacterial count of the milk is increased by poor milking practices, unclean environment, lack of cooling technology and poor animal health (Burgess 2010).

4.7.2 Coliform Count (CC):

The mean CC from raw milk samples collected from highland and midland household was 5.1 and 3.07 log10 cfu/ml respectively with over all mean value of 4.09 log10 cfu/ml which was significantly difference ($t<0.05$) between the two groups (Table 14).CC observed from raw milk samples were non-significant within highland households while were significant within midland households. The current result was similar with the reported of Abebe (2012) 4.03 log Cfu/ml in Southern Ethiopia and Zelalem (2010) 4.58 log Cfu/ml in the central Highland Ethiopia. The variation between the different sources could be attributed to the overall management and handling practices of milk from the different sources.

According to the European Union standards, CC of raw milk should be less than 10^2cfu/ml (Fernandez, 2009). CC less than 100 Colony Forming Units (CFU)/ml are considered acceptable for milk intended to be pasteurized before consumption. Counts of 10 cfu/ml or less are achievable and desirable if raw milk will be consumed directly (Jones and Sumner, 1999; Ruegg, 2003).Although, milk samples collected from the midland had lower CC than Rural raw milk producer, This high amount of milk contamination could be associated to milking of cows within the same barn and hygienic practices implemented while milking. This practice might have led to soil, dung and urine contamination of milk and failure to milk quality production at household. This could lead to consumer health problem and loss of income from milk and milk products to households. Generally, the presence of high numbers of Coliform in milk indicates that the milk has been contaminated with faecal materials, because of unclean udder and teats of cow’s, inefficient cleaning of the milking containers, poor hygiene of the milking environment, unclean water sources and cows with subclinical or clinical mastitis can all lead to elevated Coliform count in raw milk (Jayarao *et al.*, 2004)

Table 14: Microbial quality of milk in highland and midland HHs

		Mean log10 CFU/ml (±SD) of microbial load	
Households group	N	TBC	CC
Highland milk producer HHs	14	5.81 ±0.08[h]	5.1± 0.01[h]
Midland milk producer HHs	21	5.1 ±0.07[l]	3.07± 0.03[l]
Overall		5.46 ±0.08*	4.09±0.02*

*CFU= colony forming unit, SD=standard deviation, HH= household, TBC=Total Bacteria Count, CC=Coliform Count and N =number of respondents, ns= non-significant, h= higher mean, l= lower mean, *= significantly different (P<0.05)*

5 CONCLUSIONS AND RECOMMENDATION

The feed deficit observed in the study area could be one of the contributing factors affecting livestock productivity. Improved forage production and conservation are not practiced and the availability of agro-industrial byproducts is inadequate in the study area. Based on the microbial analysis of milk sampled from the study area was below international and national standards. This is mainly due to lack of good hygienic practices starting from the point of production up until consumption, including materials used for milking, transportation and storage. Therefore, good milk production and handling practices need to be practiced by both the milk producers and stakeholders involved in milk transportation and marketing. Moreover, pertinent tailor-made trainings and awareness creations need to be made to the farming community. This high level of contamination of milk might be due to initial contamination of milk originating from the udder surface, source of cleaning water, milkier hygienic condition and milking utensils. High amount of milk contamination could be associated to milking of cows within the same barn and hygienic practices implemented while milking; this practice might have led to soil, dung and urine contamination of milk and failure to milk quality production at producers. This could lead to consumer health problem and loss of income from milk and milk products to households.

Based on the findings of this study, the following recommendations were forwarded

- Chemical compositions for available feed resources are not included due to financial limits. Therefore, it would be necessary if a deeper research is investigated on the chemical composition of available feed resources to get a full picture of the livestock feed resources of the district.
- Promoting farm-level adaptation need to emphasize on the crucial role of providing information on better production techniques and enhancing producers' awareness on milk production to enable farmers adapt to production.
- Introducing and disseminating appropriate dairy technologies to smallholder farmers with a continuous follow up could be a means through which their livelihoods and income can be improved..
- The milk used for consumption as well as the water used for udder washing and cleaning of dairy products handling equipment should be heat treated.
- Extension officers and associated stakeholders have to make periodic surveillance visit to milk producers, and create awareness, advice or conduct training on good animal health management and handling practices of milk and milk products.

- Routine assessment of milk quality produced in the area and consumed by the general public has to be mandatory in order to protect the public from milk borne infections.
- Further study with wider area coverage is needed to identify the different species of microorganisms that might cause public health hazards.

6 REFERANCE

AbebeBereda, ZelalemYilma and AjebuNurfeta. 2012. Hygienic and microbial quality of raw whole cow's milk produced in Ezha district of the Gurage zone, Southern Ethiopia. Wudpecker Journal of Agricultural Research 1(11):459 – 465

Adebabay Kebede. 2014. Characterization of milk production Systems, Marketing and On-Farm Evaluation of the Effect of Feed Supplementation on Milk Yield and Milk Composition of Cows at Bure District, Ethiopia A Thesis Submitted to the Department of Animal Science and Technology School of Graduate Studies. Bahir Dar University Bhair Dar Ethiopia.

Ahmed H (2006). Assessment and evaluation of utilization practices of natural pastures and other forages in Basona Worana wereda of North Shoa Zone. An MSc Thesis Presented to the School of Graduate Studies of Haramaya University, Ethiopia. 174 p.

Ahmed M., Ehui S. and Yemesrach A. (2003): Milk development in Ethiopia. Socio economics and policy research. Working paper 58. ILRI (International Livestock Research Institute), Nairobi, Kenya. Pp.47.

Alemayehu M. (2003): Integrated Livestock Development Project (ILDP). Livestock Feed Resources Survey. North Gondar, Ethiopia.Pp. 75.

Alemayehu M (1998a). Natural Pasture Improvement Study around Smallholder Dairy areas. MoA Small Dairy Development Project (SDDP), Addis Ababa, Ethiopia.

Alemayehu M (1998b). The Borena and 1991-92 Drought. A rangeland and livestock institute for sustainable development. Addis Ababa, Ethiopia. Resource study.

Alganesh TG (2016). Assessment of Safety and Quality of Raw Whole Cow Milk Produced and Marketed by Smallholders in Central Highlands of Ethiopia. Food Science and Quality Management.Vol.49

AsaminewTassew and EyassuSeifu. 2011. Microbial quality of raw cow's milk collected from farmers and dairy cooperatives in Bahir Dar Zuria and Mecha district, Ethiopia. Agricultural and Biotechnology Journal North America, 2(1): 29-33

AshenafiMengstu. 1994. Microbial load, microflora, and keeping quality of raw and pasteurized milk from a dairy farm. Bulletin Animal Health Production Africa, 42:55

Asrat, A., Yilma, Z. and Nurfeta, A. 2013. Characterization of milk production systems in and around Boditti, South Ethiopia. Livestock Research for Rural Development. Volume 25, Article #183. Retrieved June 9, 2015, from http://www.lrrd.org/lrrd25/10/ayza25183.htm

Azage Tegegne. 2003.Financing market-oriented dairy development: The case of Ada'a Liben district Dairy Association, Ethiopia .Urban Agricultural Magazine No. 9. Koninklijke, Netherlands.45pp.

Belete A. (2006): Studies on cattle milk and meat production in Fogera district: Production systems, constraints and opportunities for development. M.Sc. Thesis. University of Hawassa, Ethiopia.

Agricultural and Biotechnology Journal North America, 2(1): 29-33

Bereda, A.Yilma, Z. and Nurfeta, Ajebu. (2012): Hygienic and microbial quality of raw whole cow's milk produced in *Ezha* district of the Gurage zone, Southern Ethiopia. *Wudpecker J. Agri. Res.* 1(11), pp. 459 – 465

Bereda, A., Yilma, Z. and Nurfeta, Ajebu., (2013): Handling, processing and utilization of milk and milk products in Ezha district of the Gurage zone, Southern Ethiopia. *J.Agri. boil.and deve.* 5(6), Pp 91-98

Beriso K, Tamir B, Feyera T. 2015. Characterization of smallholder cattle milk production system in Aleta Chukko District, Southern Ethiopia. J. Adv. Dairy Res. 3:132.

Bramley, A.J. and McKinnon, C.H. 1990. Microbiology of raw milk. In: Dairy Microbiology, Vol.1: (Robinson, R), Elsevier Science Publishers, London, pp: 163-208.

Chambers, J.V. 2002.The microbiology of raw milk.Dairy Microbiology Handbook.pp. 39-

90. In: Richard, K. (3rded.), Robinson. John Wiley and Sons, Inc., New York.

CSA (2007). The 2007 Population and Housing Census of Ethiopia. Addis Ababa: Federal Democratic Republic of Ethiopia. Retrieved on December 23, 2012 from (http://www.csa.gov.et/index.php)

CSA (Central Statistics Authority). 2010. Agricultural sample survey. Report on crop and livestock product utilization. The Federal Democratic Republic of Ethiopia, Central Statistical Agency (CSA). Private Peasant Holdings. Statistical Bulletin 468, Addis Ababa, Ethiopia

CSA. (2013): Agricultural Sample Survey. Livestock, Poultry, sheep, goat and Bee hives population (private peasant holdings). Federal Democratic Republic of Ethiopia Central Statistical Authority (CSA), Addis Ababa, Ethiopia.

Coppock DL (1994). The Borana plateau of southern Ethiopia. Synthesis of pastoral research, development and change, 1980-91. Systems study 5, ILCA Addis Ababa, Ethiopia, 299 p.

Daniel K. (1988): Role of crop residues as livestock feed in Ethiopia highlands. In: B.H Dzowela (Eds.). African Forage Plant Genetic Resources, Evaluation of Forage

DelloCastillo, L.B. 1990. Introduction. In: Handbook on Milk Collection in Warm Developing Countries. Brussels, Belgium. PP9-14.

Demissu, H .2014. Assessment on Peri-Urban Dairy Production System and Evaluation of Quality of Cows' Raw Milk: A Case of Shambu, Fincha and Kombolcha Towns of Horro

Guduru Wollega Zone, Ethiopia. *Science of Technology and Articles Research of Journal* 3(3):37-43.

Dessalegn, G. 2015. Assessment of Production and Reproductive Performances of Cattle and Husbandry Practices in Bench-Maji Zone, Southwest Ethiopia. *Global Journal of Animal Scientific Research.* 3(2): 441-452 2015

Ehui S, Benin S, Williams T, Meijer S (2002). Food security in Sub- Saharan Africa to 2002, socio-economic and policy research working paper 49, ILRI (International Livestock Research Institute), Nairobi, Kenya. P 60.

FAO (Food and Agricultural Organization). 1986. Manuals of food quality control, food analysis, quality adulteration and tests of identity, Food and Nutrition paper and Agricultural Organization of the United Nations, Rome.FAO (Food and Agricultural Organization) 2004 Milk producer group resource book: a practical guide to assist milk producer groups, byJurjenDraaijer.Rome.Availableathttp:// www.karmay.org/redirect/strred.asp?docId=21604.Accessed 21 January 2015.

FekaduBeyene. 1994. Present situation and future aspects of milk production, milk handling and processing of dairy products in Southern Ethiopia. Food production strategies and limitations: The case of Aneno, Bulbul.

Fernandes, R.2009. Microbiology Handbook Dairy Products. Leatherhead Food International Ltd., London.

GetachewFelleke, MedihinWoldergay and Getent Haile. 2008. Inventory of Dairy policy SNV Ethiopia.pp 1-123.

Getachew F. (2003): A Review of the small scale milk sector in Ethiopia. FAO prevention of food losses programme. Milk and milk products, post-harvest losses and food safety in Sub-saharan Africa and the Near East. Available on: http://www.fao.org/ag/againfo/projects/en/pf1/docs/P1assessmentcoverethiopia. pdf.

Getu K. (2008): Replacement of formulated concentrate mix with vetch (Vicia dasycarpa) hay to Lactating crossbred dairy cows fed on urea treated wheat straw. M.Sc. Thesis, Alemaya University, Ethiopia.

Getu Kitaw, LiyusewAyalew, Fekede Feyisa and Gezahegn Kebede. 2012. Liquid milk and feed value chain analysis in Wolmera District, Ethiopia.

GodefayBekele and MollaBayileyegn. 2000. Bacteriological quality of raw milk from four dairy farms and milk collection center in and around Addis Ababa. Berl.Münch.Tierärztl.Wschr. pp 113.

Grillet N., Grimaud P., Sserunjogi M.L. 2007. African Journal of Food, Agriculture, Nutrition and Development, Issue 16 (7), auteurs de cette publication.

Guterbock, W.M. and Blackmer, P.E. 1984. Veterinary interpretation of bulk-tank milk. Veternary Clinic North America Large Animal Practices, 6: 257–268.

Haile Welearegay, ZelalemYilma, YosefTekle. 2012. Hygienic practices and microbiological quality of raw milk Produced under different farm size in Hawassa, Southern Ethiopia. Journal of Agricultural Research, 1(4): 132-142.

Hogan, J.S. and Smith.K.L. 2003. Coli form mastitis. Veternary Research, 34: 507–519.

Hogan, J.S., Smith, K. L., Hoblet, K.H., Todhunter, D.A., Schoenburger, P.S., Hueston, W.D., Pritchard, D.E., Bowman, G.L., Heider, L.E., Brockett, B.L. and Conrad, H.R. 1989. Bacterial counts in bedding materials used on nine commercial dairies.Journal of Dairy Science, 72: 250–258.

IFCN (International Farm Comparison Network). 2006. Dairy Report 2006. For a better understanding of milk production world-wide. International Farm Comparison Network Dairy Research Center, Kiel, Germany.

Jay. M.J. 1992. Modern Food Microbiology, 4thEdition. Van Nostrand Reinhold, New York. Pp19, 237, 416.

Ketema H. and Tsehay R. (2004): Milk production systems in Ethiopia. Ministry of Agriculture, Addis Ababa, Ethiopia.

Ketema, W. 2014. Assessment of dairy cattle feed resources and milk yields under smallholder farmers in Kersa Malima woreda. Department of Animal Production Studies M.Sc. program in Tropical Animal Production and Health, Bishofitu, Ethiopia.

Khan, M.T.G., Zinnah, M.A., Siddique, M.P., Rashid, M.H.A., Islam, M. A. and Choudhury, K.A. 2008. Physical and microbial qualities of raw milk collected from Bangladesh Agricultural University Dairy Farm and the Surrounding Villages, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh, Bangl. Journal of Veterinary Medicine, 6: 217–221.

Kurwijila, L.R. 1989. Technology of traditional milk products in developing countries; Southern and Eastern Africa, FAO Manuscript.(www.fao.org, Accessed on 20/01/2015).

Kurwijila, L.R. 2006. Hygienic milk handling, processing and marketing: reference guide for training and certification of small-scale milk traders in Eastern Africa. ILRI (International Livestock Research Institute), Nairobi, Kenya.

Mbabazi.P. 2005.Milk industry in Uganda, 1stEdition, Fountain Publishers Kampala, pp 27- 52.

O'Connor, C.B., (1994): Rural dairy technology. ILRI training manual No. 1. International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia. Pp133

O'Connor, C.B. 1995. Rural Dairy Technology. ILRI Training Manual No.1. International Livestock Research Institute (ILRI), Addis Ababa,Ethiopia.

Ombui, J.N., Arimi, S.M., Mcdermott, J.J., Mbugua, S.K., Githua, A.A. and Muthoni, J. 1995. Quality of raw milk collected and marketed by dairy cooperative societies in Kiambu District, Kenya. Bulletin Animal Health Production Africa, 43:277-284.

Preston T. R. (1986): Strategies for optimizing the utilization of crop residues and agroindustrial by products for livestock feeding in the tropics. pp.145-166. In: ARNAB (African Research Network for Agricultural byproducts), towards optimal feeding of agricultural by products to livestock in Africa: proc.of workshop held at the university of Alexandria, Egypt, October 1985. ILCA, Addis Ababa, Ethiopia.

RahelNebiyu. 2008. Traditional and improved milk and milk products handling practices and compositional and microbial quality of raw milk and butter in Delbo, Water shed of Wollayta Zone. MSc Thesis, Hawassa University, Hawassa, Ethiopia.

Ruegg, P.L. 2003.Practical food safety interventions for Dairy Production.Journal of Dairy Science, 86: 1-9.

Sansoucy R., Jabbar M., Ehui S. and Fitzhugh H. (1995): The contribution of livestock to food security and sustainable development. In: Wilson R., Ehui S. and Mack S. (eds), Livestock development strategies for low-income countries. Proceedings of the joint FAO/ILRI roundtable on livestock development strategies for low-income countries, 27 February–2 March 1995. ILRI (International Livestock Research Institute), Addis Ababa, Ethiopia. SDDP (Smallholder Milk Development Project) (1999): Calf and heifer rearing. SDDP extension manual No.3. Ministry of Agriculture, Addis Ababa, Ethiopia.

Sintayehu Y., Fekadu B., Azage T. and Berhanu G. (2008): Dairy production, processing and marketing systems of Shashemene–Dilla area, South Ethiopia. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 9. ILRI (International Livestock Research Institute), Nairobi, Kenya. Pp62.

Teshager, A., Belay, D. and Taye, T. 2013. Smallholder Cattle Production Systems in Three Districts of Ilu Aba Bora Zone of Oromia Regional State, South Western Ethiopia. American-Eurasian Journal of Scientific Research 8 (1): 38-46, 2013 ISSN 1818-6785 © IDOSI Publications, 2013.

Tegegne, A., Gebremedhin, B., Hoekstra, D., Belay, B. and Mekasha, Y. 2013. Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 31. Nairobi: ILRI.

Thomas, S.B., Druce, R.G. and King, K.P. 1966. The microflora of poorly cleanzedfarm dairy equipment. Journal Applied Bacteriology, 29:409.

Tolera A, Yami A, Alemu D (2012). Livestock feed resources in Ethiopia: Challenges, Opportunities and the need for transformation. Ethiopia Animal Feed Industry Association, Addis Ababa, Ethiopia.

Tsehay R. (1998): Prospects of Ethiopian milk development. Pp.149-159. In: Proceeding of the role of village milk cooperatives in milk development: Prospects for improving milk in Ethiopia. 22-24 April 1998, Addis Ababa, Ethiopia.

Tsedeke, k. 2007. Production and marketing system of dairy cattle in Ethiopia international livestock institute, Addis Ababa.

Tsehay R. (2001): Small-scale milk marketing and processing in Ethiopia. In: proceeding of the south-south workshop on smallholder milk production and marketing: constraints and opportunities, Anand, India. 12-16 March.

Vasavaoa, P.C. and Smith D.E. 1987. Symposium: Health related aspects of milk and Milk products: an introduction. Journal of dairy science, 70: 381-382.

Walstra, P., Wouters Jan, T.M. and Geurts, T.J. 2006.Dairy Science and Technology Second Edition.CRC Press Taylor and Francis Group.pp 763.

Winrock. (1989): Conducting on-farm animal research: Procedures and economic analysis. National printers Ltd, Singapore.

Zegeye Y. (2003): Imperative and challenges of milk production, processing and marketing in Ethiopia. Pp.61-67. In: Proceedings of 10th Annual Conference of the Ethiopian Society of Animal Production (ESAP). August 22-24, 2002, Addis Ababa, Ethiopia.

ZelalemYilma. 2010. Quality factors that affect Ethiopian milk business: Experiences from selected dairy potential areas. Netherlands Development Organization, Addis Ababa, Ethiopia

Zelalem Yilma.2012. Microbial properties of Ethiopian marketed milk and milk products and associated critical points of contamination: An epidemiological perspective, epidemiology insights, Dr. Maria De Lourdes Ribeiro De Souza Da Cunha (Ed.), ISBN: 978-953-51-0565

Zewudie Wondatir, 2010. Livestock production systems in relation with feed availability in the highlands and central rift valley of Ethiopia. pp. 64

7 APPENDICES

Appendix 1: Household Questionnaires

Dear Participant, first of all, I appreciate your willingness to participate in this study questionnaire. This questionnaire designed with the purpose of assess the feed resource, feeding practice and milk production practice which is part of my M.Sc. Thesis research entitled with Assessment of feed resource, feeding practice, milk production and microbial quality of milk in malga district of Sidama Region, Ethiopia. I assure you that all the information gathered during this interview is purely for research purpose and any sensitive or confidential maters will be kept closed and will not be transferred to other in a personal base. Thank you for your valuable time.

I. Socio economic profile of the respondents

1. Region: __________ Zone ___________ Woreda ________________ Kebele ________________

2. Study Site Highland _________________ Midland __________________

3. Name of Enumerator: ________________________Date______________ Signature __________

4. Name of the respondent ___________________________

5. Sex of the respondent A) Male   B) Female

6. Educational status: A) Unable to read and write. B) Read and write.

C) Elementary D) High school and above

7. Age of the respondent. A) 20-40   B) 41-60   C) >61

II. Cattle husbandry and management

1. What are the purposes of milk production?

A) For household consumption B) For sale C) For consumption and sale

D) Other (Specify)

2. What are the major feed resources you use for dairy animal feeding?

A) Natural pasture   B) Crop residues C) Improved forage D) Enset leaves E) Other (Specify)

3. What type of feeding do you practices for dairy cattle?

A) Free grazing B) Stall feeding C) Based on grazing and stall feeding

4. Do you provide supplementary additional feeds for your dairy animals? A) Yes B) No

6. What type of water sources you use for dairy animals?

S/N	Water Source	Season of availability(indicate in months	Frequency of watering
1	Supplied tank/pipe		
2	Hand dug well		
3	River		
4	Spring water		
5	Pond and holes		

III. Milk Production potential and lactation length

1. Which cattle breed do you used to produce milk? A) Local B) Cross breed C) Both

2. What is the average milk production in liter per day?

For local breeds yield /cow/day/liter__________ For cross breeds/cow/day/liter_________

3. How many times do you milking your cows/day?

A) One times B) Two times) C) Three times

4. What is the average lactation length of your cow?

A) For local breeds ______________ months/year.

B) For cross breeds ______________ months/year.

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

A) Consumed at home___________ B) selling ___________C) others (specified)

6.What are the main constraints for your dairy cattle production?

Major Constraints	Rank	1st	2nd	3rd	4th	5th
Shortage of feed						
Lack of improved breed						
Lack of extension services						
Poor management						
Disease out break						

7. How do you house your dairy cattle?

A) Separate house from house hold B) shared with household

C) Separately in barn D) Other (specify) _____________________

Type of your barn	Barn Floor type	Bedding materials
1.Closed	1.Concrate floor	1.Grass

2.Open fenced	2.Natural earth	2.No bedding materials
3.Grass covered	3.Wooden bedded	3.Saw dust
Other(specify)		

11. How often do you clean the barn? A) Once a day B) Twice a day C) Once in two days

D) Once a week E) Others ___________________________

IV. Hygienic practices and handling of milk and milk products

I. Hygienic practices during milking

1. Do you wash your hands before and after milking? A, Yes B, No

2. Do you wash your cow's udder before and after milking? A, Yes B, No

3. If your response to Q2. Yes, when do you wash it?

A, before milking B, after milking only C, before and after milking

4. Do you use separate towel for drying teat? A. Yes--- B. No

5. Do you use shared towel for drying teat? A. Yes--- B. No

6. Do you practice milking mastitis cow last? A. Yes--- B. No

7. Do you clean the milk equipment before milking? A. Yes--- B. No

8. How frequently do you clean your milking equipment's?

A. Once per day B. Twice per day C.3 times per day D. Others (specify) ________________

9. Describe washing technique of milking equipment? _______________________________

10. Water source used to washing udder and milking utensils?

11. What type of milk equipment's do you use? A) Plastic B) Clay pot C) Aluminium D) Gourd E) Other

12. How often do you wash the utensils? A) Before every use B) After every use C) Before and after every use

13. How do you clean the equipment's? A) Cold water B) Warm water C) Cold water and soap D) Warm water and soap

14.Dou you milking after drying teats?

A) Yes B) No

II.Types of milk utensils and milk handling practices

6.2. What type of utensils do you use for milking?

A) Plastic B) Aluminium/ stainless steel/ C) Clay pot

6.3 What type of utensils used for milk transportation?

A) Plastic/ Jeri cans B) Aluminium /stainless steel/ C. clay pot

6.4. What type of utensils used for milk storage?

A. Plastic B) Aluminium/stainless steel/ C) Clay pot

6.5. What type of utensils used for milk churning?

A) Gourd B) Aluminium C) Clay pot

V: Check list for group discussion

1. Types of Production system in the area?

2. What are the general hygienic conditions of farm activities?

3. Constraints that affecting production system?

4. Who has the ownership of cattle in household?

Appendix 2: first lab training

Appendix 3: improved forge in study area

Appendix 4:Materials and equipment used for samples

Iceboxes

Appendix 4: Different Medias used for bacteria count

Media preparation

Appendix 5: Different bacteria's examined in the laboratory

Total bacteria count

8 BIOGRAPHICAL SKETCH

The Author of this thesis was born from his father Sanbato Shawe and his mother Bunkure Debesa in Sidama Region Bursa woreda in Haro Bule kebele in December, 1985 G.C. He attended his primary school in Bursa woreda (1-8) at Bursa elementary school (1993-2001 E.C). He attended his secondary school in Aleta wond high school (2002-2005 E.C). After completing his high school education level, he attended his bachelor of degree in Adama science and technology University College of agriculture and he followed his Bachelor Degree in Animal science and Extension (2006-2008 E.C). After completing higher education level, he employed in Malga woreda livestock and fisher Office and he joined graduate studies in Hawassa University College of Agriculture to follow his Master of Science in (Dairy Science and Technology)